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Turkish Journal of Surgery (Turk J Surg) is the official, peer reviewed, open access publication of the Turkish Surgical Society and Turkish surgical community. The journal is published quarterly on March, June, September and December and its publication language is English.

The aim of the Turkish Journal of Surgery is to publish high quality research articles, review articles on current topics and rare case reports in the field of general surgery. Additionally, expert opinions, letters to the editor, scientific letters and manuscripts on surgical techniques are accepted for publication, and various manuscripts on medicine and surgery history and ethics, surgical education and the field of forensic medicine are included in the journal.

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2. Drafting the work or revising it critically for important intellectual content;
3. Final approval of the version to be published; AND
4. Agreement to be accountable for all aspects of the work, and ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

In addition to being accountable for the parts of the work he/she has done, an author should be able to identify which co-authors are responsible for other specific parts of the work. In addition, authors should have confidence in the integrity of the contributions of their co-authors.

All those designated as authors should meet all four criteria for authorship, and all who meet the four criteria should be identified as authors. Those who do not meet all four criteria should be acknowledged in the title page of the manuscript.

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The Turkish Journal of Surgery requires and encourages the authors and the individuals involved in the evaluation process of the submitted manuscripts to disclose any existing or potential conflicts of interests, including financial, consultant, and institutional. Any financial grants or other support received for a submitted study from individuals or institutions should be disclosed to the Editorial Board. To disclose a potential conflict of interest, the ICMJE Potential Conflict of Interest Disclosure Form should be filled in and submitted by all contributing authors. Cases of a potential conflict of interest of the editors, authors, or reviewers are resolved by the journal's Editorial Board within the scope of COPE and ICMJE guidelines.

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- Author Contributions Form, and
- ICMJE Potential Conflict of Interest Disclosure Form (should be filled in by all contributing authors)

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- Grant information and detailed information on the other sources of support,
- Name, address, telephone (including the mobile phone number) and fax numbers, and email address of the corresponding author,
- Acknowledgment of the individuals who contributed to the preparation of the manuscript but who do not fulfill the authorship criteria.

Abstract: English abstract should be submitted with all submissions except for Letters to the Editor. The abstract of Original Articles should be structured with subheadings (Objective, Material and Methods, Results, and Conclusion). Please check Table 1 below for word count specifications.

Keywords: Each submission must be accompanied by a minimum of three to a maximum of six keywords for subject indexing at the end of the abstract. The keywords should be listed in full without abbreviations. The keywords should be selected from the National Library of Medicine, Medical Subject Headings database (https://www.nlm.nih.gov/mesh/MBrowser.html).

Manuscript Types

Original Articles: This is the most important type of article since it provides new information based on original research. The main text of original articles should be structured with Introduction, Material and Methods (with subheadings), Results, Discussion, Conclusion subheadings. Please check Table 1 for the limitations for Original Articles.

Statistical analysis to support conclusions is usually necessary. Statistical analyses must be conducted in accordance with international statistical reporting standards (Altman DG, Gore SM, Gardner MJ, Pocock SJ. Statistical guidelines for contributors to medical journals. Br Med J 1983; 7: 1489-93). Information on statistical analyses should be provided with a separate subheading under the Material and Methods section and the statistical software that was used during the process must be specified.

Units should be prepared in accordance with the International System of Units (SI).

Expert Opinions: Editorial comments aim to provide a brief critical commentary by reviewers with expertise or with high reputation in the topic of the research article published in the journal. Authors are selected and invited by the journal to provide such comments. Abstract, Keywords, Tables, Figures, Images, and other media are not included.

Review Articles: Reviews with high citation potential prepared by authors with extensive knowledge on a particular field and whose scientific background has already been proven by a high number of publications in the related field are welcomed. These authors may even be invited by the journal. Reviews should describe, discuss, and evaluate the current level of knowledge of a topic in clinical practice and should guide future studies. The main text should contain Introduction, Clinical and Research Consequences, and Conclusion sections. Please check Table 1 for the limitations for Review Articles.

Case Reports: There is limited space for case reports in the journal, and reports on rare cases or conditions constituting challenges in diagnosis and treatment, those offering new therapies or revealing insight not included in the literature, and interesting and educative case reports are accepted for publication. The text should include Introduction, Case Presentation, Discussion, and Conclusion subheadings. Please check Table 1 for the limitations for Case Reports.

Surgical Methods: Images of remarkable, striking and rare cases that emphasize the basic mechanisms of diagnosis and treatment of diseases, express discrepancies and extraordinary situations and explain new treatment techniques and options are evaluated for publication. Display items are important in this type of manuscripts, and supporting the manuscript with video (in WMV, AVI or MPEG formats) images can facilitate a faster evaluation process and increase the possibility of publication.

Letters to the Editor: This type of manuscript discusses important parts, overlooked aspects, or lacking parts of a previously published article. Articles on subjects within the scope of the journal that might attract the readers' attention, particularly educative cases, may also be submitted in the form of a "Letter to the Editor." Readers can also present their comments on the published manuscripts in the form of a "Letter to the Editor." Abstract, Keywords, Tables, Figures, Images, and other media should not be included. The text should be unstructured. The article being commented on must be properly cited within this manuscript.

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All research involving human participants must have been approved by the authors' Institutional Review Board (IRB) or by equivalent ethics committee(s) and must have been conducted according to the principles expressed in the Declaration of Helsinki. Authors should be able to submit, upon request, a statement from the IRB or ethics committee indicating approval of the research. The Journal reserves the right to reject work believed to have not been conducted in a high ethical standard, even when formal approval has been obtained.

Subjects must have been properly instructed and have indicated that they consent to participate by signing the appropriate informed consent paperwork. Authors may be asked to submit a blank, sample copy of a subject consent form. If consent was verbal instead of written, or if consent could not be obtained, the authors must explain the reason in the manuscript, and the use of verbal consent or the lack of consent must have been approved by the IRB or ethics committee.

Animal Research

All animal research must have approval from the authors' Institutional Animal Care and Use Committee (IACUC) or equivalent ethics committee(s), and the research must have been conducted according to applicable national and international guidelines. Approval must be received prior to beginning the research.

Table 1. Limitations for each manuscript type

Type of manuscript	Word limit	Abstract word limit	Reference limit	Table limit	Figure limit
Original Article	5000	250 (Structured)	50	6	7 or total of 15 images
Review Article	5000	250	50	6	10 or total of 20 images
Case Report	1500	250	15	No tables	10 or total of 20 images
Surgical Methods	500	No abstract	5	No tables	10 or total of 20 images
Letter to the Editor	500	No abstract	5	No tables	No media

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Manuscripts reporting animal research must state in the Methods section: The full name of the relevant ethics committee that approved the work, and the associated permit number(s). Where ethical approval is not required, the manuscript should include a clear statement of this and the reason why. The author should provide any relevant regulations under which the study is exempt from the requirement of approval.

Tables

Tables should be included in the main document, presented after the reference list, and numbered consecutively in the order they are referred to within the main text. A descriptive title must be placed above the tables. Abbreviations used in the tables should be defined below the tables by footnotes (even if they are defined within the main text). Tables should be created using the "insert table" command of the word processing software and they should be arranged clearly to provide easy reading. Data presented in the tables should not be a repetition of the data presented within the main text but should be supporting the main text.

Figures and Figure Legends

Figures, graphics, and photographs should be submitted as separate files (in TIFF or JPEG format) through the submission system. The files should not be embedded in a Word document or the main document. When there are figure subunits, the subunits should not be merged to form a single image. Each subunit should be submitted separately through the submission system. Images should not be labeled (a, b, c, etc.) to indicate figure subunits. Thick and thin arrows, arrowheads, stars, asterisks, and similar marks can be used on the images to support figure legends. Like the rest of the submission, the figures too should be blind. Any information within the images that may indicate an individual or institution should be blinded. The minimum resolution of each submitted figure should be 300 DPI. To prevent delays in the evaluation process, all submitted figures should be clear in resolution and large in size (minimum dimensions: 100 × 100 mm). Figure legends should be listed at the end of the main document.

All acronyms and abbreviations used in the manuscript should be defined at first use, both in the abstract and in the main text. The abbreviation should be provided in parentheses following the definition.

When a drug, product, hardware, or software program is mentioned within the main text, product information, including the name of the product, the producer of the product, and city and the country of the company (including the state if in the USA) should be provided in parentheses in the following format: "Discovery St PET/CT scanner (General Electric, Milwaukee, WI, USA)"

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Limitations, drawbacks, and the shortcomings of original articles should be mentioned in the Discussion section before the conclusion paragraph.

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While citing publications, preference should be given to the latest, most up-to-date publications. If an ahead-of-print publication is cited, the DOI number should be provided. Authors are responsible for the accuracy of references. Only references cited in the text should be included in the reference list. The reference list must be numbered according to the order of mention of the references in the text. In the main text of the manuscript, references should be cited using Arabic numbers in parentheses. Journal titles should be abbreviated in accordance with the journal abbreviations in Index Medicus/MEDLINE/PubMed. When there are six or fewer authors, all authors should be listed. If there are seven or more authors, the first six authors should be listed followed by "et al." The reference styles for different types of publications are presented in the following examples.

Journal Article: Rankovic A, Rancic N, Jovanovic M, Ivanović M, Gajović O, Lazić Z, et al. Impact of imaging diagnostics on the budget - Are we spending too much? Vojnosanit Pregl 2013; 70: 709-11.

Book Section: Suh KN, Keystone JS. Malaria and babesiosis. Gorbach SL, Barlett JG, Blacklow NR, editors. Infectious Diseases. Philadelphia: Lippincott Williams; 2004. pp. 2290-308.

Books with a Single Author: Sweetman SC. Martindale the Complete Drug Reference. 34th ed. London: Pharmaceutical Press; 2005.

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Manuscripts Accepted for Publication, Not Published Yet: Slots J. The microflora of black stain on human primary teeth. Scand J Dent Res. 1974.

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REVISIONS

When submitting a revised version of a paper, the author must submit a detailed "Response to the reviewers" that states point by point how each issue raised by the reviewers has been covered and where it can be found (each reviewer's comment, followed by the author's reply and line numbers where the changes have been made) as well as an annotated copy of the main document. Revised manuscripts must be submitted within 30 days from the date of the decision letter. If the revised version of the manuscript is not submitted within the allocated time, the revision option may be canceled. If the submitting author(s) believe that additional time is required, they should request this extension before the initial 30-day period is over.

Accepted manuscripts are copy-edited for grammar, punctuation, and format. Once the publication process of a manuscript is completed, it is published online on the journal's webpage as an ahead-of-print publication before it is included in its scheduled issue. A PDF proof of the accepted manuscript is sent to the corresponding author and their publication approval is requested within 2 days of their receipt of the proof.

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FROM THE EDITOR'S DESK
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10.47717/turkjsurg.2022.9901

The Non-Medical but Medical Issues of the Surgeons

Dear Readers of Turkish Journal of Surgery,

We are impatient to kick off the new year 2022 with this March issue which is full of interesting articles in different fields of surgery. We do hope that you will enjoy reading these papers and benefit for your future research.

The surgeons have typically a very busy daily schedule, including operations, ward rounds, tumor-boards as well as education and research duties. There is very little time left for us to think about the non-medical issues which influence directly our daily medical works. There are two articles in the March 2022 issue which address the current important "non-medical but medical" problems of the surgery. The first one aim to discuss the existing "who can perform it?" licensing dilemma of the endoscopic procedures in Turkey. The procedures like endoscopy are the shared fields with the other disciplines and the education as well as the authorization are sometimes difficult to define. The review article from Yılmaz S reports the current legal aspects and ongoing judicial processes of ERCP licensing in Turkey (1). I would highly recommend this article if you were interested or being involved this turbulent issue. Moreover the article from Sahinler et al focuses on the "pay for performance" system of the heathcare management worldwide. The study the key points of this concept from the surgeons' perspective. I sincerely hope a future for all of us where we will not have to worry about these "para-surgical" problems that discomfort our already stressful work environment.

I am sure that you have already noted in your calendar the 22th National Surgical Congress which will take place in Antalya between March 23rd-27th 2022. It is the largest scientific event for the Turkish surgeons. We do hope a highly successful meeting for the organization and all the participants.

On behalf of the editorial team, I wish you a pleasant reading!

Kindest regards,

Kaya SARIBEYOĞLU

Editor-in-Chief
Turkish Journal of Surgery

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2. *Şahiner İT, Esen E, Uçar AD, Karaca AS, Yastı AÇ. Pay for performance system in Turkey and the world; a global overview. Turk J Surg 2022; 38 (1): 46-54.*

REVIEW
Turk J Surg 2022; 38 (1): 1-4

ERCP licence in the context of medical practices, legal regulations, medical ethics and patient's rights in our country

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ABSTRACT

Endoscopic Retrograde Cholangiopancreatography (ERCP) is an invasive endoscopic procedure mainly used for hepatobiliary and pancreatic disorders. Although it was first developed by a surgeon, McCune, there is still debate on who can perform this procedure. This problem, which actually needs to be solved within medical ethics, has been brought to the courts, and lawsuits have been filed against general surgeons to prevent them from performing ERCP. The current situation in our country demonstrates that 50-70% of ERCP procedures are performed by general surgeons. In regions where there are not enough gastroenterology specialists, only general surgeons perform this procedure. Today, general surgeons have hundreds of articles on ERCP procedures and studies accepted as international guideline. ERCP procedure -which is in fact a surgical procedure- is included in hepatobiliary surgical procedures in the general surgery core training schedule. General surgeons receive ERCP education in a 6-month challenging program at centers accredited by the Turkish Surgical Society. The problem of ERCP license cannot be solved by legal authorities but by medical, ethical and deontological discussions. Our recommendation here is that the Ministry of Health should associate this procedure with a specific legislation, just like in endoscopy, and establish a specific ERCP training program accepted for license. In this article, the problem of who should perform ERCP was discussed within the framework of legal legislation, medical doctrine and realities of our country.

Keywords: ERCP, licence, law, patient's rights

INTRODUCTION

There is a significant increase in demand for healthcare services provided to patients due to the gradually rising health problems in the world. On the other hand, the healthcare services provided have become different with technological advances, and these innovative ventures are adapted to healthcare services. Endoscopic retrograde cholangiopancreatography (ERCP), one of the most important examples of technology being adapted to healthcare services, is an endoscopic invasive procedure performed for diagnostic and treatment purposes in the bile ducts. ERCP procedure, which was first developed by a surgeon from Ohio named McCune in 1968, is performed by general surgery, gastroenterology and invasive radiology specialists in developed countries such as the United States of America, the United Kingdom and Germany. Surgical history of ERCP procedure introduced to the field of medicine by McCune et al. can be accessed from "Güncel Gastroenteroloji Dergisi" (Journal of Current Gastroenterology) published by the Turkish Gastroenterology Foundation (1).

The Current Status in Our Country

ERCP procedure, which was first performed in our country in 1977, has also been performed by general surgeons as of 1993 and today, nearly two hundred general surgeons can carry out the ERCP procedure. The number of ERCP procedures performed annually by general surgeons varies between 9.500 and 10.000, and the total number of cases performed until today is assumed to be around 110.000. When it is considered that 15.000-20.000 patients require ERCP procedure annually in our country, it is seen that 50-60% of ERCP procedure is fulfilled by general surgeons. In our country today, general surgeons, along with gastroenterologists, meet a significant part of ERCP load in major cities like Ankara, İstanbul and İzmir.

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On the other hand, this procedure is performed by only general surgeons in many Anatolian cities such as Bandırma, Urfa, Antalya, Uşak, Trabzon, Balıkesir, Afyon, Isparta, Nevşehir, Tekirdağ, Edirne, Konya, Balıkesir, and Rize where a gastroenterology specialist is not present or ERCP procedure cannot be performed even if there is a gastroenterologist. These data can be confirmed by codes 701360, 701370 and 701440 on the database of Ministry of Health with ERCP procedure entries.

ERCP training of general surgeons is executed with a 6-month actual curriculum that has been introduced as a result of consultations held between the Ministry of Health and Turkish Surgical Society (TSS) and has been going on for over ten years (2). The scope of the training program determined by TSS has been prepared by grounding on precedent curriculum programs abroad but also by making many of their parameters more difficult. Compliance to the training program is strictly followed by the documents the trainee submits. Residents also receive ERCP training in centers offering ERCP training programs and include in their professional practice this procedure along with gastroscopy and colonoscopy. This program has both theoretical and practical parts and requires six months of continuous study.

When ERCP training is assessed in terms of academic material, there are three local textbooks on comprehensive technical information of ERCP procedure. Two of these books have been written by general surgeons (3,4). Courses and panels related to ERCP have been implemented in all national congresses such as the 20th, 21st, and 22nd Turkish National Surgical Congresses or the 14th and 5th Turkish Endoscopic Laparoscopic Surgery Congresses. Hundreds of articles on ERCP written by the general surgeons performing the procedure have been published in national and international journals, and some articles have been included in European Guidelines (5).

Legal Conditions of ERCP License

ERCP procedure, due to its context, is clearly a surgical procedure. For instance, sphincterotomy is an incision procedure performed with the help of a cautery and sphincterotome, and Dictionary of the Turkish Language Association defines surgery as a medical activity including procedures of incision, suturing, and excision. Law no 1219 (Law on the Mode of Execution of Medicine and Medical Sciences) clearly states that surgical license is required for surgical intervention. Therefore, as is thoroughly pointed out below, general surgeons are capable of and responsible for performing ERCP procedures, and prohibiting them to perform ERCP surgery is against the clear provision of the law. It must be underlined that ERCP procedure is not found under endoscopic procedures but under Hepatobiliary Surgical Procedures in the General Surgery Core Training Program (CTP). After all, the procedure itself is indeed a hepatobiliary surgical procedure, and prohibiting surgeons from this procedure is not only pseudo-scientific but also non-conscientious.

Who Should Perform ERCP Procedures?

The right and license of a medical practice is regulated as per legal legislation not by the request and opinion of real person and corporate entity. In short, the persons who have the right and license to perform ERCP procedure are determined as per the legislation within the current positive legal framework and by the relevant regulations of the Ministry of Health (6). However, it is not expected nor possible for law to establish legislation for each and every medical intervention. Likewise, it is not the duty of law to make regulations individually for hundreds of practices carried out by surgeons, and it is against the natural flow of life. Fundamentally, lawmakers have meticulously avoided such an elaborative approach. Being that, lawmakers have left other subjects to the ethical values of the members of medicine and sources of medical doctrine as long as they do not constitute contradiction to general legislation. Searching for a solution only on a legal basis draws us away from a permanent solution. There are many court verdicts that contradict one another on who can perform ERCP procedures. For instance, while the decision of the Ministry of Health denying general surgeons' demand for ERCP training has been revoked due to direct opposition to the Constitution in a lawsuit taking place in the Administrative Court of Bursa, a general surgeon has been prohibited from performing ERCP justifying on only the Endoscopy Regulation of the Ministry of Health by the Administrative Court of Ankara (7,8). Therefore, general provisions of the legislation should be considered with regard to who can perform ERCP procedures, and the ethical and deontological norms of medicine should be consulted in fields with legal loophole.

Legislative Provisions on ERCP Procedures

There is no regulation in our legislation that directly refers to ERCP procedure. The most important legislation that guides us in the right and license of such an invasive procedure is the Law on the Mode of Execution of Medicine and Medical Sciences (9). Article 3 of this Law no. 1219 clearly states that "No one without proper surgical license can perform any surgical intervention". Therefore, according to that law, the right and license of ERCP procedure, which is a surgical procedure as mentioned above, belongs to surgeons. It should be noted that no regulation, by-laws or communique can be against the law, which is the mandatory provision. Again, as per the additional Article 14 of this law, it is stated that "Training curricula of the specialties and the fundamental execution area of the specialties and the framework of the duties and authorities shall be determined by the Board of Specialty in Medicine." A Regulation on Specialty in Medicine has been made by this Board pursuant to the provision of this article, and CTP determining the minimum level of residency training in all specialties have been established immediately afterwards. However, there is no other legislation determining the duties and authorities of relevant specialists of the field other than the programs

specifying the minimum qualities of residency training. Therefore, the debate is rooted in this legislative loophole, and right and license in activities following specialty are considered as per CTP, which is a residency training program. However, CTP, which determines the curriculum of the residency training program, is an advisory document specifying the minimum standards of this training. This document cannot be used as a criterion in determining the right and license of a general surgery specialist. Moreover, within their specialty framework, general surgeons perform many surgical procedures that are not included in Level 1 category of CTP. All kinds of transplants and bariatric surgery, in particular, can be given as examples to these procedures.

The same situation is valid for gastroenterology. Procedures like endoscopic ultrasound (EUS), endoscopic mucosal resection (EMR). endoscopic submucosal dissection, which are included in Level 1 category of gastroenterology CTP, and procedures like submucosal tunneling endoscopic resection and peroral endoscopic myotomy which are not found in the relevant CTP, are also performed by gastroenterologists.

On the other hand, if a resident does not receive any training on ERCP in the clinic where the training is given, he/she does not have direct license to perform this operation solely since this procedure is a Level 2 procedure in CTP. When there is a legal conflict, the individual has to prove with evidence that he/she has received training for this surgical procedure following specialty since he/she did not receive this training during residency. Therefore, CTP is not a document that determines the license of a specialty affirmatively or negatively but is an advisory document specifying the minimum standards of the residency training field. Training in medicine is a dynamic process that continues even after specialty.

On this matter, in the Annex 1/b article of (10), it is stated that "a specialist physician executes his/her profession with the knowledge and skills gained during medical school and specialty training and additionally within the framework of the knowledge and skills gained through vocational training and scientific activities after specification". It is understood by this statement that specialist physicians can include the skills they have gained following their residency training into their professional activities.

It is observed that the problem with ERCP license is frequently debated by justifying endoscopy certification regulation no. 457 and TUK; 2014/405 of the Ministry of Health. Yet, this endoscopy certification program established by the Ministry of Health, Board of Specialty in Medicine has been regulated for only endoscopic procedures, and along with ERCP, procedures like EUS and EMR have been left out of this regulation. However, even though procedures like EUS and EMR that are excluded from this certification regulation are found in Level 1 category of gastroenterology CTP, they are performed by gastroenterologists without being subject to any restrictions. On the other hand, in the case of general surgery as the specialty field, it is ruled that ERCP procedure is not within the scope of the certification and cannot be performed since it is found in Level 1 category. To the best of our knowledge, since there are no training programs oriented at EUS and EMR in gastroenterology societies as there are in TSS, what should be debated is that with what authority gastroenterologists perform procedures like EUS and EMR.

ERCP training is totally different from endoscopy training. It is not possible for a specialist with only endoscopy certificate to perform ERCP. Thus, general surgeons perform ERCP procedure after having received the basic ERCP training conducted by TSS and with a totally different certificate from that of the abovementioned one. What should be done by the Ministry of Health, which is already commissioned on this matter by law no 1219, is to standardize the training of ERCP, EUS, EMR and similar procedures that do not currently have a certification regulation at the moment.

Turkish Gastroenterology Association states that general surgeons can perform ERCP but must hold a subspecialty in gastro surgery. Although TGA does not have such authority, the matter should be clarified in a few points:

1. All of a couple of gastro surgeons performing ERCP in our country have received their ERCP training from the program regulated by TSS.

2. ERCP training is not given in any of the 11 centers offering gastro surgery training and, in these centers, ERCP is performed by general surgeons or gastroenterologists.

3. There is no rotation in gastro surgery including gastroenterology. Therefore, it is impossible for a resident to receive ERCP training while doing subspecialty in gastro surgery.

4. When we look at the practices abroad, we see that general surgeons, radiologists and gastroenterologists perform this procedure (11-13).

It is also vital to evaluate the matter on grounds of patient rights. It is necessary to emphasize that the prevention of a patient's right to undergo ERCP procedure due to cholangitis with a general surgeon in whose knowledge, experience and academic qualities are trusted is contradictory to Articles 17 and 54 of the Constitution that regulates patient rights and to the Patient Right Regulation adaptationally made from International Agreements to which Turkey is a party.

CONCLUSION

Another field of specialization cannot decide on which activities a field of specialization can be engaged in. Therefore, as it is not scientific for gastroenterologists to think that surgeons cannot perform ERCP, it is also unethical and immoral. The decision-making body on this matter is the commissions and regulations to be determined by the Ministry of Health pursuant to law no 1219. What should be done is that a standardized training

program and a legislation should be formed for procedures like ERCP and EUS just as in endoscopy, and certifications should be made accordingly. Until these regulations are made, surgeons naturally receive ERCP training through their professional organization, TSS, with a 6-month training program which is more difficult and scientific than its counterparts in many countries.

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DERLEME-ÖZET
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Ülkemizdeki sağlık hizmetleri, mevzuat, tıp etiği ve hasta hakları bağlamında ERCP işlemlerinde ehliyet sorunu

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ÖZET

Endoskopik retrograt kolanjiopankreatografi (ERCP), esas olarak hepatobiliyer ve pankreas hastalıklarında kullanılan invaziv bir endoskopik işlemdir. Her ne kadar ilk defa bir cerrah olan McCune tarafından tanımlanmışsa da halen bu işlemin kimin yapacağı ile ilgili tartışmalar yaşanmaktadır. Aslında tıbbi etik çerçevesinde çözülmesi gereken bu problem mahkemelere taşınmakta ve genel cerrahların bu işlemi yapmaması için davalar açılmaktadır. Ülkemizdeki gerçek durum değerlendirildiğinde de ERCP işlemlerinin %50-70'inin genel cerrahlar tarafından yapıldığı görülmektedir. Sınırlı sayıda gastroenteroloji uzmanının olduğu bölgelerde de bu işlemi sadece genel cerrahlar gerçekleştirmektedir. Günümüzde genel cerrahların ERCP işlemleriyle ilgili yüzlerce makaleleri, uluslararası kılavuzlara girmiş çalışmaları mevcuttur. Gerçekte bir cerrahi işlem olan ve genel cerrahi çekirdek eğitim programında hepatobiliyer cerrahi işlemler sınıfında yer alan ERCP işlemi Türk Cerrahi Derneği'nin akredite ettiği merkezlerde altı aylık zorlu bir programla öğretilmektedir. ERCP işlemlerinde ehliyet sorunu hukuki mercilerce değil tıbbi, etik ve deontolojik tartışmalarla belirlenir. Burada önerimiz Sağlık Bakanlığı'nın bu işlemi de aynı endoskopide olduğu gibi özel bir mevzuata bağlaması ve ERCP ile ilişkili bir sertifikasyon eğitim programı oluşturmasıdır. Bu çalışmada ERCP işlemini kimin yapması gerektiği sorunsalı hukuki mevzuat, tıbbi doktrin ve ülkemizin reel koşulları çerçevesinde ele tartışılmıştır.

Anahtar Kelimeler: ERCP, ehliyet, hukuk, hasta hakları

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ORIGINAL ARTICLE
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Seasonal effects on the mechanisms of burn injuries

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ABSTRACT

Objective: This study aimed to evaluate seasonal effects on the mechanisms of burn injuries in patients requiring hospitalization.

Material and Methods: A retrospective evaluation was made using the information of 419 hospitalized burns patients, including demographic data, degree and percentage of burn injury, cause and mechanism of burn injury, morbidity and mortality. Burn mechanisms were grouped as thermal burns (flame, boiling liquid, contact), chemical burns and electrical burns. When calculating the percentage of body surface area burned, the rule of nines was applied. Seasonal classification was made appropriate to the northern hemisphere.

Results: According to the seasons, the most burns were seen in spring months (n= 130, 31.0%). In the examination of the mechanism of burn injury, the most common type of injury was boiling liquid in 159 patients followed by flame injury in 146 patients. There was an increase in electrical and chemical burns in spring and summer. A statistically significant difference was determined between the types of burns according to the seasons (p= 0.024). The burn injury occurred as a result of a workplace accident in 82 cases, the majority of which were in autumn, and summer, and the difference in the seasons was determined to be statistically significant (p= 0.045). There was a statistically significant increase in the exposure of individuals aged >65 years to boiling liquid burns in winter and summer months (p= 0.014).

Conclusion: The results of this study showed a seasonal effect on the types of burn injuries. A higher rate of thermal burns was expected to be found in winter, but this was not the case in patients with indications for hospitalization, as chemical and electrical burns in workplace accidents were seen more frequently in warmer seasons of spring and summer. In this context, burns units should be prepared for patient profiles to vary according to the season.

Keywords: Burn injury, etiology of burns, seasonal effects

INTRODUCTION

Burn injuries are the fourth most common type of all traumas, with approximately 90% seen in under-developed and developing countries, causing severe morbidity and mortality (1,2). Previous studies have reported that the frequency and mechanism of injury show differences according to age, sex, socio-economic status, and season (3-6). There are evaluations in the literature on the relationship between thermal burns and seasons or between the increase in the use of resources and the seasonal increase in patient rates (7). However, no study could be found in the literature on the subject of the seasonal links to less commonly seen burn types other than thermal burns. Providing informative education for the community on public health problems such as burns involving the whole society is known to reduce the frequency. Moreover, raising the awareness of physicians of this seasonal relationship will allow them to be better prepared for burn traumas.

The aim of this study was to determine whether or not there was any seasonal difference in types of burn injuries, primarily thermal burns, but also other less frequently seen burn types.

MATERIAL and METHODS

Approval for this retrospective study was granted by the Local Ethics Committee (Decision no: E-19-2543, Date: 21.02.2019). The study was conducted in the Burns Treatment Centre between January 2017 and September 2019. All study procedures were applied in compliance with the 1964 Helsinki Declaration and later revisions, and the ethical standards of the institutional and/or national research committee.

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Demographic data of the patients, physical examination findings, degree of burn, percentage of burned body surface area, mechanism of burn injury, cause of burn injury, morbidity, and mortality were retrieved from computer files, patient records, operating notes, and anesthesia follow-up forms. Burn mechanisms were grouped as thermal burns (flame, boiling liquid, contact), chemical burns and electrical burns. The degree of the burns was classified by a burns unit specialist physician, and when calculating the percentage of body surface area burned, the rule of nines was applied. Areas of first-degree burns were not included in the calculations.

As Turkey is geographically located in the northern hemisphere, seasonal classification was made accordingly; the months of December, January, and February were accepted as winter, March, April, and May as spring, June, July and August as summer, and September, October, and November as autumn.

Statistical Analysis

The conformity of the continuous numerical data to normal distribution was assessed with the Kolmogorov-Smirnov test. As the data were seen to be normally distributed, the relationship between the seasons and the continuous data of age and burn percentage was investigated with the Kruskal Wallis test. Chi-square test was applied to categorical data. A value of $p< 0.05$ was accepted as statistically significant.

RESULTS

Evaluation was made on 419 patients comprising 288 (68.7%) males and 131 (31.3%) females with a mean age of 41.92 ± 19.71 years (range, 0-91 years). Mean percentage of burned body surface area was 12.11% ± 16.83% (1%-97%), and mortality developed in 32 (7.60%) patients.

According to the seasons, the most burns were seen in spring months (n= 130, 31.0%). In the examination of the mechanism of burn injury, the most common type of injury was boiling liquid in 159 patients followed by flame injury in 146 patients. There was an increase in electrical and chemical burns in spring and summer. A statistically significant difference was determined between the types of burns according to the seasons (p= 0.024). The burn injury occurred as a result of a workplace accident in 82 cases, the majority of which were in autumn, and summer, and the difference in the seasons was determined to be statistically significant (p= 0.045) (Table 1).

No statistically significant seasonal change was observed according to age (p= 0.805). When the patients were evaluated according to age and season, no significant difference was de-

Table 1. Demographic variables of burn patients grouped according to seasons

	Winter n (%)	Spring n (%)	Summer n (%)	Autumn n (%)	Total n (%)	p	Effect Size
Age (years)							
mean ± SD	45.55 ± 19.21	43.02 ± 19.58	41.91 ± 18.18	43.61 ± 17.30	43.94 ± 18.50	0.790	0.060
≤65	63 (%15.0)	87 (%20.8)	115 (%27.4)	89 (%21.2)	344 (%82.1)	**0.014**	
>65	24 (%5.7)	16 (%3.8)	15 (%3.6)	10 (%2.5)	67 (%17.9)		
Burn type							
Electrical	3 (%7.9)	13 (%34.2)	14 (%36.8)	8 (%21.1)	38 (%9.1)	**0.024**	0.236
Chemical	1 (%3.7)	7 (%25.9)	10 (%37.0)	9 (%33.3)	27 (%6.4)		
Hot liquids	41 (%25.8)	34 (%21.4)	57 (%35.8)	27 (%17.0)	159 (%38.0)		
Flame	33 (%22.6)	36 (%24.7)	33 (%22.6)	44 (%30.1)	146 (%34.8)		
Heat contact	9 (%18.4)	13 (%26.5)	16 (%32.7)	11 (%22.4)	49 (%11.7)		
Total	87 (%20.8)	103 (%24.6)	130 (%31.0)	99 (%23.6)	419 (%100)		
Mortality							0.132
Negative	78 (%20.2)	100 (%25.8)	122 (%31.5)	87 (%22.5)	387 (%92.4)	0.064	
Positive	9 (%28.1)	3 (%9.4)	8 (%25.0)	12 (%37.5)	32 (%7.6)		
Industrial injury							
Negative	76 (%22.6)	82 (%24.3)	108 (%32.0)	71 (%21.1)	337 (%80.4)	**0.045**	0.138
Positive	11 (%13.4)	21 (%25.6)	22 (%26.8)	28 (%34.1)	82 (%19.6)		
Sex							
Male	57 (%13.6)	70 (%16.3)	94 (%32.6)	67 (%23.3)	288 (%68.7)	0.736	0.055
Female	30 (%22.9)	33 (%25.2)	36 (%27.5)	32 (%24.4)	131 (%32.3)		

*Pearson's Chi-square test $p< 0.05$ was considered statistically significant.

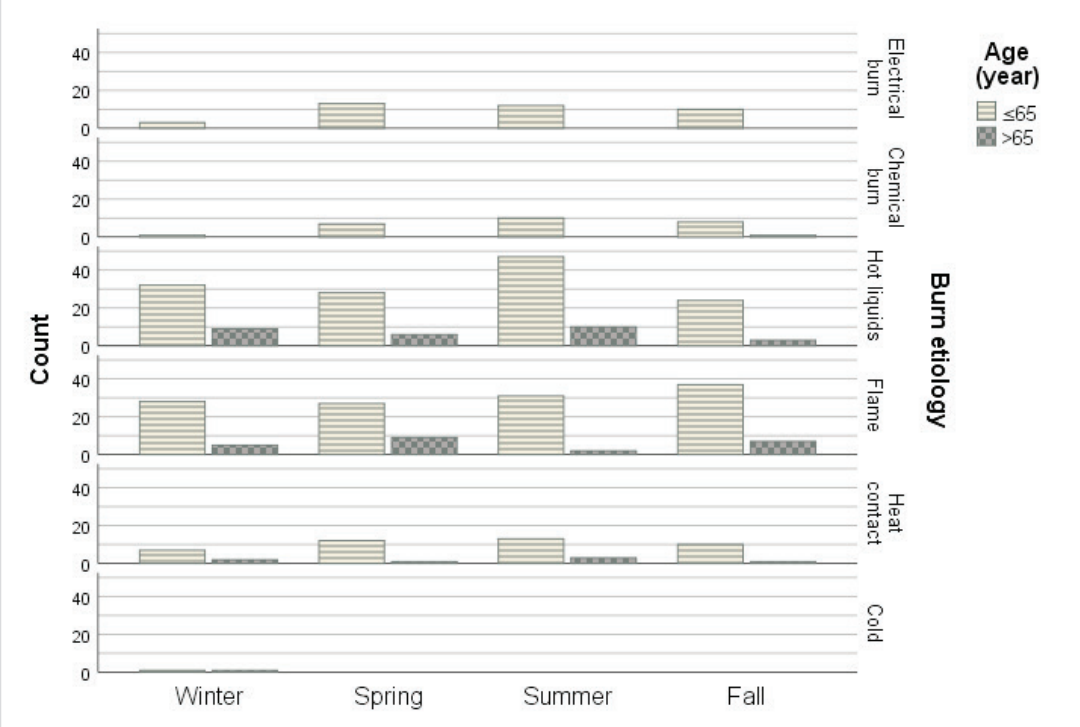

Figure 1. Burn causes classified by age.

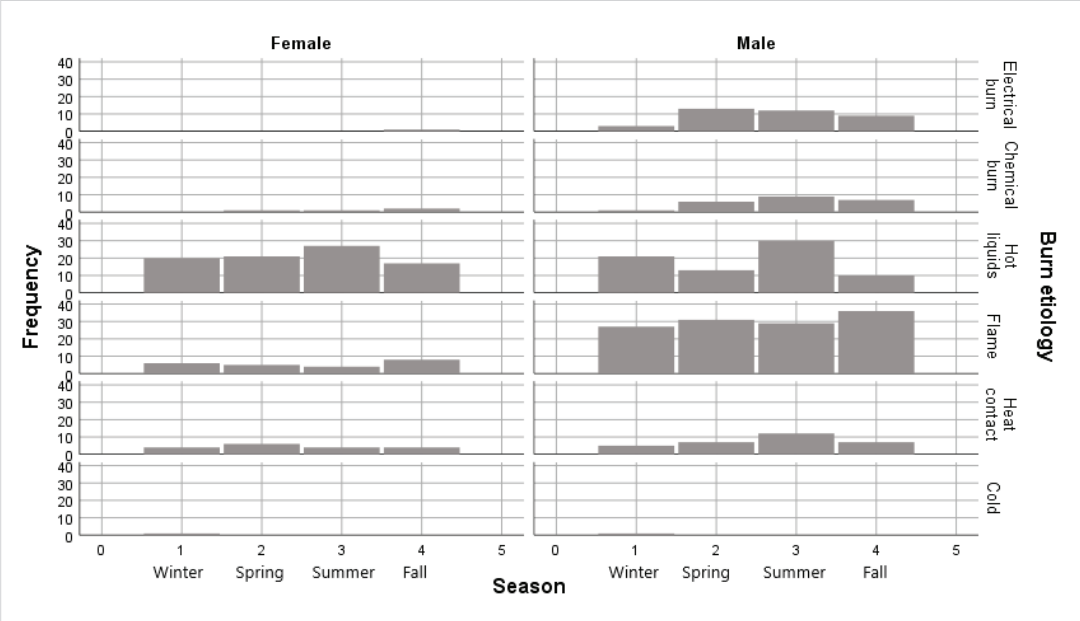

Figure 2. Fall=Autumn.

termined between the groups (p= 0.790). There was seen to be a statistically significant increase in the exposure of individuals aged >65 years to boiling liquid burns in winter and summer months (p= 0.014) (Figure 1). Despite the lack of seasonal difference in respect of sex, there was a significant difference between the groups when they were evaluated in respect of sex, seasonal change, and cause of burn (p< 0.001) (Figure 2).

The percentage of burned body surface area was seen to be greater in summer and autumn months on presentation at hospital (p= 0.006), and seasonal comparison of the total burn area values was found to have a moderate clinical effect (effect size= 0.325) (Table 2).

Table 2. Comparison of burn area percentages by seasons

	Seasons				p	Effect Size
	Winter	Spring	Summer	Autumn		
Total burn area (%)	5 (1-97)	5 (1-60)	7 (1-85)	8 (1-95)	**p= 0.006**	0.325

* Kruskal Wallis test p< 0.05 was considered statistically significant.

DISCUSSION

There are studies in the literature which have reported that seasonal effects can have an impact on surgical outcomes, may increase hospital presentations, and could have positive or negative effects on the use of resources. It has been shown that seasonal status does not only affect burns patients, but can also affect breast cancer recurrence (8), high HbA1c levels (9), cardiopulmonary arrest (10), and admission to intensive care units (ICU) (11). Knowledge of these types of conditions can allow planning of resources and personnel in hospitals, ICUs, and burns centers, and even the provision of information to the community on this subject using mass communication tools.

Although the current study results showed no difference in patient sex according to the seasons, it has been reported in the literature that there is a higher rate of hospital presentation and admission of males than females, irrespective of season. For example, a large patient series in Germany has reported that males constituted approximately 70% of all burn injury patients (12). Studies from other countries have shown similar results. In a study by Schiefer et al. it has been shown that the presentation rate of male patients was higher in all months, and in summer months, this rate was further increased. The same study has reported that the rates of female patients were relatively increased in the months of December, January, February, and March (13). Consistent with these findings in the literature, the rate of male patients in the current study was 68.7%.

When the patients were evaluated in respect of age and season, there was no difference between the groups (p= 0.790), but in winter and summer months, individuals aged >65 years were seen to be more exposed to boiling liquid burn injuries. Similar to the findings of Williams et al. (14), the main reason for this was thought to be that these patients spent more time at home in these periods and probably were exposed to accidents in the house.

There are different opinions on the subject of the seasonal relationship with the development of burns. While there are studies from developed countries showing no difference between the seasons of the year in respect of burns injuries (12,13) studies from developing countries have reported seasonal differences (14,15). One of the noticeable points in the studies published in developing countries is that the causes of burns are directly affected by conditions such as the geographic features of the region, seasonal condition, and the level of development. For example, in a study published by the Tampa General Regional Burns Centre, burns patient admissions reached a peak immediately after the end of the hurricane season related to accelerants used for the destruction of rubble (16). In a large-scale (n= 3515) pediatric study in Australia, winter has been reported to be the season of most boiling liquid and flame injuries, but this has not been observed for contact burns (17). Hultman et al. have evaluated 740 patients and reported that spring was the season with the highest rate of hospitalizations (15). In another study of 1600 patients in the Dominican Republic, it has been reported that the demographic profile was seen to have an effect on electrical burns, but there was not seen to be any statistically significant difference in the mechanisms of burn injury according to season (7). Tyler et al. have shown that the frequency of boiling liquid and flame burns was greater and although the seasons had no effect on mortality, the incidence of burns was higher in the winter months (5). In the current study, summer was seen to be the season of most hospitalizations.

Although patient hospitalizations have been reported in the literature to be higher in autumn and winter, the seasonal shift to summer seen in the current study was thought to be due to the conversion from apartment block central heating systems to individual home heating in the last 15 years in this region where our center is located, as it is a region which is highly developed. Williams et al. have similarly evaluated a 10-year period of hospital admissions, and despite an increase in winter, in the last two years there was an increase in presentations at the burns center in the summer similar to in winter (14). No reasons for this were given by Williams et al. but in the current study, this was thought to be due to an increase in workplace accidents in summer and the fact that in the rural areas of our region, it is traditional at the end of summer to prepare sauces, molasses and cheese over an open fire, and that chemical and electric burns could contribute to these results in the warmer months of spring, summer and autumn.

The most important limitation of this study is its retrospective design. However, our clinic is the most important reference burns center in the region, and records have been kept electronically for more than ten years in addition to the written records system still being maintained, and therefore, data loss can be considered to be at a minimum level.

CONCLUSION

The results of this study clearly showed that there was a seasonal effect on the mechanisms of burn injuries. It was also seen from literature review that seasonal predominance and the mechanisms of burn injuries could show differences. The results of the current study demonstrated an increase in electrical and chemical burns in warmer months. In this context, it can be seen to be necessary for burns units to investigate seasonal incidences of the region and to be prepared for potential accidents.

Ethics Committee Approval: The study was approved by the Local Ethics Committee (Decision no: E-16-912, Date: 21.02.2019)

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ORİJİNAL ÇALIŞMA-ÖZET
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Mevsimlerin yanık mekanizmaları üzerine etkileri

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ÖZET

Giriş ve Amaç: Bu çalışmanın amacı yatış gerektiren yanıklarda mevsimlerin yanık mekanizmaları üzerinde etkisini ortaya koymaktır.

Gereç ve Yöntem: Çalışmada yatış gerektiren 419 yanık hastasının demografik verileri, yanık derece ve yüzdelerine, yanık yaralanma mekanizmaları, yanık nedenleri ve mortalite, morbidite bilgileri retrospektif olarak elde edildi. Yanık mekanizmaları termal yanıklar (alev yanığı, haşlanma yanığı, temas yanığı), kimyasal ve elektrik yanıkları olarak gruplandırıldılar. Yanık yüzdeleri hesap edilirken yüzey alanına göre dokuzlar kuralı kullanılarak hesaplandı. Mevsimsel ayrım kuzey yarım küreye göre yapıldı.

Bulgular: Mevsimlere göre en fazla yanık 130 hasta (%31,0) ile ilkbaharda olduğu görüldü. Yanık mekanizmalarından en fazla yanık türü 159 hasta ile haşlanma yanığı ve bunu takiben 146 hasta ile alev yanığı izlemekteydi. Elektrik ve kimyasal yanıkların daha çok ilkbahar ve yaz aylarında sıklığının arttığı görüldü. Yanık türleri ile mevsimler arasında istatistiksel olarak anlamlı farklılık olduğu görüldü (p= 0,024). Vakaların 82'si iş kazası olmakla birlikte çoğunluğu sırası ile sonbahar ve yaz mevsimlerinde olduğu görüldü ve iş kazaları ile mevsimler arasında istatistiki olarak anlamlı farklılık görüldü (p= 0,045). Kış ve yaz mevsiminde 65 yaş üzeri bireylerin haşlanma ve nedenli yanık yaralanmasına anlamlı oranda daha fazla maruz kaldıkları görüldü (p= 0,014).

Sonuç: Mevsim değişikliklerinin yanık türlerindeki etkisi görülmekle birlikte, kış mevsimlerinde özellikle termal yanıkların daha sık olması beklenirken, yatış endikasyonu olan hastalarda bunun beklendiği gibi olmadığı görüldü ve özellikle iş kazalarında daha sık görülen kimyasal, elektrik yanıklarının yaz ve ilkbahar gibi sıcak mevsimlerde olduğu görüldü. Bu anlamda, yanık birimleri mevsimlere göre değişen hasta profillerine hazırlıklı olmalıdır.

Anahtar Kelimeler: Yanık yaralanmaları, yanıkların nedenleri, mevsimsel etki

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ORIGINAL ARTICLE
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The role of bioimpedance spectroscopy method in severity and stages of breast cancer-related lymphedema

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ABSTRACT

Objective: The correlation between lymphedema severity and stages determined by standard diagnostic methods and Bioimpedance Spectroscopy (BIS) technique was examined in breast cancer-related lymphedema (BCRL) patients.

Material and Methods: The bioimpedance analyzer device was connected to the 1.0 cm disc electrodes which were connected to the affected and unaffected (healthy) arm of the patients. We evaluated the performance of the impedance (Z) at multiple frequencies (5-50-100-200 kHz) and phase angle (PA), resistance (R), and reactance (XC) at 50 kHz on the lymphedema severity and stages. Bioimpedance measurements were applied to all volunteers in cooperation with the Physical Therapy and Rehabilitation Department. In this study, the correlation between BCRL severity and stages and bioimpedance values was examined.

Results: A total of 31 female patients were recruited to compare the BIS technique with standard diagnostic techniques. The severity of lymphedema was found among the patients as follows; mild 14 (45.2%), moderate 10 (32.3%), and severe 7 (22.6%). The stage distribution of volunteers was; 15 (48.4%) patients in Stage 0, 10 (32.3%) patients in Stage 1, 5 (16.1%) patients in Stage 2, and 1 (3.2%) patient in Stage 3. The ratio of affected and unaffected arm bioimpedance mean values were calculated. Although, this ratio at 50-100-200 kHz Z and 50kHz R were significantly correlated with the lymphedema stages ($p< 0.05$), there was no correlation and significant difference between the ratio of the bioimpedance values and lymphedema severity ($p> 0.05$).

Conclusion: The BIS technique is timesaving and can determine lymphedema stages. We found a significant correlation between BCRL stages and BIS, and it appears that BIS is an appropriate, inexpensive, simple, and noninvasive technique for detecting the stages of BCRL.

Keywords: Bioimpedance spectroscopy, breast cancer, lymphedema, stages, severity

INTRODUCTION

Breast cancer (BC) is the most common cancer among women with an estimated 2.3 million new cases in 2020, accounting for 11.7% of all cancers. This disease is also the leading cause of cancer deaths in more than 100 countries. Its incidence and mortality rates are gradually increasing in developing countries, including Turkey (1).

Breast cancer-related lymphedema (BCRL) is one of the most frightening and disturbing complications of BC treatment caused by obstruction of lymphatic ducts and lymph nodes and infiltration with tumor cells (lymphangitis carcinomatosis) (2).

Traditionally, BCRL has been associated with multidisciplinary treatments (breast-conserving surgery versus mastectomy; axillary lymph node dissection (ALND) and sentinel lymph node biopsy (SLNB); radiation therapy including regional nodal irradiation, regional nodal-free irradiation) and systemic treatments (3).

Early diagnosis and monitoring of the disease, even in subclinical BCRL, allows for reduced limb volume. Conventional methods used to obtain limb measurements include perometer, arm circumference, and water displacement. Besides, the early stage of BCRL can be identified via some techniques that include dual energy X-ray absorptiometry (DXA), bioimpedance spectroscopy (BIS), computed tomography (CT), magnetic resonance imaging (MRI), lymphoscintigraphy, color doppler imaging, and lymphography (4).

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Impedance (Z) is an electrical term that represents the capacity of a material to resist alternating current flow. When an electrical potential is applied to the tissue, the current flows through the intra and extra-cellular spaces at high frequencies, and the current passes extracellular spaces at low frequencies. The cell membrane acts as an insulator at low frequencies while acts as a conductor at high frequencies. Resistance (R) and reactance (XC) are the components of Z and XC is related to the capacitance that generates the phase shift that is determined by the phase angle [PA= $\tan^{-1}$(XC/R)].

Bioimpedance analysis is a potential tool with proven benefits in the diagnosis and follow-up of even subclinical BCRL (5). In recent years, early diagnosis of BCRL has focused on non-invasive and less costly interventions (6,7).

Bioimpedance values were simultaneously measured with electrodes and these values were compared with the conventional circumference tape measurement (TM) technique. The aim of our study was to investigate the electrical differentiation of BCRL patients' healthy and affected arms. We hypothesized that the BIS could be used as a non-invasive, quick diagnostic tool especially in BCRL patients with early stage.

MATERIAL and METHODS

Study Design

A total of 31 patients diagnosed with BCRL who applied to Sanko University Faculty of Medicine Physical Medicine and Rehabilitation between January 2020 and August 2020 for the first time or control purposes were included in this cross-sectional descriptive research. Age, body mass index (BMI), disease severity and stages, disease durations, history of radiotherapy (RT), chemotherapy (CT), hormone replacement therapy (HRT), and neoadjuvant therapy (NT), types of surgery, and the number of positive dissected lymph nodes were recorded. The inclusion criteria were defined as: (1) an affected arm circumference of 2 cm greater than that of the healthy; (2) the presence of BCRL for at least a month or longer; (3) being aged 18 years over. All volunteers who met these criteria were recruited in our study. The exclusion criteria were defined as: (1) Patients with metastatic or advanced cancer; (2) those with bilateral BC; (3) those with a previous history of neurologic and/or orthopedic disease in the affected arm. This clinical research was conducted at Physical Medicine and Rehabilitation department with the approval of the Sanko University Ethics Committee (2020/01-01). Written informed consent was acquired from all BCRL patients.

Circumferential measurements (cm) of the arms taken at the same place were made using a TM.

Lymphedema severity was defined according to the difference between the extremities (affected and unaffected) that was adopted by the American Physiotherapy Association (8). Lymphedema staging was evaluated with a degree between 0 and 3 according to the International Society of Lymphology. In this regard, BCRL patients were classified as:

Stage 0: subclinical lymphedema;

Stage 1: spontaneous reversible;

Stage 2: spontaneous irreversible;

Stage 3: severe lymphedema (9).

Bioimpedance Measurements

Bioimpedance Analyzer (Quadscan 4000, Bodystat Inc.) device was used for bioimpedance measurement, and it was connected to the 1.0 cm disposable Ag/AgCl disc electrodes (3M, Brazil). The electrode placement protocol was set to maximize the current pathway in the arm and minimize the variable's influence. For this reason, the volunteers were seated, and two-disc electrodes were placed on the 10 cm above and below the elbow of affected and unaffected arms. We used electrodes to send an electrical signal to the arms and get its response (10). Current at multiple frequencies was given to the affected and unaffected arm of the patients and the Z at multiple frequencies (5-50-100-200 kHz), PA, R, and X_C values at 50 kHz were recorded according to this current information. These bioimpedance measurements were applied to all volunteers in cooperation with the Physical Therapy and Rehabilitation Department. Acquired bioimpedance values were recorded to examine the correlation between the BIS values and severity and stages of lymphedema. Numerous bioimpedance analyzers use 50 kHz as a frequency where the capacitor's X_C becomes relatively small so that the current is represented mostly by the R. The 50 kHz is one of the most basic and optimal frequencies. Also, most literature has been carried out using bioimpedance devices with a frequency of 50 kHz to discriminate the biological structures (11). For this reason, we found it appropriate to give your R, PA, and X_C values only at 50 kHz. Three bioimpedance measurements were taken from each volunteer within 1-2 minutes, and the ratio of affected to unaffected arm bioimpedance mean values were used for analysis. Because Z, R, X_C, and PA decrease with increased fluid, the ratio was expressed as affected/unaffected to provide a lymphedema index less than 1.

Statistical Analysis

IBM SPSS Statistics 23 was utilized for statistical analyses (12). As descriptive statistics: mean ± standard deviation and median (min-max values) values for continuous variables, frequency, and percentages for qualitative variables were given. We performed a Kendall Tau-B coefficient to investigate the correlation between mean values ratio of Z at multiple frequencies (5-50-100-200 kHz), PA, R, and X_C values at 50 kHz, and severity, and stages of lymphedema. P-values less than 0.05 were considered statistically significant.

RESULTS

A total of 31 female patients were included in our study to compare BIS with standard diagnostic techniques. Demographic and clinical-pathological data of the patients were given in Table 1. Mean age of the volunteers was 52.58 ± 8.72. Their average BMI was 28.30 ± 4.49 kg/m^2. Median number of positive dissected lymph nodes was 9 (0-55). Median disease duration was 12 (1-108) months, and the onset of BCRL was 8 (1-84) months for patients. The stage distribution was as follows; 15 (48.4%) patients in Stage 0, 10 (32.3%) patients in Stage 1, 5 (16.1%) patients in Stage 2, and 1 (3.2%) patient in Stage 3. Cancer types among patients were invasive ductal carcinoma (87.1%); invasive lobular carcinoma (9.7%); and sarcoma (3.2%). The pathological stages of the patients in the study were mostly staged 2A (32.3%). Most of the patients who developed lymphedema after surgery had received CT (71%) and RT (51.6%). The severity of lymphedema among the patients was as follows: mild 14 (45.2%), moderate 10 (32.3%), and severe 7 (22.6%). Affected and unaffected arm bioimpedance mean values and their ratios were given in table 2. Although, the ratio of 50-100-200 kHz Z (Figure 1) and 50 kHz R (Figure 2) values were significantly correlated with the lymphedema stages ($p< 0.05$) (Table 3), there was no correlation and significant difference between the ratio of the bioimpedance values and lymphedema severity ($p> 0.05$) (Table 4).

DISCUSSION

The primary object of this study was to investigate whether bioimpedance measurements could help in predicting the severity and staging of lymphedema in BCRL patients. The ratio of 50-100-200 kHz Z and 50 kHz R values were significantly correlated with the lymphedema stages ($p< 0.05$) and this result agrees with results from previous studies (13-15).

There was no correlation and significant difference between the ratio of the bioimpedance values and lymphedema severity ($p> 0.05$).

BCRL may develop months or even years after diagnosis and treatment start (16,17) where the critical point is not to miss the latent stage in follow-up, even if patients do not have clinical edema despite the presence of lymphatic dysfunction. The average time for lymphedema development was 8 (1-84) months in our study.

BCRL is known as a significant clinical problem for BC survivors in that causes a negative impact on the quality of life (18). While there is no definitive way to predict patients likely to develop BCRL, a consensus has been reached on some risk factors such as ALND (19), BMI (20), ALN radiotherapy (19), and the number of positively dissected lymph nodes (21). The risk of BCRL is significantly higher in patients who underwent a total mastectomy and modified radical mastectomy compared to patients

Table 1. Demographics of the patients

Characteristics	
Age[a]	52.58 ± 8.72
BMI[a]	28.30 ± 4.49
Cancer type[b]	
IDC	27 (87.1%)
ILC	3 (9.7%)
SAR	1 (3.2%)
Disease stage[b] (Pathology report)	
1	2 (6.5%)
2A	10 (32.3%)
2B	8 (25.8%)
3A	8 (25.8%)
3C	3 (9.7%)
Affected extremity[b]	
Right	14 (45.2%)
Left	17 (54.8%)
Dominant extremity[b]	
Right	27 (87.1%)
Left	4 (12.9%)
Type of surgery[b]	
Modified Radical Mastectomy	21 (67.7%)
Total Mastectomy	10 (32.3%)
RT[b]	
Yes	16 (51.6%)
No	15 (48.4%)
CT[b]	
Yes	22 (71%)
No	9 (29%)
HRT[b]	
Yes	10 (32.3%)
No	21 (67.7%)
NT[b]	
Yes	4 (12.9%)
No	27 (87.1%)
Severity of lymphedema[b]	
Mild	14 (45.2%)
Moderate	10 (32.3%)
Severe	7 (22.6%)
Lymphedema stage[b]	
Stage 0	15 (48.4%)
Stage 1	10 (32.3%)
Stage 2	5 (16.1%)
Stage 3	1 (3.2%)
Disease duration (months)[c]	12 (1-108)
Number of dissected positive lymph node[c]	9 (0-55)
The onset of BCRL (months)[c]	8 (1-84)

BMI: Body mass index, IDC: Invasive ductal carcinoma, ILC: Invasive lobular carcinoma sarcoma, SAR: Sarcoma, CT: Chemotherapy, RT: Radiotherapy, NT: Neoadjuvant therapy, HRT: Hormone replacement therapy, BCRL: Breast cancer-related lymphedema, [a](Mean ± SD), [b]n (%), [c][Median (min-max)].

Table 2. Bioimpedance values

Factors	Frequency	Affected arm	Unaffected arm	Ratio of affected to unaffected arm
Impedance (Z)	5 kHz	1419.11 ± 747.43	1496.89 ± 793.33	0.96 ± 0.19
	50 kHz	500.41 ± 119.31	525.35 ± 162.89	0.97 ± 0.14
	100 kHz	437.86 ± 85.49	448.40 ± 96.46	0.98 ± 0.13
	200 kHz	405.50 ± 73.95	411.73 ± 74.03	0.99 ± 0.13
Resistance (R)	50 kHz	452.23 ± 82.26	461.32 ± 84.77	0.98 ± 0.12
Reactance (X_C)	50 kHz	196.98 ± 121.11	225.54 ± 178.85	0.94 ± 0.21
Phase angle (PA)	50 kHz	22.20 ± 8.62	23.76 ± 10.37	0.96 ± 0.15

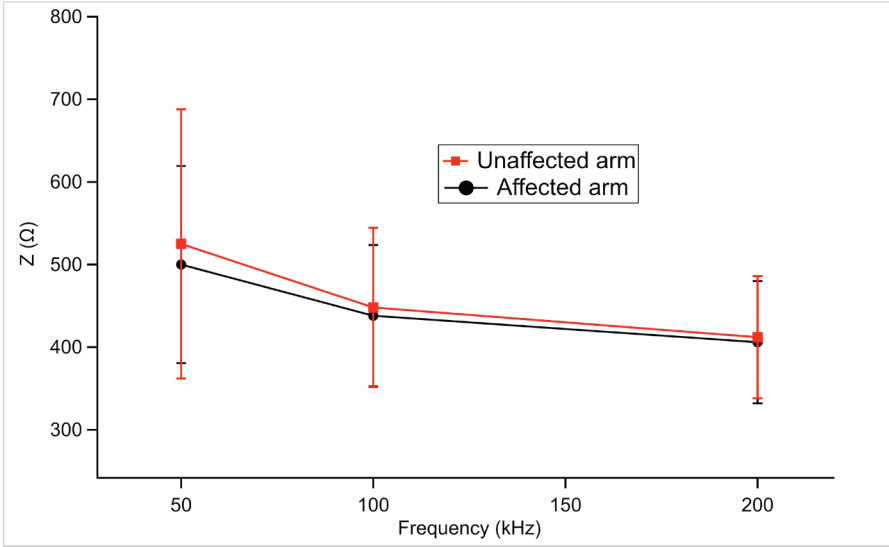

Figure 1. Affected and unaffected arm Z values at 50-100-200 kHz.

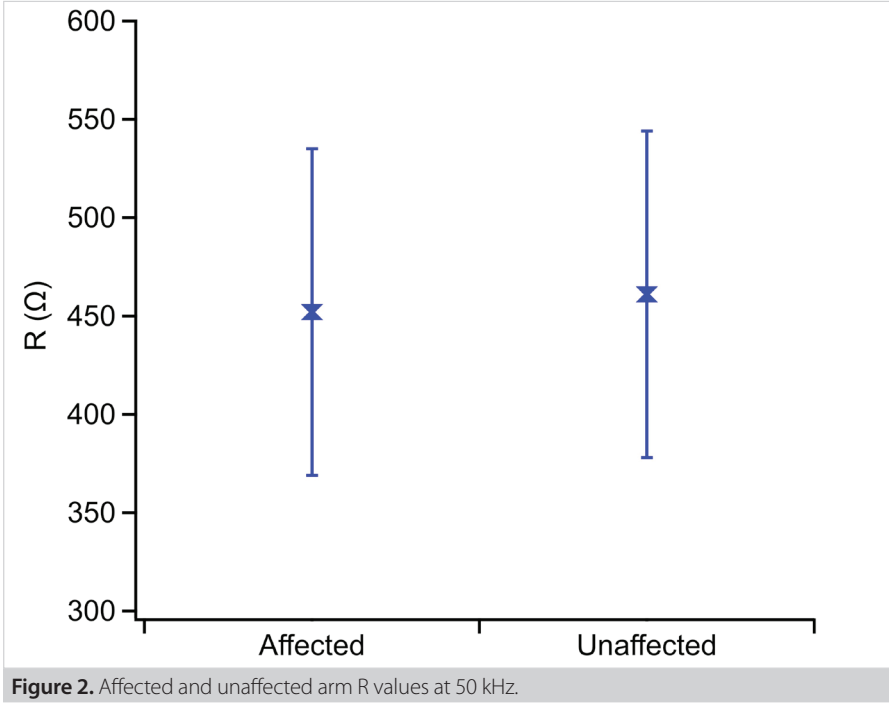

Figure 2. Affected and unaffected arm R values at 50 kHz.

Table 3. Correlation of bioimpedance ratio values and lymphedema stages

Factors	Frequency	p
Impedance (Z)	5 kHz	0.052
	50 kHz	0.012*
	100 kHz	0.015*
	200 kHz	0.021*
Resistance (R)	50 kHz	0.015*
Reactance (X_C)	50 kHz	0.115
Phase angle (PA)	50 kHz	0.781

* Correlation is significant p< 0.05.

Table 4. Correlation of bioimpedance ratio values and lymphedema severity

Factors	Frequency	p
Impedance (Z)	5 kHz	0.659
	50 kHz	0.825
	100 kHz	0.713
	200 kHz	0.769
Resistance (R)	50 kHz	0.825
Reactance (X_C)	50 kHz	0.769
Phase angle (PA)	50 kHz	0.912

who did not undergo axillary intervention. Similar to the previous literature, axillary surgery 67.7% (n= 21), RT 51% (n= 16), number of dissected lymph nodes [9 (0-55)], and BMI (28.30 ± 4.49) values were found compatible with lymphedema development in our study.

Mean age of the patients was 52.58 ± 8.72 in our study. The presence of CT history was 71% (n= 22) among patients, and the number of patients receiving NT was very low 12.9% (n= 4). It is still controversial whether age (22-24) and CT (24,25) are risk factors for BCRL.

Among the extremity circumferential measurements used in the diagnosis and follow-up of BCRL, there are many non-invasive volumetric measurement methods such as water displacement, perometer, and 3D laser scanning (26). However, assessment of volume alone is insufficient as results depend on subjective estimates. Circumferential measurements do not provide an accurate assessment of volume. The displacement of water is not a hygienic method, and it does not provide information about the swelling localization. Although the perometer method detects localized lymphedema, the results are highly variable and not very reliable as arm tissue composition is not evaluated. 3D laser scanner can detect extremely small variations of arm volume, but it is a costly assessment method with difficulties in identifying arm reference points. Lymphoscintigraphy is currently considered the gold standard imaging technique for the diagnosis of limb lymphedema. However, it has disadvantages such as exposure to radiation, low resolution, and high cost (27).

Compared to traditional methods, BIS seems to be more objective and more specific, and sensitive in studies (80-99%) (28).

We evaluated the performance of BIS based on severity and clinical stage. According to extremity circumference measurements, 14 (45.2%) of our patients were in the mild stage. Clinical symptoms vary in each patient according to the severity of BCRL. However, in our study, there was no correlation and no significant difference between the ratio of bioimpedance values and the severity of lymphedema.

The International Lymphedema Society (ISL) defines lymphedema stages as 0 to 3. Among the volunteers, 15 stages 0 patients had subjective complaints such as heaviness, tightness, and numbness in the arms or hands but did not have any apparent swelling. Patients with Stage 0 lymphedema can live for months or years without showing any symptoms (9). Stage 0-1 lymphedema is considered reversible with treatment. This stage, which is defined as the latent phase, may not always be easily detected by physical examination. BIS technique is a potential for the detection of this reversible subclinical phase, which can last for months or years and even result in progressive and fibrotic lymphedema. Aside from being a safe, painless, and rapid method, BIS provides objective data for the early diagnosis of lymphedema and is reproducible. Traditional diagnostic tools used for early detection and therefore early intervention have limited ability to confirm and detect BCRL. Ward et al. have recommended that bioimpedance is a sensitive and accurate early detection system for identifying patients at risk of developing lymphedema (29).

It is known that BIS can detect lymphedema in as early as four months compared to volume-based evaluation methods (5), thus reducing lymphedema-related morbidity. Soran et al. have detected subclinical lymphedema with BIS- follow-up managed to reduce the incidence of clinical lymphedema from 36.4% to 4.4% with early treatment (30). Because of extreme accumulation of lymph fluid, lymphedema usually results in an overall increase in the total amount of extracellular water in the affected limb. As the volume of extracellular water increases, the Z to the current decreases (31-34). We found Z, R, X_C, and PA values decrease with increased fluid. In our study, it was determined that the device we used did not correlate with the stages of lymphedema at a frequency lower than 50 kHz and the severity of lymphedema at multiple frequencies.

The limitations of our study include the fact that due to the low number of patients (n= 31) and secondly, due to the high number of patients with early-stage lymphedema, it was not possible to estimate how much BIS measurements reflect edema in chronic stage patients, and thirdly, the population in our study consisted of only female patients.

CONCLUSION

Our results show that 50-100-200 kHz Z and 50 kHz R values are correlating factors for the stages of patients with lymphedema. We concluded that these values can be used as a screening tool for predicting the stages of BCRL patients. The BIS technique was timesaving and noninvasive but was not able to determine the lymphedema severity in the present study. There was no significant correlation with arm circumferences changes, and it appears that BIS is not an appropriate technique for detecting the severity of lymphedema. We believe that the bioimpedance device applied in patients undergoing breast surgery will confirm the diagnosis of lymphedema in the subclinical stage and prevent the formation of chronic BCRL.

Ethics Committee Approval: This study was conducted in accordance with the amended Declaration of Helsinki. The institutional review board (Sanko University Ethics Committee (Decision No: 2020/01-01) approved the study, and all participants provided written informed consent.

Peer-review: Externally peer-reviewed.

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ORİJİNAL ÇALIŞMA-ÖZET
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Meme kanserine bağlı lenfödem şiddeti ve evrelerinde biyoimpedans spektroskopi yönteminin rolü

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ÖZET

Giriş ve Amaç: Meme kanserine bağlı lenfödem (BCRL) hastalarında lenfödem şiddeti ile standart tanı yöntemleri ve Biyoimpedans Spektroskopisi (BIS) tekniği ile belirlenen evreler arasındaki korelasyon incelendi.

Gereç ve Yöntem: Biyoimpedans analiz cihazı, hastaların etkilenen ve etkilenmeyen (sağlıklı) koluna bağlanan 1.0 cm'lik disk elektrotlara bağlandı. Çoklu frekanslarda (5-50-100-200 kHz) ve faz açısında (PA), dirençte (R) ve 50 kHz'de reaktansta (XC) empedansın (Z) performansını lenfödem şiddeti ve evreleri üzerinde değerlendirdik. Fizik Tedavi ve Rehabilitasyon Bölümü ile iş birliği içinde tüm gönüllülere biyoempedans ölçümleri yapıldı. Bu çalışmada BCRL şiddeti ile evreleri ve biyoempedans değerleri arasındaki ilişki incelenmiştir.

Bulgular: BIS tekniğini standart tanı teknikleri ile karşılaştırmak için toplam 31 kadın çalışmaya alındı. Hastalar arasında lenfödem şiddeti şu şekilde bulundu; hafif 14 (%45.2), orta 10 (%32.3) ve şiddetli 7 (%22,6). Gönüllülerin etap dağılımı ise; Evre 0'da 15 (%48,4) hasta, Evre 1'de 10 (%32,3), Evre 2'de 5 (%16,1) hasta ve Evre 3'te 1 (%3,2) hasta etkilenen ve etkilenmeyen kol biyoempedans ortalaması oran değerleri hesaplandı. 50-100-200 kHz Z ve 50kHz R'de bu oran lenfödem evreleri ile anlamlı olarak korele olmasına rağmen ($p< 0,05$), biyoempedans değerlerinin oranı ile lenfödem şiddeti arasında korelasyon ve anlamlı fark yoktu ($p> 0,05$) .

Sonuç: BIS tekniği zamandan tasarruf sağlar ve lenfödem evrelerini belirleyebilir. BCRL evreleri ile BIS arasında anlamlı bir korelasyon bulduk ve BIS›nin BCRL evrelerini saptamak için uygun, ucuz, basit ve invaziv olmayan bir teknik olduğu görülüyor.

Anahtar Kelimeler: Biyoimpedans spektroskopisi, meme kanseri, lenfödem, evreler, şiddet

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ORIGINAL ARTICLE
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Laparoscopic liver right posterior sectionectomies; surgical technique and clinical results of a single surgeon experience

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ABSTRACT

Objective: Laparoscopic liver resections have been performed with increasing frequency in recent years. With increasing surgical experience and technological developments, more complex laparoscopic liver resections can now be applied. Laparoscopic right posterior sectionectomy (LSPS) requires a sophisticated and highly challenging surgical technique due to the length of the parenchyma transection line and the camera out of view in laparoscopic surgery. The aim of this study was to share tips and tricks about resection which will contribute to the operation time and technique.

Material and Methods: Evaluation was made of the laparoscopic major liver resections performed consecutively between 2015-2020 in our center. During the resections, three different inflow control techniques were used; hilar, glassonian and intraparenchymal approach.

Results: A total of 14 LSPS surgeries were performed. Mean age of the patients was 51.6 ± 10.2 years (34-68), and mean operation time was 300 ± 58 (200-440) minutes. The Pringle maneuver was applied to all patients, with a mean time of 58.4 ± 14.4 (30-75) minutes. Mean perioperative bleeding was measured as 290 ± 105 (140-550) mL. Additional surgery was performed on six patients in the same session. Complications occurred in three patients. No perioperative mortality was observed.

Conclusion: LSPS is a technically difficult process, which requires advanced skills in both liver surgery and laparoscopic surgery. Surgeons should consider applying this method, which offers different advantages depending on the location and nature of the lesion, after completing the learning curve by performing laparoscopic liver surgery of the correct number and type. In our article, we stated the tips and tricks that make it easy to perform laparoscopic right posterior sectionectomies, which have been thought to be difficult until recently and these difficulties have been clearly stated in many articles.

Keywords: Hepatobiliary surgery, laparoscopic, liver resection, right posterior, sectionectomy, techniques

INTRODUCTION

Laparoscopic liver surgery has made rapid progress in recent years in parallel with positive developments in terms of feasibility, safety and oncological efficacy (1,2). Compared with the open approach, laparoscopic liver surgery offers lower complication rates, reduced intraoperative blood loss, and shorter hospital stay (3,4). However, laparoscopic major and complex resections are performed in a small number of centers worldwide due to doubts about the reported advantages of performing major resections, oncological surgical margin safety and technical complexities.

The majority of early studies report data from case-control series, and although there have been some recent multicenter good quality comparative studies (5), randomized controlled trials have not been conducted to provide definitive answers. Traditionally, resections involving only one or two Couinaud segments are classified as minor resections, while resections involving three or more segments are called major resections (6). However, given the technical complexity of posterosuperior segment resections (segments 4a, 7, and 8), these have been technically classified as major resections to distinguish them from minor resections, and it has been proposed that their difficulties should be acknowledged (7). The technical complexity of this major resection is due to the limited access and difficulty in exposing the posterosuperior part of the liver, which is close to the diaphragm and vena cava inferior (8). Right posterior sectionectomy (RPS) is scored as 9 or 10 points, according to the difficulty scoring system derived by Ban et al. (9) for

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laparoscopic liver surgery, and it is considered one of the most complex procedures (for example, laparoscopic right hemihepatectomy is scored as 7).

Difficult access to segment 7, the potential for a close relationship between the lesion and the right hepatic vein, the fact that the right posterior section is not separated by a clear anatomic structure, the requirement for complex inflow control and the need for a wide resection line significantly complicate the procedure.

In our center, laparoscopic liver resection operations were started in 2013. After completing the learning curve and with increasing experience and technological advances, we began to routinely perform laparoscopic, complex and major liver resections, including laparoscopic right posterior sectionectomy. The aim of this article was to share our experiences with this difficult procedure, as well as tips, tricks and outcomes that we think may be useful.

MATERIAL and METHODS

Our study was approved by the local ethics committee's decision dated 29.09.2021 and numbered 2021/70. The study included 14 patients with indication for right posterior sectionectomy and who underwent consecutive LSPS operation between 2015-2020. LSPS was applied in cases with multiple lesions in segments 6 and 7, large lesions involving both segments and cases where segmental or parenchymal sparing resections could not be performed (such as central lesions involving both segments). The most common indication was liver metastasis with colorectal cancer in 6 patients. Three of the patients were operated on for HCC, 1 for KCC, 2 for symptomatic hemangioma, and 2 for hepatic adenoma.

The operation was planned with a multidisciplinary approach, preoperative evaluation with CT, MRI and other necessary imaging techniques, for all patients. The patients were examined in terms of surgery type, operation time, blood loss, rate of conversion to open surgery, resection margins, morbidity, mortality, Pringle maneuver time and number, postoperative hospital stay and whether additional surgery was performed in the same session. Demographic characteristics of the patients and other data regarding the operation are shown in Table 1.

Surgical Technique

The inflow control approach in LSPS surgery was carried out using one of the following methods:

1. **Inflow Control with Hilar Dissection**

   Inflow control was provided by hilar dissection and dissection of RPS vessels. In this technique, transection is guided by the demarcation line and intraoperative ultrasonography (IOUS). This technique was used in 6 patients (41.6%).

Table 1. Demographic characteristics of the patients and operational data

Patient	Age (years)	Sex	Diagnosis	Operation	Inflow control method	Operation time (min)	Pringle time (min)	Blood loss (mL)	Complications	Length of stay (days)
1	44	Male	Hemangioma	Lap.	Hilar	310	45	350	-	6
2	34	Female	Adenoma	HA	Hilar	270	30	200	-	6
3	49	Male	CRLM	HA	Parenchymal	280	N/A	550	Wound infection	11
4	50	Male	CRLM	Lap	Hilar	340	60	280	-	13
5	60	Male	CCC	Lap	Hilar	330	60	380	-	7
6	43	Male	CRLM	Lap	Parenchymal	440	45	380	-	10
7	55	Male	CRLM	Lap.	Hilar	250	75	220	-	8
8	62	Female	HCC	Lap.	Glissonian	300	45	200	-	8
9	68	Female	HCC	Lap.	Parenchymal	290	70	340	Bile leakage + liver failure	12
10	40	Female	Hemangioma	Lap.	Parenchymal	240	60	250	-	7
11	55	Male	HCC	Lap.	Parenchymal	200	50	140	-	6
12	58	Male	CRLM	Lap.	Parenchymal	320	70	280	-	9
13	63	Male	CRLM	Lap.	Parenchymal	280	75	200	Liver failure	7
14	41	Female	Adenoma	Lap.	Hilar	360	75	300	-	4
Mean ± SD (min-max)	51.6 ± 10.2 (34-68)	-	-	-	-	300 ± 58 (200-440)	58.4 ± 14.4 (30-75)	290 ± 105 (140-550)	-	8.1 ± 2.5 (4-13)

CCC: Cholangiocellular carcinoma, CRLM: Colorectal cancer - liver metastasis, HA: Hand-assistant, HCC: Hepatocellular carcinoma, Lap: Laparoscopic, N/A: Not available.

In the hilar approach, the gallbladder and falciform ligament are suspended for convenient access to the hepatic pedicle, and the pedicle is reached by opening the hepatoduodenal ligament, over the hepatoduodenal ligament, conventionally. By following the main hepatic artery, the right hepatic artery is reached near the cystic duct and the dissection is advanced towards the right posterior pedicle. The portal branch, which runs just posterior to the artery, is identified with the same method and the demarcation line is controlled by clamping the pedicle with the help of a laparoscopic bulldog clamp after right posterior pedicle isolation. Confirmation that the right posterior pedicle was clamped is made with ultrasonography. Subsequently, pedicle transection is performed with the appropriate method (hem-o-lock clip or vascular stapler).

2. Inflow Control with Glissonian Approach

Inflow control is performed by dividing at the level of the Rouviere sulcus (RS), and resection is directed by the demarcation line and IOUS. This technique was used in one patient (8.4%). In the Glissonian approach, under the guidance of Rouviere's sulcus, hepatotomy is performed above or below the sulcus, and inflow control is achieved by exploring the right posterior pedicle. The parenchyma transection line is determined with the help of the demarcation line and ultrasonography after bulldog clamping. Subsequently, pedicle transection is performed with the appropriate method (hem-o-lock clip or vascular stapler). The Glissonian approach is considered to be more advantageous compared to the hilar approach in terms of reduced possibility of major (main portal vein and hepatic artery) injury and keeping the hilar region intact for future liver surgery that the patient may undergo. This approach allows for highly selective control of Glissonian pedicles without hilar or extensive parenchymal dissection. However, in cases where there is no Rouviere sulcus or the tumor is very close to or in contact with the posterior pedicle, it is necessary to perform resection with a hilar approach or an ultrasonography-guided parenchymal approach instead of the Glissonian approach.

3. Parenchymal Approach

In cases where the hilar approach or Glissonian approach is considered unsuitable, without any inflow control, intraoperative USG is used, and the resection line is placed 5-10 mm to the right of the right hepatic vein. After parenchymal transection, inflow control is achieved by exploring the right posterior pedicle and transecting the pedicle with an appropriate method (hem-o-lock clip or vascular stapler). This technique was used in 7 (50.0%) patients.

When patients are approached through the parenchyma, they are placed in the left lateral decubitus position. When the hilar approach or the Glissonian approach is adopted, the modified French position with a 15° reverse Trendelenburg and a left inclination of about 40° is placed in the transection stage. In our experience, we have seen the great benefit of the left lateral decubitus position for ligation and cutting of the short hepatic veins and transection of the hepatocaval ligament when the parenchymal approach is applied, while the modified French position provides better access to the hilum and the Rouvier sulcus.

At the beginning of the surgery, a 12 mm trocar is placed in the right upper quadrant to create a pneumoperitoneum (port I). Pneumoperitoneum is involved between 12 and 14 mmHg. One 10 mm trocar (port II) is placed approximately 4 cm below the point where the right anterior axillary line intersects the costal line. A 5 mm trocar (port III) is placed just below the xiphoid and a 10 mm working trocar is placed 5 cm right lateral to the umbilicus (port IV). A 5 mm port (port V) is placed 4 cm below where the left midclavicular line intersects the arcus costa and a 5 mm trocar is placed approximately 5 cm left lateral to the umbilicus (port VI). Patient positions and port entry areas are shown in Figure 1.

The camera, Cavitron ultrasonic surgical aspirator (CUSA), energy devices and laparoscopic clips were placed from ports I and II, alternately. To be able to view the transection line from the front and to avoid dissection tools obstructing the surgeon's view, vision was always provided with a 30° or 45° laparoscopic camera aligned with the transection plane. Port I was used as the working port for hilar dissection and port II was used during parenchyma dissection.

The third port was used for dissection of the hepatic artery and portal vein, division of the coronary ligament, retraction of the falciform ligament and elevation of the posterior surface of the right hemi-liver during dissection of the right triangular ligament. The fourth port was used for laparoscopic clips and laparoscopic linear stapler application. The fifth port was used for gallbladder retraction, dissection of the triangular ligament and allows the assistant to achieve suction, liver retraction, and elevation. The sixth port was used for the traction of the nelaton catheter used in the Pringle maneuver.

IOUS was used to define the relationship of the lesion to vascular structures and to mark the transection line. The Pringle maneuver was made by turning the nelaton catheter around the hepatoduodenal ligament and was controlled with the instrument inserted through the 5 mm port (Figure 2).

Outflow Control

Right hepatic vein (RHV) dissection and suspension may be required to protect the right hepatic vein, control bleeding in

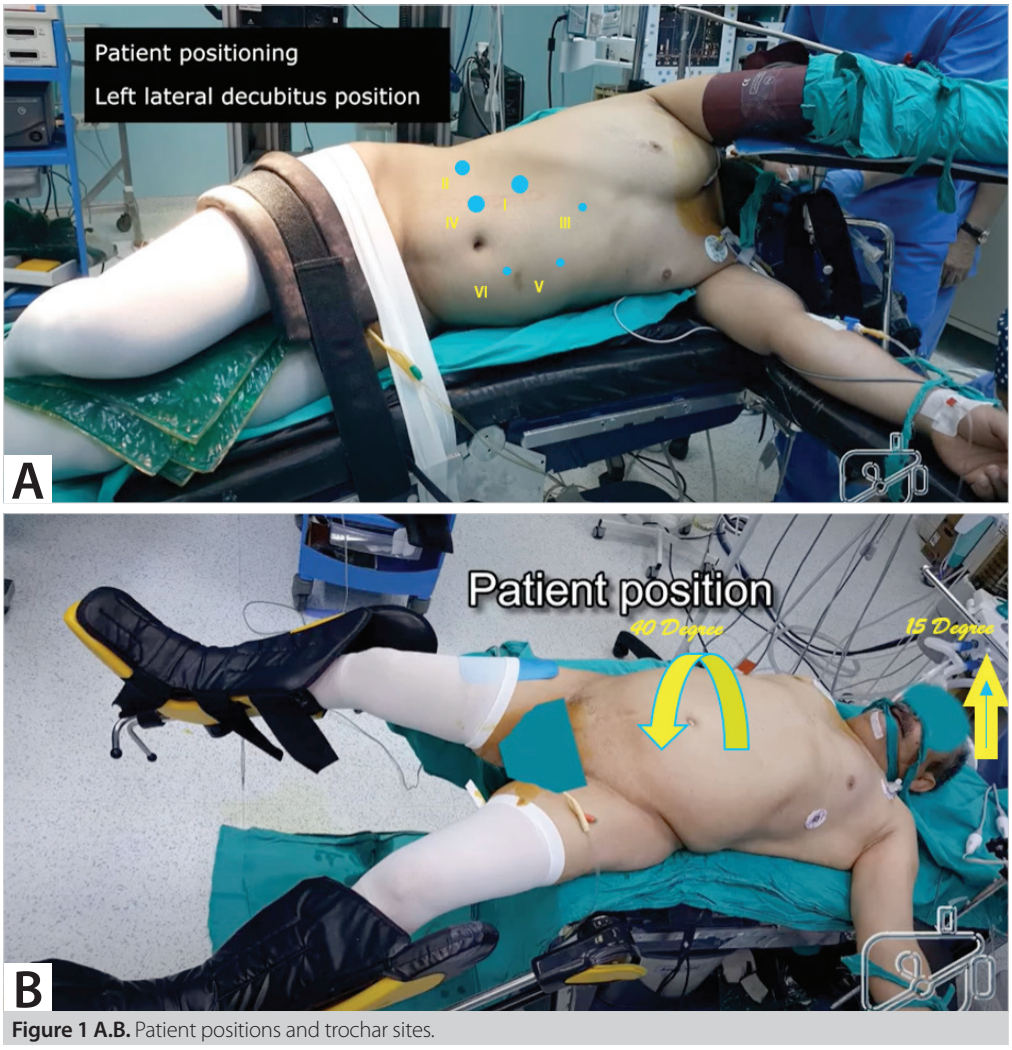

Figure 1 A.B. Patient positions and trochar sites.

possible venous bleeding and resection safety for lesions very close to the RHV. In this case, the coronary and right triangular ligaments were opened and the right hepatic vein was suspended after the hepatocaval ligament was cut and outflow control was achieved.

Parenchymal Transection

Before parenchyma transection, it was attempted to obtain a good view by ensuring the mobilization of the right lobe of the liver over the vena cava and by ligating and cutting the short hepatic veins. Subsequently, laparoscopic ultrasonography was performed on all patients, and the location and borders of the tumor and its relationship with the right hepatic vein and vascular structures were determined. Parenchyma transection was started by marking the transection line with the help of cautery. The liver capsule and approximately 1-2 cm deep superficial, partially avascular layers were transected with Ultracision Harmonic Scalpel® or THUNDERBEAT®. During the parenchyma transection, it was tried to keep the central venous pressure (CVP) low (≤5 cmH_2O) by coordinating with the anesthesia team. During transection, we generally did not use sutures for traction and preferred parenchymal traction with manual tools. We used laparoscopic CUSA for deep tissue transection and the hepatic artery, portal vein and small branches of the hepatic vein were cut and tied with titanium clips or tissue-vessel sealing devices. Structures thought to be bile ducts were necessarily clipped. A laparoscopic aspirator was used to keep the line dry during parenchyma transection.

Hemostasis and Removing the Specimen

After the transection process was completed, the surface was checked for bleeding and bile leakage. Gas tampon was placed on the transection line and the presence of bile leakage was checked again, and the leak was closed using titanium clips, hem-o-lock clips or sutures, depending on the situation. Various bleeding control materials were used over time to control especially venous leakage type parenchymal bleeding (TachoSil®, FLOSEAL®, SURGICEL SNoW®, SURGICEL FIBRILLAR®). Recently,

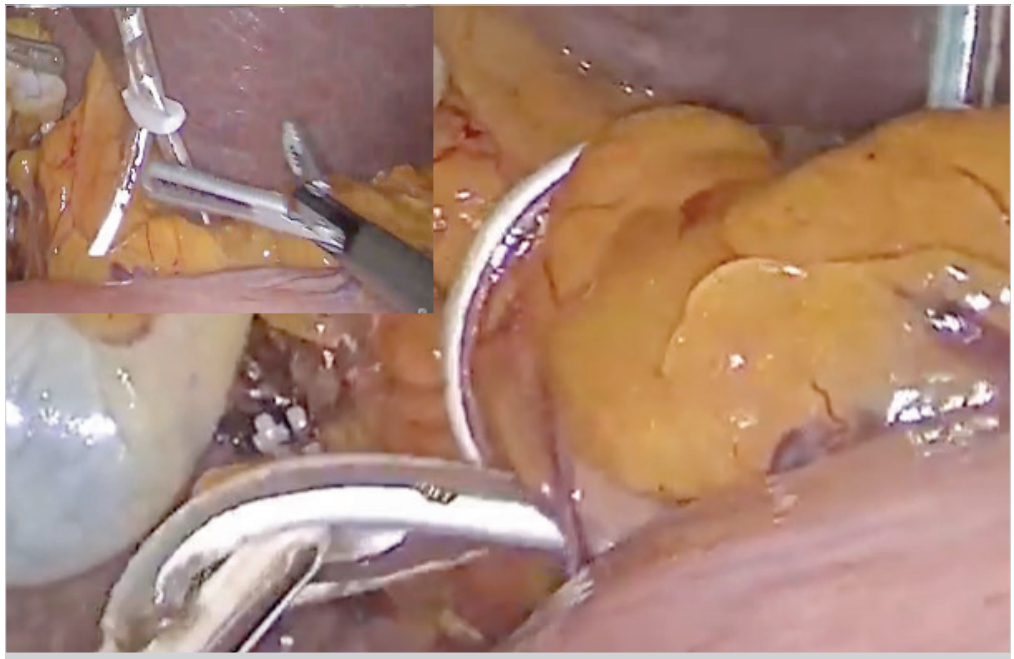

Figure 2. Pringle manoeuvre.

permanent surface hemostasis has been routinely performed with SURGICEL SNoW®/SURGICEL FIBRILLAR. Usually, the specimen taken in the endo-bag was removed with a Pfannenstiel incision. In female patients, it was sometimes removed transvaginally, depending on the size of the specimen.

RESULTS

Fourteen LSPS surgeries were performed in a five-year period. The patients comprised 9 males and 5 females with mean age of 51 years and mean BMI of 30 (22-38). An incision scar from previous open surgery was present in 6 patients, and 1 patient had a history of liver surgery. The procedure was hand-assisted in the first 2 patients in the series, while the others were performed purely laparoscopically. Additional surgery was performed in 7 patients (50%) in the same session. Colorectal surgery was performed in 3 patients, lymph node dissection in 1, secondary liver resection in 2, and colorectal surgery and RF application in one patient in the same session. Vascular inflow control was performed using the Glissonian approach in one patient, the parenchymal approach in 7 patients, and hilar approach in 6 patients. Portal vein embolization was not performed in any patient in the preoperative period. Resection surgery was performed in all patients in a single session. The ASA scores were 3 in 2 patients, and 1 or 2 in the other patients. Cirrhosis was present in 5 patients. While the child score of one patient with an ASA score of 3 was "B", the other patients' child score was "A". Three patients had lesions other than in the right posterior segment. RF was applied to one of these patients, and additional resection was performed laparoscopically in the others. The size of the major lesion was measured as mean 60 mm (35-150 mm). The lesion was closer than 2 cm to the hilus in 2 patients and less than 2 cm to the hepatic veins in 5 patients. Resection was completed as R1 in one patient, while the others were completed as R0. The tumor of the patient who underwent R1 resection was located very close to the hepatic hilus. The resection margin of all patients who underwent R0 resection was >1 mm. The mean operative time was 300 minutes (200-440). The Pringle maneuvre was applied to all patients, and the average Pringle time was determined as 58 minutes (30-75 minutes). Mean perioperative bleeding was measured as 290 ml (140-550 mL). Red blood cell suspension was required intraoperatively or postoperatively in only 5 patients. The length of stay in hospital was an average of 8 (4-13) days, Minor complications (Accordion grade I or II) developed in 3 patients, as stage 1 wound infection in 1, which was treated with dressing and appropriate antibiotics, and 2 patients had stage 2 bile leakage and liver failure. One of these patients was a patient with child B cirrhosis, and the findings that regressed with medical treatment and follow-up in the early period were not reflected in the long term. Grade A liver failure developed in the other patient, but the patient was discharged in seven days without any problems. No perioperative mortality was observed in the patients.

DISCUSSION

Since the first laparoscopic liver resection was reported, data on more than 9000 laparoscopic liver resections have been published (1). Although laparoscopic liver surgery is more widely accepted, LSPS is considered a technically demanding procedure reserved for specialist liver surgeons with experience in advanced laparoscopic liver resections (6,10). Minimal

working space, the need to perform curvilinear-parenchymal transections and the difficulty in controlling bleeding from the branches of the major hepatic veins contribute to the technical complexity of the operation. In fact, right hepatectomy is an acceptable option for right posterior lesions. However, if the parenchymal approach is to be made with a protective technique, while resection performed by preserving the anterior sector decreases the chance of developing early-stage liver failure and decreases the morbidity rates, it increases the resectability capacity for other pathologies of the liver that may develop in the late period (11,12). Such parenchymal sparing procedures are more difficult than major resections, so major resections are more preferred. The reason that right posterior segment resection was preferred in this series of patients was that the major mass was located in segments 6-7. In 2 patients, a second resection was performed laparoscopically in one of the lesions located in other segments of the liver and RF ablation was performed in the other patient.

In a multi-center study evaluating 171 LSPS surgeries including the current study group (5) , 4 of the 9 centers (44%) preferred inflow control with the parenchymal approach with IOUS more, 3 (33%) stated that they preferred hilar control, and 2 (22%) stated no specific preference. In the operations of the current series, the Glissonian approach (1/14), hilar approach (6/14) and parenchymal approach (7/14) with IOUS were preferred. Machado et al. have reported that the Glissonian approach is a reliable approach in their 7-year laparoscopic hepatectomy series involving 234 patients (13). In the current study, no significant difference was observed between the two methods most used for inflow control (hilar and parenchymal) in terms of operation time and intraoperative bleeding (mean 300 and 293 min, mean 288 and 306 mL, respectively). An average of 2 units of erythrocyte suspension replacement were required by five patients. In order to reduce the amount of intraoperative bleeding, the Pringle maneuver was applied in all surgeries as 15 minutes of clamping and 5 minutes of rest. The average Pringle time was measured as 58 minutes, which can be considered quite long compared to the average time of 33 minutes stated in the multicenter study (5). However, when it was determined that one Pringle more was applied on average in the current study. This excess does not affect either the amount of intraoperative bleeding or the morbidity rate observed in the postoperative period. At the same time, as previously stated, CVP was kept below 5 cm H_2O, and venous bleeding was minimized by performing outflow control. In the Oslo-CoMet study, minimally invasive liver parenchymal sparing surgery for liver metastases of colorectal cancers has been reported to be associated with lower postoperative complications (14). The common denominator of postoperative complications was bile leakage. In the current study, minor bile leakage and mild liver failure developed in one patient. This patient was also being followed up for Child B cirrhosis. Accordion II wound site infection developed in one patient, and Grade A liver failure in one patient.

The aim of liver tumor surgery is R0 resection and if the surgical margin does not involve major vascular structures, a tumor-free parenchymal margin >1 mm is considered sufficient. In this study, R0 resection was achieved in 13 patients, and one patient had a microscopic tumor at the surgical margin in a location different from that of the tumor identified after postoperative pathology. According to the pathology results of this series, it can be seen that we also approached the R0 resection percentages of 95% as stated in the multicenter study (5). The results of this study, in which no 90-day mortality was observed, were similar to those of other studies.

CONCLUSION

LSPS is a specialized surgery that requires advanced technique and skill in both liver surgery and laparoscopic surgery. Although the learning curve is considered to be longer and slower, the application of this method, which offers different advantages depending on the location and nature of the lesion, should be considered following the completion of the learning curve with the correct number and type of laparoscopic liver surgeries, especially in high-volume centers.

Ethics Committee Approval: The approval for this study was obtained from Gülhane Training and Research Hospital Ethics Committee (Decision no: 2021/70, Date: 29.09.2021).

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Conflict of Interest: The authors have no conflicts of interest to declare.

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ORİJİNAL ÇALIŞMA-ÖZET
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Laparoskopik karaciğer sağ arka kesitektomiler; tek cerrah deneyiminin cerrahi tekniği ve klinik sonuçları

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ÖZET

Giriş ve Amaç: Laparoskopik karaciğer rezeksiyonları, son yıllarda artan sıklıkla uygulanan ameliyatlardandır. Artan cerrahi deneyim ve teknolojik gelişmelerle birlikte giderek daha kompleks laparoskopik karaciğer rezeksiyonları uygulama alanı bulabilmektedir. Laparoskopik sağ posterior sektörektomi (LSPS), parankim transeksiyon hattının uzunluğu ve laparoskopik cerrahide kamera açısı dışında kalması nedeniyle sofistike ve yüksek zorluk derecesine sahip bir cerrahi teknik gerektirmektedir.

Gereç ve Yöntem: 2015-2019 yılları arasında ardışık olarak yapılan laparoskopik majör karaciğer rezeksiyonlarımızı değerlendirdik. Rezeksiyonlar esnasında üç farklı inflow kontrol tekniği kullandık; intraparankimal, hiler ve glassonian yaklaşım.

Bulgular: Dört yılda 12 adet LSPS ameliyatı gerçekleştirildi. Hastaların ortalama yaşı 51'di, ortalama ameliyat süresi 290 (140-380) dakikaydı. Tüm hastalara pringle manevrası uygulandı, ortalama pringle süresi 55 (30-75) dakika olarak belirlendi. Ortalama perioperatif kanama 297 (140-550) ml ölçüldü. Hastaların yarısına (6 hasta) aynı seansta ek cerrahi işlem uygulandı. Ameliyatların tamamı laparoskopik olarak tamamlandı ve hastalarda perioperatif mortalite gözlenmedi.

Sonuç: LSPS uygulanabilir, verimli ve güvenlidir. Bununla birlikte, teknik olarak zor bir işlemdir ve hem karaciğer cerrahisi hem de laparoskopik cerrahide ileri beceriler gerektirir. Cerrahlar, öğrenim eğrisini doğru sayı ve türde laparoskopik karaciğer cerrahisi yaparak tamamlamalı ve lezyonun yeri ve doğasına bağlı olarak farklı avantajlar sunan bu yöntemi uygulamayı düşünmelidir.

Anahtar Kelimeler: Hepatobilier cerrahi, laparoskopik karaciğer rezeksiyonu, sağ posterior sektörektomi, teknik

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ORIGINAL ARTICLE
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Clinical spectrum and management outcome in gallbladder perforation-a sinister entity: Retrospective study from Sub-Himalayan region of India

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ABSTRACT

Objective: Gallbladder perforation is an infrequent entity seen among surgical patients. Rare occurrence owes to difficulty in diagnosing gallbladder perforations. The aim of the present study was to determine the optimal management strategy that may decrease the morbidity and mortality associated with this potentially life-threatening condition.

Material and Methods: This was a retrospective study from hospital health records wherein the experience of 40 consecutive patients with gallbladder rupture, either spontaneous or secondary to both benign conditions and malignancy, was noted at a tertiary care hospital over 48 months from February 2017 till January 2021. The etiology, clinical presentation, and treatment given were analysed.

Results: Out of 40 patients included, 23 were females and the majority of patients were more than 45 years of age. Twelve patients responded to intravenous antibiotics and analgesics alone while five required an ultrasound-guided pigtail catheter drainage due to non-improving clinical condition. The failure of expectant management led to a delayed laparotomy in seven patients while four patients required emergency laparotomy because of generalized peritonitis. An elective cholecystectomy was offered to 12 patients with cholecystoenteric fistulae after diagnostic laparoscopy in the same admission. Thirty-eight patients were discharged in stable condition and doing well at 30-day follow-up.

Conclusion: Gallbladder perforation is seen more commonly in acute calculous cholecystitis compared to other conditions. It is more evident when the treatment of acute calculous cholecystitis is delayed by more than 6-8 weeks. The spectrum of clinical presentation varies from mild pain and vomiting to generalized peritonitis. The patient often requires a step-up approach to control the ongoing sepsis for an improved outcome.

Keywords: Acute calculous cholecystitis, secondary gallbladder rupture, gallbladder perforation, acalculous cholecystitis, biliary peritonitis

INTRODUCTION

Gallbladder perforation (GBP) is a less encountered clinical condition owing to its infrequent occurrence and difficulty in diagnosis. More often, diagnosis of GBP is established during surgery. The treatment strategy is yet not clear and has been primarily focused on emergency surgery. Though emergency surgery is performed with curative intent but is associated with high mortality.

Historically, in 1934, Niemeier worked upon these gallbladder perforations and introduced a three-tier classification system for this rare condition. Niemeier classified GBP into three types based on the duration of perforation (1).

Type 1: Acute free perforation- into the peritoneal cavity without any protective adhesion.

Type 2: Sub-acute perforation- perforation walled off by adhesions from the peritoneal cavity with surrounding abscess.

Type 3: Chronic perforation- having fistulous communication between the gallbladder and bowel.

The most commonly seen GBP is type 2 (46%) followed by type 3 (40%) and lastly, type 1 (10%). The mortality rate in GBP is reported to be as high as 12-42% irrespective of the type of perforation (2).

Anderson has added another category of Gallbladder perforation (3):

Type 4: Perforation with cholecysto-biliary fistula.

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Table 1. Summary of the studies reporting more than 15 patients with their different type of perforation

Study	Number of patients	Age (years)	Perforation type			Cholelithiasis	Mortality
			I	II	III		
Lennon, 1983	32	67	37.5%	53.1%	9.4%	84.4%	12.5%
Wig, 1984	27	50	44.4%	7.4%	48.1%	88.9%	11.1%
Menakuru, 2004	31	68	2.9%	4.5%	2.6%	93.5%	9.7%
Derici, 2006	16	70	44.8%	44.8%	12.5%	-	12.5%
Stefanidis, 2006	30	60	70%	30%	-	-	-
Ergul, 2008	37	64	32.4%	56.8%	10.8%	-	10.8%
Date, 2012	19	72	47.4%	47.4%	5.3%	78.9%	0%
Present study	40	54	10%	60%	30%	72.5%	5%

Many case series have been published to date, some studies enrolling more than 15 patients are mentioned below (Table 1).

We aimed at presenting our clinical experience in gallbladder perforations.

MATERIAL and METHODS

Setting

This study was conducted in a tertiary care academic institution from the Sub-Himalayan region in Uttarakhand, India. The Institutional Ethics Committee at All India Institute of Medical Sciences Rishikesh had approved the study with Letter No-AIIMS/IEC/21/167. All patients were admitted under the Department of General Surgery and treated in the same specialty. The treating team provided standard care until discharge from the hospital and also followed them at 30 days post-discharge in the outpatient department. When no 30-day follow-up was planned, patients were contacted over phone calls about the follow-up status.

Sample Size

Forty consecutive patients with the diagnosis of gallbladder perforation from health records searched between February 2017 and January 2021 (48 months).

Inclusion and Exclusion Criteria

Patients of all age groups and both sexes were enrolled in the study. All patients included had been diagnosed for gallbladder perforation either radiologically by the institute radiology team with contrast-enhanced computed tomography (CECT) abdomen or intra-operatively by the treating team.

Data Acquisition and Management

All patient-related data was acquired by formative proforma and entered in Microsoft Excel 2019. All statistics are represented in the form of a bar graph using Microsoft excel.

Study Parameters

Baseline patient demographic profile, comorbidities, and clinical symptoms at presentation were recorded. An abdominal ultrasound was the initial imaging modality used to evaluate the hepatobiliary tree. All patients subsequently underwent CECT Abdomen (patients with acute kidney injury were hydrated to bring down the creatinine level) and perforations were graded as intrahepatic, intraperitoneal (free or localized), and hollow viscous communications. All cases were further evaluated with magnetic resonance cholangiopancreatography (MRCP) to rule out any downstream bile duct pathology. The treatment strategies were categorized as expectant, drainage under radiological control, and surgery. After initial resuscitation, if the patient had frank generalized peritonitis, an emergency laparotomy was undertaken. Expectant management (intravenous antibiotics, fluids, and analgesics) was adopted in patients having localized peritonism. The patients who did not improve clinically over subsequent 24 h after expectant management were offered ultrasound-guided pigtail catheter drainage for the intraabdominal collection. A delayed laparotomy to control the ongoing sepsis was the last resort in patients not responding even 48h after draining the collections. Those patients in the expectant or drainage group who improved clinically were planned for interval cholecystectomy. All patients with cholecystoenteric fistulae were offered diagnostic laparoscopy followed by exploration through a right subcostal incision (extended to the left side depending on desired exposure). The 30-day follow-up and status at discharge were marked on Karnofsky performance status.

Study Objectives

The primary objective was an overall, 30-day outcome for different treatment strategies. The secondary objective was to evaluate the various etiology, age, and sex-based incidence of gallbladder perforation.

RESULTS

- The patient's age ranged from 20-80 years in the study and the mean age of patients with gallbladder perforation was 54.15 years (Figure 1).

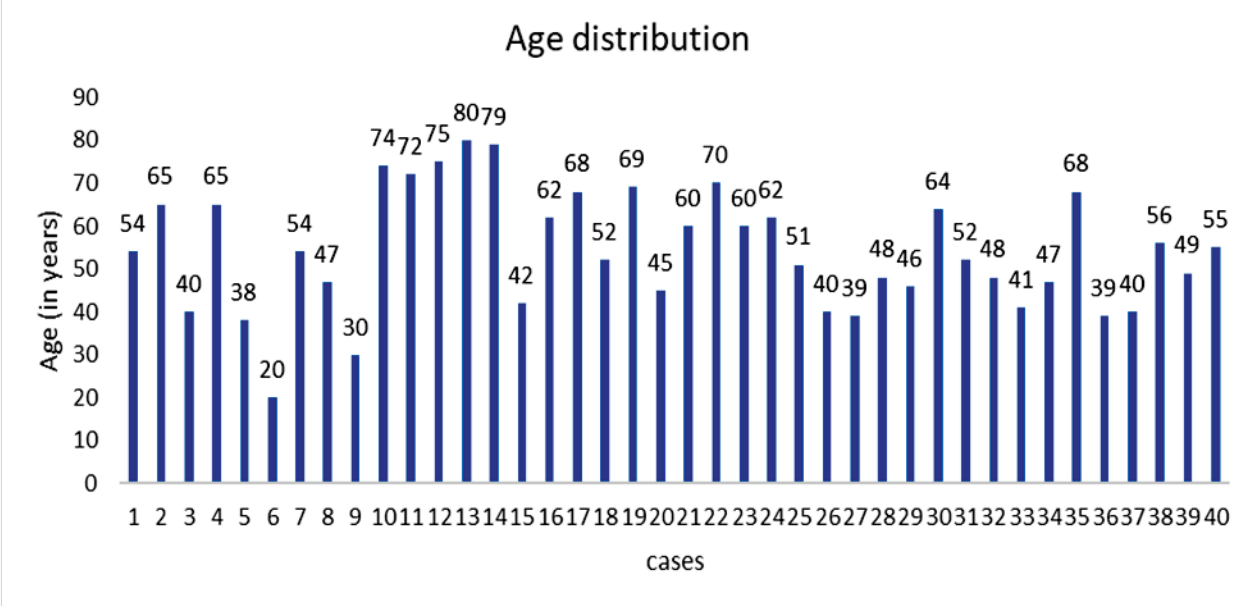

Figure 1. Bar diagram showing the age distribution of gallbladder perforations.

Figure 2. Bar diagram showing comorbid illness in gallbladder perforation.

- The majority of patients with gallbladder perforation were females (female: male ratio 23:17), though literature suggests that the perforation is more common in male patients.
- The most common comorbid illness seen in the study population was diabetes mellitus (30%) followed by leptospirosis, typhoid, and dengue infections (Figure 2).
- The most common clinical presentation was abdominal pain (90%), and fever (75%). Four patients with Type I gallbladder perforation presented with frank peritonitis and underwent emergency laparotomy after initial resuscitation.
- There were different etiologies seen for gallbladder perforations; the majority were secondary to cholelithiasis (72.5%), malignancy (12.5%), choledocholithiasis with bile duct stricture (10%), one case each of empyema gallbladder and emphysematous cholecystitis (Figure 3).
- The patients enrolled in the study were treated according to their clinical status (Table 2). 57.5% of the patients underwent exploration and cholecystectomy (emergency/

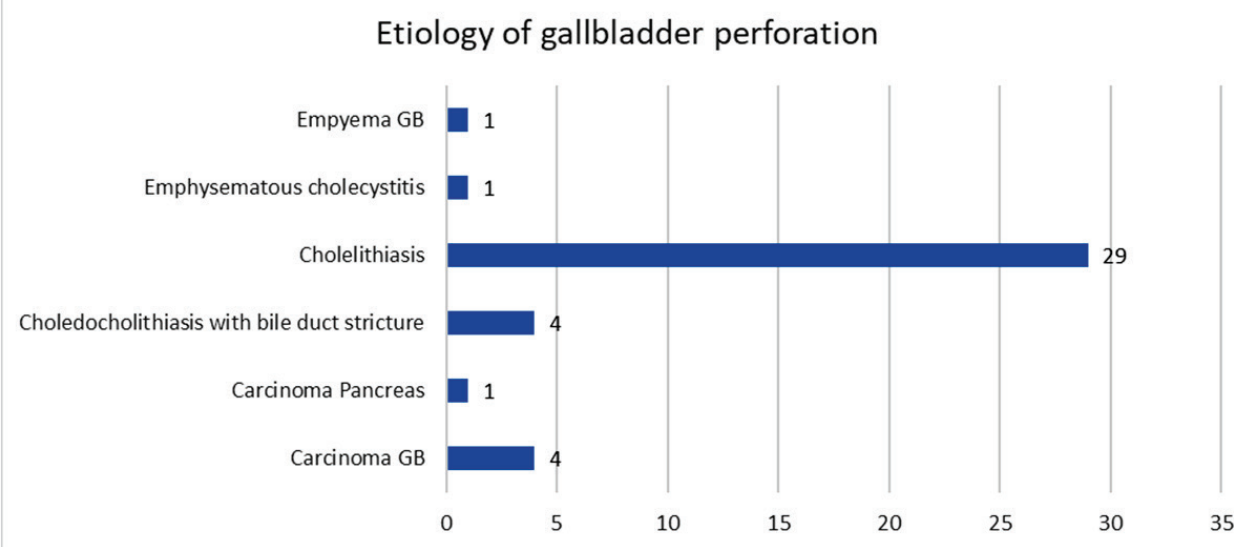

Figure 3. Bar diagram showing different etiologies of gallbladder perforation.

delayed/elective) in the index admission, 30% responded to intravenous antibiotics and analgesics (expectant management) alone while 12.5% of the patients required ultrasound-guided pigtail catheter drainage to control the ongoing sepsis (Figure 4). All patients of the expectant and drainage group were planned for a definitive procedure at 6-8 weeks after a thorough evaluation.

- The study witnessed all Niemeier types of gallbladder perforation (Figure 5). The majority of patients were of type 2 perforation (60%) followed by Type 3 (30%), and type 1 (10%).
- The operating time ranged from 90 to 150 minutes. The estimated blood loss was 100 to 300 ml. Given the severe inflammation around hepatoduodenal ligament and dense adhesions in the calot's triangle area, it was only possible to do subtotal cholecystectomy in patients undergoing laparotomy in the same admission. The patients who had distal bile duct obstruction underwent additional T-tube drainage.
- Twenty-six percent (n= 10) of the patients had surgical site infection post laparotomy, approximately 60% (n= 24) of the patients had postoperative atelectasis and fever related to laparotomy. The mean hospital stay was 12 days for Type 1 perforation, four days for type two perforation, and seven days for Type 3 perforation.
- 95% (n= 38) of patients were discharged from the hospital and a follow-up after 30 days revealed their healthy status. Five percent (n= 2) of the patients could not survive the disease. Thirty-five percent (n= 14) of the patients had ICU stay with a mean duration of 4.5 days, the majority of ICU admissions were seen in patients undergoing laparotomy for gallbladder perforation (n= 12).

DISCUSSION

Gallbladder perforation has variable clinical presentation and thus difficult to diagnose clinically. This entity is seen in male patients more commonly, though uncomplicated acute cholecystitis is common in females. In the present study, gallbladder perforation was seen as more common in females (23:17) (4).

The most common site of gallbladder perforation is the fundus owing to the most distal blood supply (Figure 6) (5). Gallbladder perforation is seen as a complication in only 1-4% of cholecystitis but 90-95% of gallbladder perforation are seen secondary to cholelithiasis (3,5). The current study demonstrated cholelithiasis as the lead etiology seen in 70% of gallbladder perforations. Mean duration for gallbladder perforation after acute cholecystitis was 4-8 weeks, which is per the literature (4).

In a systematic review by Ravindra S. date et al., it has been observed that Type 2 perforation is the most common gallbladder perforation as evident in our study also (2). Four patients had intrahepatic abscess due to gallbladder rupture towards the liver bed (Figure 7).

The management of gallbladder perforation depends on the patient's clinical status. In our study, 57.5% of the perforations were managed surgically while 30% of patients responded to expectant management, and 12.5% of the patients required an ultrasound-guided pigtail catheter drainage of the pericholecystic collection. All Type 1 (10%) perforations were diagnosed intra-operatively (Figure 8) after an exploration was performed given generalized peritonitis at presentation, and supported by a preoperative CT that revealed pneumoperitoneum and free

Table 2. Summary of the enrolled patients in the current study

S. No.	Age (years)	Sex	Type of GBP	Treatment approach used	Morbidity & Outcome
1)	54	Female	II	Expectant management → Ultrasound guided pigtail drainage	Discharged
2)	65	Female	II	Expectant management → Ultrasound guided pigtail drainage	Postoperative atelectasis; Discharged
3)	40	Male	I	Emergency laparotomy	Postoperative atelectasis and surgical site infection; Discharged
4)	65	Female	II	Expectant management → Ultrasound guided pigtail drainage → Delayed laparotomy	Postoperative atelectasis and surgical site infection; Discharged
5)	38	Male	II	Expectant management	Discharged
6)	20	Male	I	Emergency laparotomy	Postoperative atelectasis; Discharged
7)	54	Female	II	Expectant management → Ultrasound guided pigtail drainage → Delayed laparotomy	Postoperative atelectasis and surgical site infection; Discharged
8)	47	Male	III	Elective cholecystectomy	Postoperative atelectasis; Discharged
9)	30	Male	II	Expectant management	Discharged
10)	74	Male	II	Expectant management → Ultrasound guided pigtail drainage → Delayed laparotomy	Postoperative atelectasis and surgical site infection; Discharged
11)	72	Male	II	Expectant management → Ultrasound guided pigtail drainage → Delayed laparotomy	Postoperative atelectasis; Multiorgan dysfunction syndrome; Mortality
12)	75	Female	II	Expectant management	Discharged
13)	80	Male	II	Expectant management → Ultrasound guided pigtail drainage	Postoperative atelectasis; Discharged
14)	79	Male	II	Expectant management → Ultrasound guided pigtail drainage → Delayed laparotomy	Postoperative atelectasis and surgical site infection; Discharged
15)	42	Female	II	Expectant management	Discharged
16)	62	Male	II	Expectant management → Ultrasound guided pigtail drainage	Postoperative atelectasis; Discharged
17)	68	Female	I	Emergency laparotomy	Postoperative atelectasis and adult respiratory distress syndrome; Mortality
18)	52	Male	II	Expectant management → Ultrasound guided pigtail drainage → Delayed laparotomy	Postoperative atelectasis; Discharged
19)	69	Male	III	Elective cholecystectomy	Postoperative atelectasis; Discharged
20)	45	Female	III	Elective cholecystectomy	Postoperative atelectasis; Discharged
21)	60	Female	III	Elective cholecystectomy	Discharged
22)	70	Female	III	Elective cholecystectomy	Postoperative atelectasis and surgical site infection; Discharged
23)	60	Female	II	Expectant management	Discharged
24)	62	Female	III	Elective cholecystectomy	Postoperative atelectasis; Discharged
25)	51	Female	III	Elective cholecystectomy	Postoperative atelectasis and surgical site infection; Discharged
26)	40	Female	III	Elective cholecystectomy	Postoperative atelectasis and surgical site infection; Discharged
27)	39	Female	III	Elective cholecystectomy	Discharged

Table 2. Summary of the enrolled patients in the current study (continue)

S. No.	Age (years)	Sex	Type of GBP	Treatment approach used	Morbidity & Outcome
28)	48	Male	II	Expectant management	Postoperative atelectasis; Discharged
29)	46	Female	III	Elective cholecystectomy	Discharged
30)	64	Female	III	Elective cholecystectomy	Postoperative atelectasis and surgical site infection; Discharged
31)	52	Male	II	Expectant management	Discharged
32)	48	Female	I	Emergency laparotomy	Postoperative atelectasis; Discharged
33)	41	Female	III	Elective cholecystectomy	Discharged
34)	47	Female	II	Expectant management	Discharged
35)	68	Male	II	Expectant management → Ultrasound guided pigtail drainage	Postoperative atelectasis; Discharged
36)	39	Female	II	Expectant management	Discharged
37)	40	Male	II	Expectant management	Discharged
38)	56	Female	II	Expectant management → Ultrasound guided pigtail drainage → Delayed laparotomy	Postoperative atelectasis and surgical site infection; Discharged
39)	49	Male	II	Expectant management	Discharged
40)	55	Female	II	Expectant management	Discharged

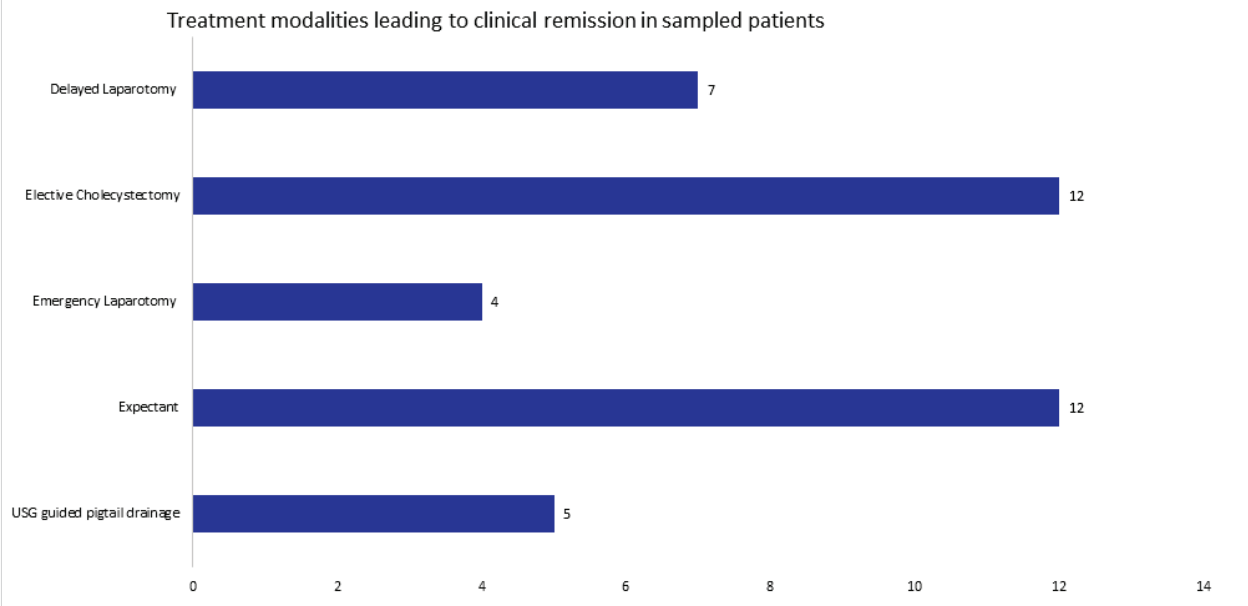

Figure 4. Bar diagram showing different treatment modalities that led to clinical remission in the sampled patients.

fluid (NCCT was ordered in patients with acute kidney injury). Ultrasound abdomen revealed a spectrum of findings like thickened gallbladder, rent in gallbladder wall (Figure 9), pericholecystic fluid, or a contracted gallbladder. Ultrasound sensitivity for detecting gallbladder perforation is nearly 70% and thus CECT is needed for an accurate diagnosis (6). The diagnosis of Type 2 and 3 perforations were made after a contrast-enhanced CT scan (Figures 10,11), and most of them were managed with delayed laparotomy. The magnetic resonance cholangiopancreatography confirmed the gallbladder perforation and also aided to rule out any downstream bile duct pathology (Figure 12). Only Type 2 perforations that demonstrated clinical improvement and resolving sepsis were managed with antibiotics alone strategy. There were a total of two mortalities, that occurred in the Type 1 perforation group. Mean hospital stay was 12 days for Type 1 perforation, four days for Type 2 perforation,

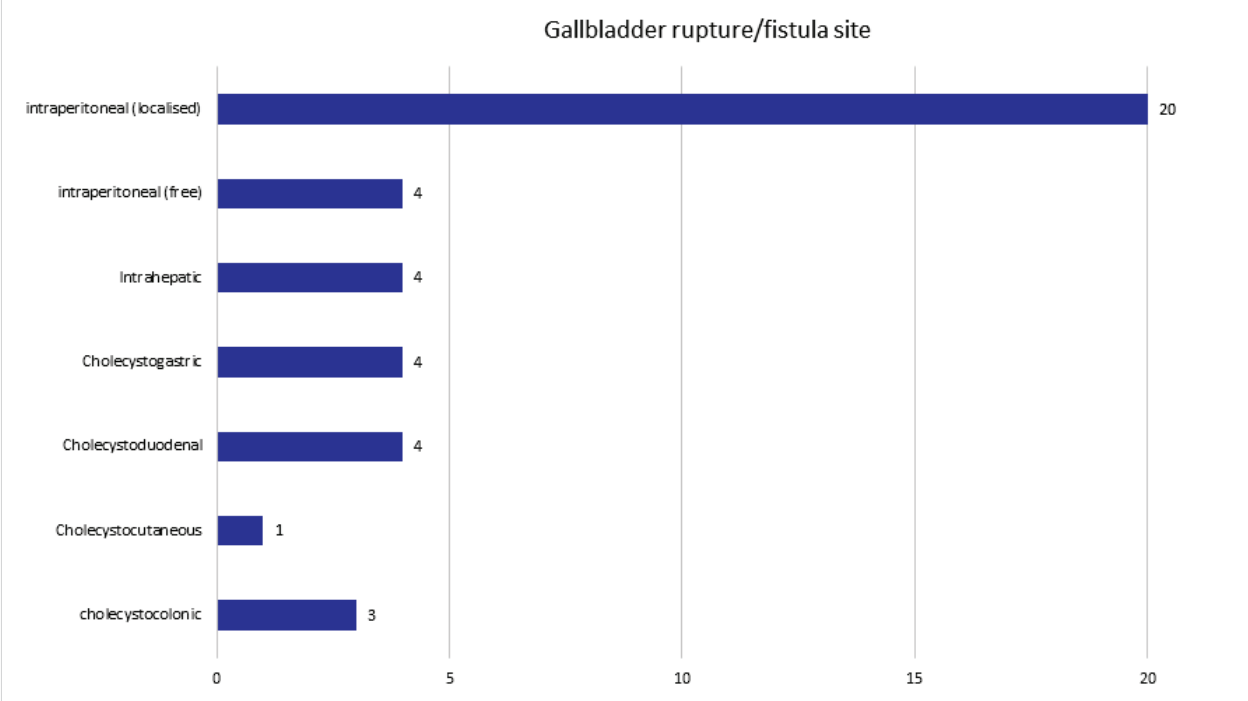

Figure 5. Bar diagram showing the gallbladder rupture/fistulization site.

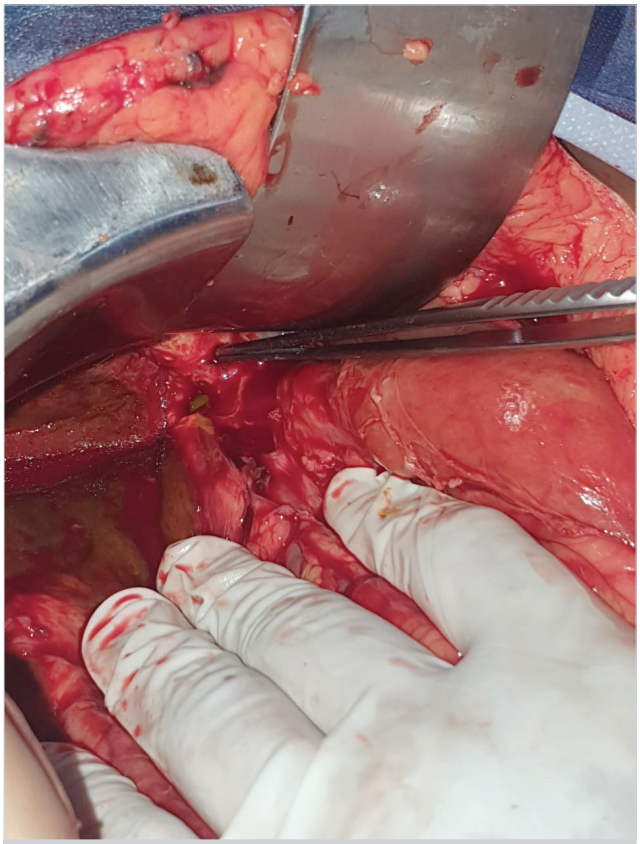

Figure 6. Intraoperative photograph showing perforation over the fundus of the gallbladder - pointed by the instrument.

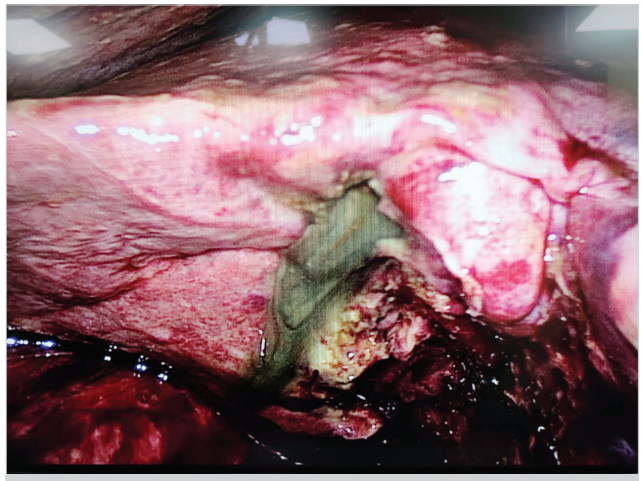

Figure 7. Laparoscopic view of an intrahepatic rupture of gallbladder perforation.

and seven days for Type 3 perforation. The antibiotics used were third-generation cephalosporin preferably cefoperazone and metronidazole as per the Surgical Infection Society of North America (SIS) and Infectious Disease Society of America (IDSA) (7,8).

The most common comorbid illness observed in our study was diabetes mellitus followed by infections including leptospirosis, typhoid, and dengue (3:2:1) which has been reported in the literature. Typhoid is one of the leading causes of bowel perforation among the tropical population. *Salmonella* as the etiology of gallbladder perforation is rare (9). Our study also witnessed

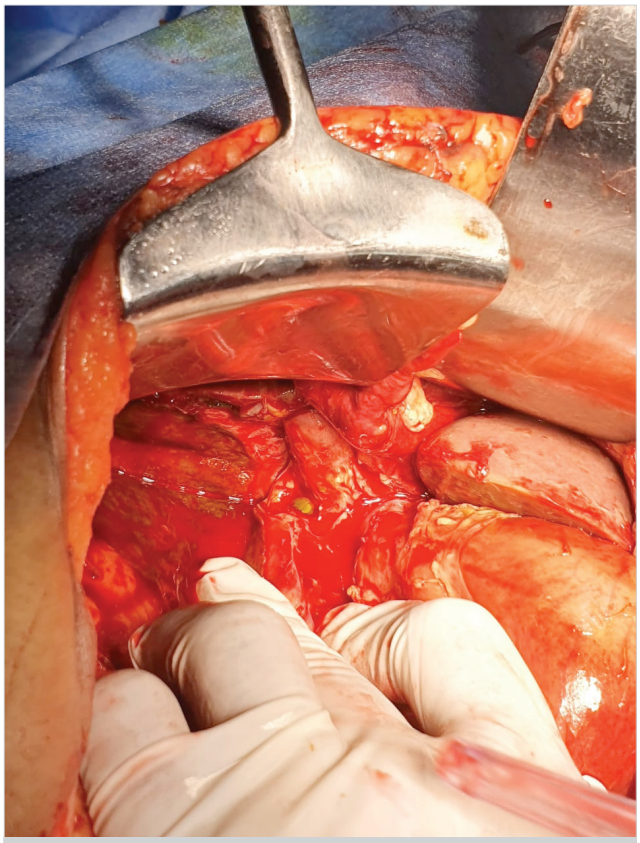

Figure 8. Type 1 Gallbladder perforation with bile leak seen on exploration.

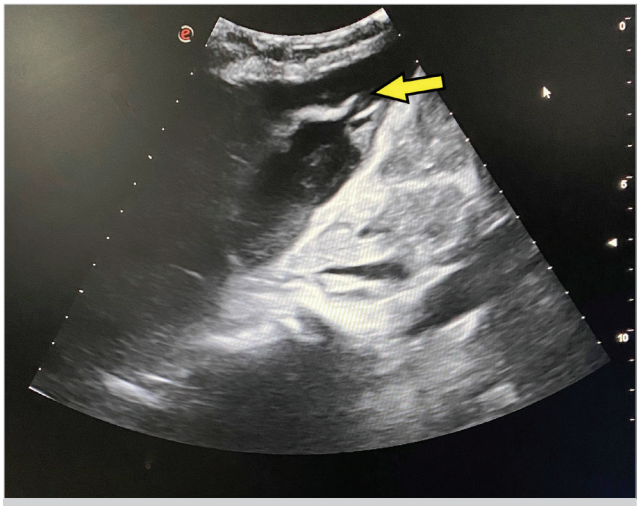

Figure 9. Ultrasound showing rent in the gallbladder wall depicted by yellow arrow.

two patients with spontaneous gallbladder rupture with typhoid as a comorbid illness. The pathophysiology of gallbladder perforation in typhoid is not well understood. Perforation in typhoid illness could be due to thrombosis of blood vessels, immune-compromised state, or severe inflammation. Different

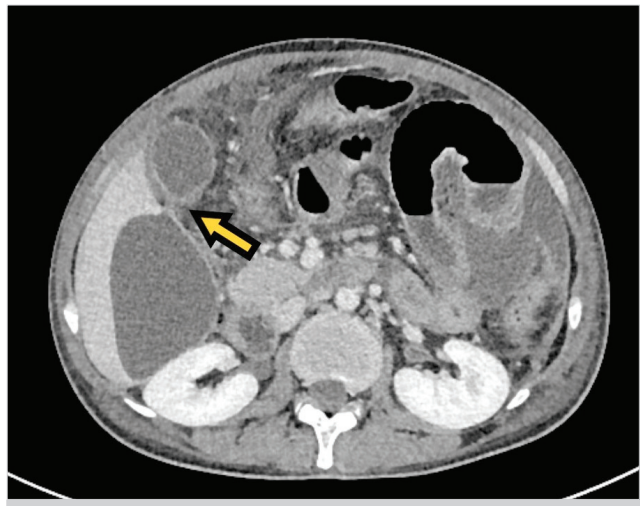

Figure 10. Axial section of abdominal tomography showing gallbladder perforation with thickened gallbladder wall and pericholecystic fluid.

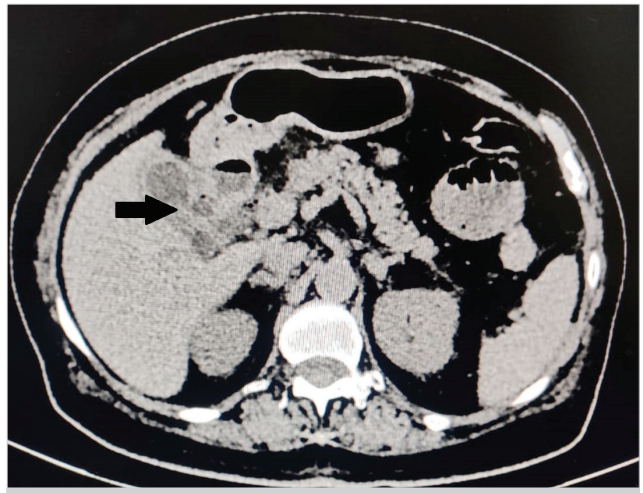

Figure 11. Computed tomography scan of the abdomen showing suspicious communication between the gallbladder and first part of duodenum depicted by horizontal black arrow in axial view.

tissue injury factors such as hemolysin, endotoxin, and lipase release tend to have complex interactions, resulting in capillary vasculitis and loss of red blood cells via swollen junctions and fenestra, resulting in ischemic necrosis.

Other causes of gallbladder perforation mentioned in the literature are trauma, viral infection, and pneumonia. The incidence of gallbladder perforation in trauma post blunt injury is less than 2% (10).

Type 3 gallbladder perforation (Figure 13) is categorized as chronic perforation leading to fistulous communication between the gallbladder and adjacent bowel (mostly duodenum, stomach, and transverse colon) (11,12). The most common cholecystoenteric fistula is between the gallbladder and duo-

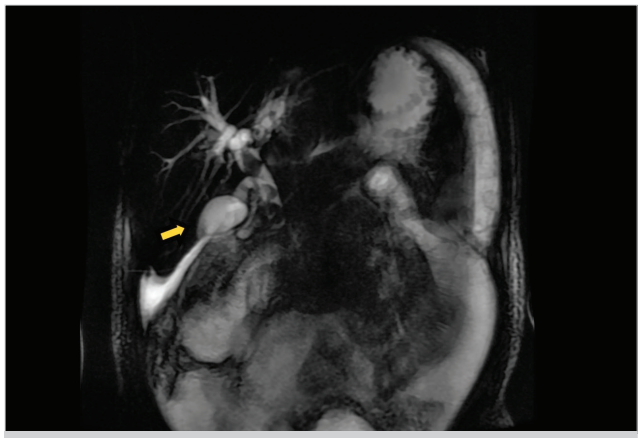

Figure 12. Magnetic resonance cholangiopancreatography scan showing gallbladder perforation with bile leak in the coronal view.

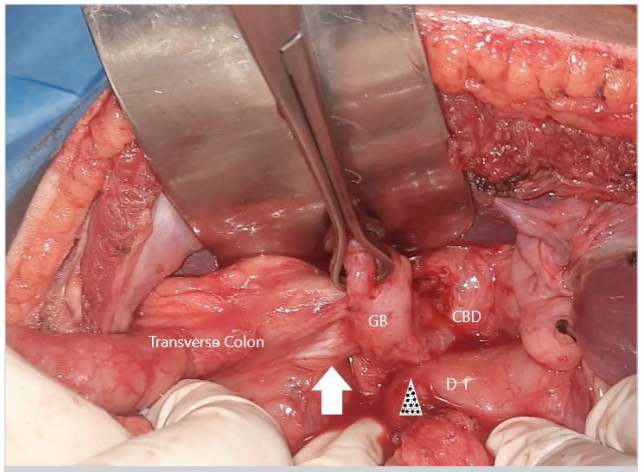

Figure 13. Intraoperative photograph of a Type 3 perforation with vertical white arrow showing fistulous communication between the gallbladder and transverse colon and dotted arrow-head showing adhesions between the gallbladder and first part of the duodenum.

denum due to its proximity (13). Twelve out of 40 cases in our study had Type 3 perforation having communication with the stomach, duodenum, and transverse colon (4:4:3). All of these perforations are seen secondary to cholelithiasis. The pathogenesis of cholecystoenteric fistula is due to an obstructing stone in the gallbladder neck or cystic duct causing ischemic necrosis and perforation of the gallbladder (Figure 14) forming a walled-off abscess. This abscess perforates in the adjacent bowel lumen forming a fistulous communication. These cholecystoenteric fistulae seldom cause gallstone ileus, though it is a known entity (12,13).

Ultrasound has proven to be 100% successful in the diagnosis of cholecystitis, but based on ultrasound, no definitive indication can be made of cholecystoenteric fistula. Although CECT may not be able to diagnose cholecystoenteric fistula as such, it helps to rule out malignant conditions or suspected lymphadenopathy and can provide a reasonably straightforward route

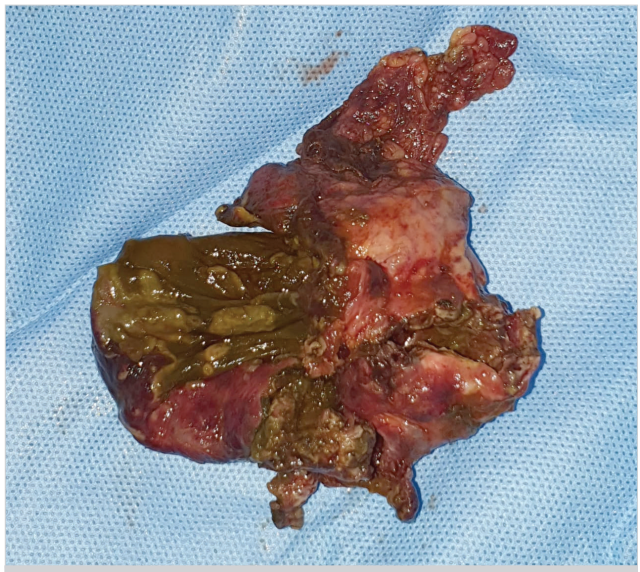

Figure 14. Resected specimen of the ruptured gallbladder.

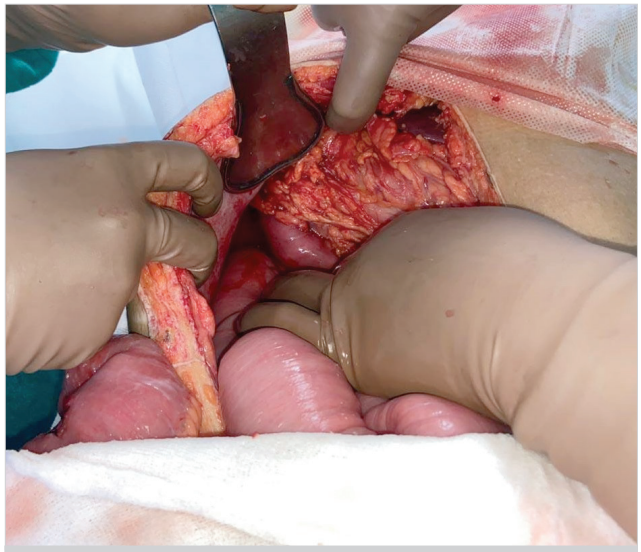

Figure 15. Omental wrapping seen around the gallbladder area on laparotomy.

through which the surgeon can move (14). Diagnostic Laparoscopy was performed in all patients to visualize the gallbladder and adjacent structures. Subsequently, all of them underwent open subtotal cholecystectomy with excision of fistulous tract and closure of the fistulous opening on the gastrointestinal side because of omental wrapping around the gallbladder and non-visualization of calot's area (Figure 15). Conservative management in asymptomatic, high-risk surgical patients has been reported (15). In the treatment of this disease, laparoscopic management can be used with continuously evolving new and improved methods, but the rate of conversion to open surgery and the cost burden is still high (16).

A single case of cholecysto-cutaneous fistula (Type 3 perforation) due to cholelithiasis was seen, with abdominal wall abscess as the clinical presentation in the present study, which has also been reported earlier (17). The treatment given was the drainage of the abdominal abscess, approx. 100 ml of bile stained purulent discharge was noticed. The underlying gallbladder malignancy was ruled out with a contrast-enhanced CT scan of the abdomen. The patient underwent open cholecystectomy and excision of the fistula tract.

Limitations

The present report contains retrospective data from health records from which association but not causation can be derived. Though there are many case series and systematic reviews in the literature for gallbladder perforation, still a guideline for managing this entity is lacking and needs to be focussed. A single-centre experience was presented. The patients with this pathology are treated based on clinical status and treatment lies on the surgeon's decision.

CONCLUSION

This study concludes with the need for rapid diagnosis and treatment of gallbladder perforation to reduce the associated morbidity and mortality. The diagnosis of Type 1 perforation is usually observed intra-operatively due to overlapping symptoms of many acute abdomen conditions (hollow viscus perforation, cholecystitis), Type 2 and 3 perforation are often made based on contrast-enhanced CT Scan. The patients with Type 1 perforation present with peritonitis and are hemodynamically unstable requiring an emergency laparotomy after initial stabilization with postoperative ICU care. The patients with Type 2 and Type 3 perforations present with chronic symptoms and can be managed with delayed surgical management. Most of the time, a subtotal cholecystectomy can only be offered given the presence of dense adhesions and severe inflammation in the region of the hepatoduodenal ligament. Niemeier, in 1934, gave an excellent classification for gallbladder perforation, but a more elaborate classification system is needed for managing this entity.

Ethics Committee Approval: The ethical approval for this study was obtained from All India Institute of Medical Sciences Institutional Ethics Committee (Date: 09.04.2021, Decision No: 167).

Peer-review: Externally peer-reviewed.

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Conflict of Interest: The authors have no conflicts of interest to declare.

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ORİJİNAL ÇALIŞMA-ÖZET
Turk J Surg 2022; 38 (1): 25-35

Safra kesesi perforasyonunda klinik spektrum ve tedavi sonuçları - olumsuz bir durum: Hindistan'ın Alt Himalaya bölgesinden retrospektif bir çalışma

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ÖZET

Giriş ve Amaç: Safra kesesi perforasyonu cerrahi hastalarda nadir görülen bir durumdur. Bu durumun sebebi safra kesesi perforasyonlarının tanısının zor oluşudur. Bu çalışmanın amacı, potansiyel olarak hayatı tehdit edici bu durumun yol açtığı mortalite ve morbiditeyi azaltacak optimal yönetim stratejisini oluşturmaktı.

Gereç ve Yöntem: Bu retrospektif çalışmada, Şubat 2017 ile Ocak 2021 arasındaki 48 ayda üçüncü basamak hastanede spontan veya benign ya da malign durumlara sekonder gelişen safra kesesi rüptürü ile tedavi edilen ardışık 40 hastanın hastane kayıtları incelendi. Etiyoloji, klinik görünüm ve uygulanan tedavi değerlendirildi.

Bulgular: Çalışmaya dahil edilen 40 hastanın 23'ü kadındı ve hastaların çoğunluğu 45 yaş üstüydü. On iki hasta intravenöz antibiyotik ve analjeziklere yanıt verirken beş hastaya iyileşmeyen klinik durumları sebebiyle ultrason rehberliğinde perkütan pigtail kateter drenajı uygulandı. Yedi hastaya gecikmiş laparotomi, dört hastaya ise yaygın peritonit sebebiyle acil laparotomi uygulandı. Aynı yatışta tanısal laparoskopi sonrası kolesistoenterik fistülleri olan 12 hastaya elektif kolesistektomi önerildi. Otuz sekiz hasta stabil olarak taburcu edildi ve 30 günlük takipleri normaldi.

Sonuç: Diğer durumlara kıyasla safra kesesi perforasyonu akut taşlı kolesistitte daha yaygın görülmektedir. Akut taşlı kolesistit tedavisi 6-8 hafta arasında geciktiğinde daha da yaygın hale gelir. Klinik görünüm hafif ağrı ve kusmadan yaygın peritonite kadar uzanır. Hastalar genellikle devam eden sepsisi kontrol altına almak amacıyla basamaklı yaklaşıma gerek duymaktadır.

Anahtar Kelimeler: Akut taşlı kolesistit, sekonder safra kesesi rüptürü, safra kesesi perforasyonu, taşsız kolesistit, biliyer peritonit

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ORIGINAL ARTICLE
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Demographic factors associated with length of stay in hospital and histological diagnosis in adults undergoing appendicectomy

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ABSTRACT

Objective: Appendicectomy remains of the most common emergency operations in the United Kingdom. The exact etiologies of appendicitis remain unclear with only potential causes suggested in the literature. Social deprivation and ethnicity have both been demonstrated to influence outcomes following many operations. There are currently no studies evaluating their roles with regards to severity and outcomes following appendicectomy.

Material and Methods: Demographic data were retrieved from health records for adult patients who underwent appendicectomy between 2010-2016 within a single NHS trust. To measure social deprivation, Indices of Multiple Deprivation (IMD) rankings were used. Histology reports were reviewed and diagnosis classified into predefined categories: non-inflamed appendix, uncomplicated appendicitis, complicated appendicitis and gangrenous appendicitis.

Results: Three thousand four hundred and forty-four patients were identified. Mean age was 37.8 years (range 73 years). Using a generalized linear model, South Asian ethnicity specifically was found to be independently predictive of increased length of stay following appendicectomy ($p< 0.001$). Amongst South Asian patients, social deprivation was found to be further predictive of longer hospital stay ($p= 0.005$). Deprivation was found to be a predictor of complicated appendicitis but not of gangrenous appendicitis ($p= 0.01$). Male gender and age were also independent predictors of positive histology for appendicitis ($p< 0.001$ and $p= 0.021$ respectively).

Conclusion: This study is the first to report an independent association between South Asian ethnicity and increased length of stay for patients undergoing appendicectomy in a single NHS trust. The associations reported in this study may be a result of differences in the pathophysiology of acute appendicitis or represent inequalities in healthcare provision across ethnic and socioeconomic groups.

Keywords: Appendicitis, general surgery, deprivation, ethnicity

INTRODUCTION

Appendicitis is one of the most common but also one of the most challenging acute surgical diagnoses (1). Despite an ongoing debate of conservative versus surgical management, appendicectomy remains one of the most frequently performed emergency surgical procedures in the world.

The wide differential diagnosis of acute lower abdominal pain often results in equivocal diagnosis of acute appendicitis. Whilst risk scoring systems have been developed that utilize a mixture of clinical and biochemical parameters (2-4), these are poorly implemented particularly in the United Kingdom. Due to a lack of validation of these scoring systems, a strong belief remains among practitioners that the decision to investigate invasively and consider operative management is best left to the judgement of the surgeon (5). The difficulties in clinical diagnosis of appendicitis, which are not purely investigation related, can therefore result in variability in the delivery of treatment and a potential subsequent variation in outcome.

Socioeconomic deprivation has been shown to be associated with increased length of stay in a variety of admissions, such as for coronary artery bypass and hip surgery (6,7). This is also supported by various national economic studies that suggest that lower income groups utilize more healthcare facilities, potentially due to later presentation to health professionals and as a result being more acutely unwell at first healthcare contact (8). This association has been reported to hold across pri-

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mary care services, emergency departments and tertiary care centers (9-11).

The continued refinement of modern acute surgical services and the ongoing uptake of laparoscopic surgery for even severe appendicitis has led to shortened length of stay in hospital (12). These improvements in care should apply to patients of all ages and ethnicities and across all socioeconomic classes. However, evidence from centers around the world exists for differences between socioeconomic groups in both postoperative recovery and length of stay. An 11-year national analysis carried out in Taiwan demonstrated longer length of stay and increased costs in patients undergoing appendicectomy who belonged to lower socioeconomic groups (13). Despite ongoing debate on the etiology of appendicitis with many studies published on appendicitis pathology (14), there remains a paucity of research investigating the impact of social deprivation on outcomes following surgery for acute appendicitis.

Although differential incidence rates of appendicitis based on ethnic origin have been previously suggested, no direct associations have been proven definitively (15). Investigating the influence of ethnicity on the risk of developing acute appendicitis remains challenging as many other factors may be confounding such as social deprivation, cultural attitudes and biological factors that have yet to be elucidated.

The aim of our study was to investigate the relationship between demographic factors (including ethnicity and social deprivation) and length of stay in hospital and the final histological diagnosis in patients who had undergone appendicectomy in a single NHS trust.

MATERIAL and METHODS

Data Source

All patients aged 17 years or older who underwent appendicectomy between 2010 and 2016 at any of the three hospitals within a single UK NHS Foundation trust in the West Midlands were included. The study was registered with the relevant NHS organisation's governance department as a clinical audit, therefore an NHS Research Ethics Committee review was not required. Data were extracted from electronic health records. Variables collected included date of birth, gender, ethnicity, residential postcode, admission date, discharge date and histological diagnosis.

Variables Used

Due to significant heterogeneity in the clinical coding of ethnicity, patients were reclassified into one of a set of nine ethnic categories: African, Asian (east/south/other), Caribbean, Caucasian, mixed, other or unknown.

Residential postcodes were used to obtain each patient's corresponding ranking score based on the 2015 Indices of Multiple Deprivation. This is a multi-domain score generally regarded as the best measure of social deprivation available in the UK (16). As an indication, Birmingham ranked as the 6th most deprived Core City Local Authority at the time the indices were derived. Furthermore, areas within both the top and bottom deciles of deprivation were present within the catchment area of the NHS trust investigated in this study.

Admission and discharge dates were used to calculate each patient's length of stay; this was rounded up and measured in whole calendar days.

Histology reports were reviewed for any macroscopic or microscopic confirmation of inflammation within the appendix. A modified version of the classification system for appendicitis previously described by Carr was used (17). Diagnoses were categorized into one of four groups: *(i)* normal or non-inflamed appendix, *(ii)* 'uncomplicated appendicitis' - inflamed appendix with or without suppuration, *(iii)* 'complicated appendicitis' - evidence of perforation, necrosis or both arising from the appendix, *(iv)* 'gangrenous appendicitis' - evidence of gangrene within the appendix with or without perforation. Where histological analysis gave an alternative diagnosis such as a neuroendocrine tumor or inflammatory bowel disease, these were categorized as a non-inflamed appendix. This enabled us to correlate demographic variables against histological evidence of appendicitis and not other diseases, as well as ensure maximal inclusion of patients in the analysis.

Statistical Analyses

The predictive potential of the demographic variables collected against length of stay in hospital was investigated using a generalized linear model. For histological diagnosis, a nominal variable, multinomial logistic regression was used. Statistical analysis was performed using R version 3.5.1 'Feather Spray' (18).

RESULTS

3444 patients were included in the study (Table 1). There were 1675 female patients (48.76%) and 1769 male patients (51.24%). There was no significant difference in the sexual distribution (Chi-squared test, p= 0.2573). The average age for the whole cohort of patients was 37.8 years (range 73 years), however as expected there were a higher number of younger patients amongst both genders.

Distribution of the included patients across the defined ethnic categories used in this study can be found in Table 1. The two most prevalent categories were Caucasian (72.82%) and South Asian (12.70%). The ethnic categories with the highest mean IMD rankings and therefore the most socioeconomically deprived was African and South Asian, whereas the least deprived ethnic categories were East Asian and Caucasian (Table 2).

The total mean length of stay in hospital for all included patients was 4.33 days (SD 5.9 days); however, amongst older pa-

Table 1. Summary table of sex, mean length of stay in days (LOS) and ethnic distribution by age group

Age Group (y)	Sex, n (%)		Mean LOS (range)	Ethnic Category, n (%)								Total
	Female	Male		African	Asian (East)	Asian (Other)	Asian (South)	Caribbean	Caucasian	Mixed	Other	Unknown	
17-27	628 (50.00)	628 (50.00)	2.97 (0-93)	16 (1.27)	5 (0.40)	13 (1.04)	189 (15.05)	18 (1.43)	909 (72.37)	9 (0.72)	41 (3.26)	56 (4.46)	1256
28-37	353 (47.70)	387 (52.30)	3.04 (0-26)	11 (1.49)	5 (0.68)	8 (1.08)	128 (17.30)	16 (2.16)	471 (63.65)	5 (0.68)	50 (6.76)	46 (6.22)	740
38-47	236 (45.30)	285 (54.70)	3.57 (0-24)	9 (1.73)	3 (0.58)	4 (0.77)	71 (13.63)	15 (2.88)	355 (68.14)	1 (0.19)	21 (4.03)	42 (8.06)	521
48-57	195 (50.39)	192 (49.61)	4.48 (0-47)	5 (1.29)	1 (0.26)	0 (0.00)	24 (6.20)	10 (2.58)	303 (78.29)	1 (0.26)	10 (2.58)	33 (8.53)	387
58-67	130 (49.43)	133 (50.57)	6.81 (0-74)	2 (0.76)	1 (0.38)	2 (0.76)	13 (4.94)	2 (0.76)	221 (84.03)	0 (0.00)	2 (0.76)	20 (7.60)	263
68-77	96 (49.48)	98 (50.52)	9.07 (0-85)	3 (1.53)	0 (0.00)	0 (0.00)	9 (4.64)	2 (1.03)	172 (88.66)	0 (0.00)	0 (0.00)	8 (4.12)	194
77-87	33 (42.31)	45 (57.69)	10.94 (0-65)	0 (0.00)	0 (0.00)	0 (0.00)	2 (2.56)	1 (1.28)	70 (89.74)	0 (0.00)	1 (1.28)	4 (5.13)	78
88+	4 (80.00)	1 (20.00)	22.80 (2-69)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	5 (100)	0 (0.00)	0 (0.00)	0 (0.00)	5
Total	1675 (48.64)	1769 (51.36)	4.09 (0-93)	46 (1.34)	15 (0.44)	27 (0.78)	436 (12.66)	64 (1.86)	2506 (72.76)	16 (0.46)	125 (3.63)	209 (6.07)	3444

Table 2. Summary of indices of multiple deprivation rankings (IMD Rank) for all ethnic categories

Ethnicity	Mean IMD Rank (Range)
African	5800.4 (105-31937)
Asian (East)	16537.6 (705-31936)
Asian (Other)	8059.7 (30-32555)
Asian (South)	6434.7 (105-32037)
Caribbean	8712.5 (181-31267)
Caucasian	14351.2 (52-32829)
Mixed	7915.0 (105-27446)
Other	8400.0 (105-32693)
Unknown	12825.3 (105-32718)
Total	12751.7 (30-32829)

tients, length of stay in general was greater than this (Table 1). Figure 1 illustrates mean length of stay in hospital for quartiles of social deprivation in each of the ethnic categories. Amongst most ethnic categories, length of stay was variable amongst quartiles of deprivation. Notably however, length of stay was similar across deprivation quartiles amongst Caucasian patients and interestingly shows an increasing trend in South Asian patients. This suggests that deprivation influenced length of stay on South Asian patients specifically, with more deprived South Asian patients having a greater length of stay than more affluent patients.

The percentage of appendixes that were histologically reported as normal or non-inflamed across all included patients was 28.37% (Table 3). 54.38% of reports were of uncomplicated appendicitis, with 17.25% of histology reports containing one or more of necrosis, perforation or gangrene.

Length of Stay

A generalized linear model was created to test the associations of age, gender, ethnicity and deprivation against length of stay (Table 4). Due to a potential confounding association between ethnicity and deprivation, an interaction term was included for these two variables.

Age was found to be the most significant predictor of increased length of stay in hospital (Z-value= 52.448, p< 0.001). This association was to be expected.

South Asian ethnicity was found to be independently associated with an increased length of stay in hospital (Z-value= 3.478, p< 0.001). Sex and social deprivation were not statistically significant independent predictors of increased length of stay.

However, when interaction terms between deprivation and each of the ethnicities were considered, it was found that amongst South Asian patients only, social deprivation was associated with an increased length of stay in hospital (Z-value

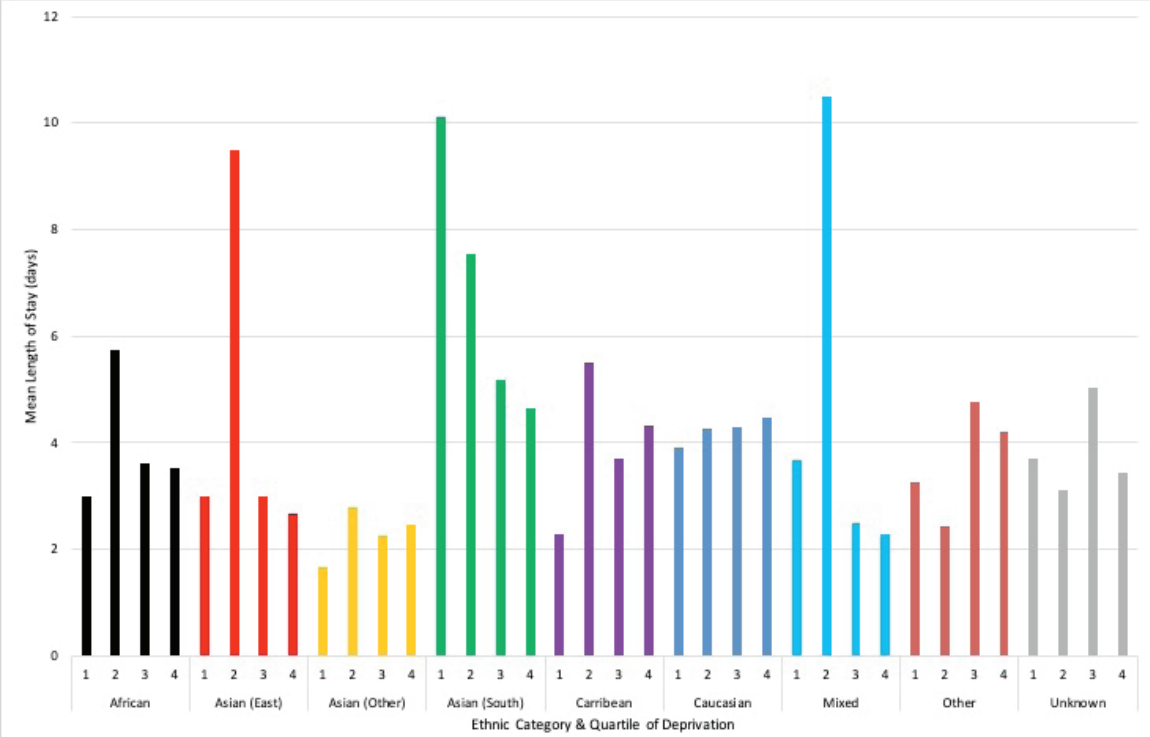

Figure 1. Mean length of stay in hospital for quartiles of social deprivation in each of the ethnic category (Quartile 1= most deprived, Quartile 4= least deprived).

Table 3. Distribution of histological diagnostic categories by age group

Age Range (y)	1 - Non-inflamed Appendix		2 - Uncomplicated Appendicitis		3 - Complicated Appendicitis		4 - Gangrenous Appendicitis		Total
	n	%	n	%	n	%	n	%	
17-27	387	30.81%	688	54.78%	113	9.00%	68	5.41%	1256
28-37	192	25.95%	448	60.54%	62	8.38%	38	5.14%	740
38-47	146	28.02%	276	52.98%	65	12.48%	34	6.53%	521
48-57	82	21.19%	209	54.01%	62	16.02%	34	8.79%	387
58-67	61	23.19%	135	51.33%	45	17.11%	22	8.37%	263
68-77	77	39.69%	82	42.27%	22	11.34%	13	6.70%	194
77-87	31	39.74%	34	43.59%	8	10.26%	5	6.41%	78
88+	1	20.00%	1	20.00%	3	60.00%	0	0.00%	5
Total	977	28.37%	1873	54.38%	380	11.03%	214	6.21%	3444

2.841, p= 0.005). This suggests that although social deprivation is not a predictor of longer hospital stay in all patients, it may influence the admission duration of South Asian patients specifically.

Histological Diagnosis

The histological diagnoses found in each ethnic category are shown in Table 5. From a multinomial logistic regression analysis with histological diagnostic category as the dependent variable and a non-inflamed appendix as the reference outcome, it was found that IMD rank was independently predictive of having specifically 'complicated' appendicitis following appendicectomy (p= 0.01), but was not associated with having any evidence of gangrene on histology (p= 0.68). Therefore, the results of this study suggest that being more socioeconomically deprived results in a greater likelihood of having necrosis with or without perforation reported on histology but not gangrene.

Age was found to be a significant predictor of having confirmed appendicitis compared to having a histologically non-inflamed

Table 4. Generalized linear model coefficients of index of multiple deprivation ranking (IMD Rank), ethnic category, age and interaction terms of deprivation ranking and ethnic category with length of stay as the dependent variable

	Coefficient	Standard Error	Z-value	p
(Intercept)	4.203×10^{-1}	9.684×10^{-2}	4.34	**<0.001**
IMD Rank	-4.168×10^{-6}	9.467×10^{-6}	-0.44	0.660
Ethnicity-Asian (East)	1.899×10^{-1}	2.599×10^{-1}	0.731	0.465
Ethnicity-Asian (Other)	-2.797×10^{-1}	1.871×10^{-1}	-1.495	0.135
Ethnicity-Asian (South)	3.431×10^{-1}	9.867×10^{-2}	3.478	**<0.001**
Ethnicity-Caribbean	1.007×10^{-1}	1.272×10^{-1}	0.791	0.429
Ethnicity-Caucasian	1.709×10^{-1}	9.615×10^{-2}	1.778	0.075
Ethnicity-Mixed	-1.471×10^{-1}	2.141×10^{-1}	-0.687	0.492
Ethnicity-Other	3.472×10^{-1}	1.133×10^{-1}	3.064	**0.002**
Ethnicity-Unknown	7.501×10^{-2}	1.088×10^{-1}	0.689	0.491
Sex (Male)	-3.605×10^{-2}	1.651×10^{-2}	-2.183	**0.029**
Age	2.329×10^{-2}	4.441×10^{-4}	52.448	**<0.001**
IMD Rank x Asian (East)	-2.139×10^{-6}	1.48×10^{-5}	-0.144	0.885
IMD Rank x Asian (Other)	4.891×10^{-6}	1.633×10^{-5}	0.3	0.765
IMD Rank x Asian (South)	2.751×10^{-6}	9.682×10^{-6}	2.841	**0.005**
IMD Rank x Caribbean	-8.689×10^{-8}	1.209×10^{-6}	-0.007	0.994
IMD Rank x Caucasian	-5.77×10^{-6}	9.512×10^{-6}	-0.607	0.544
IMD Rank x Mixed	4.06×10^{-5}	1.563×10^{-5}	2.597	**0.009**
IMD Rank x Other	-1.775×10^{-5}	1.116×10^{-5}	-1.591	0.112
IMD Rank x Unknown	-5.962×10^{-6}	9.999×10^{-6}	-0.596	0.551

(Note: coefficients and standard errors are very small as length of stay is a numerically low value).

Table 5. Distribution of histological diagnostic categories by ethnic category

Ethnic Category	1 - Non-inflamed Appendix		2 - Uncomplicated Appendicitis		3 - Complicated Appendicitis		4 - Gangrenous Appendicitis		Total
	n	%	n	%	n	%	n	%	
African	11	23.91%	26	56.52%	4	8.70%	5	10.87%	46
Asian (East)	4	26.67%	7	46.67%	3	20.00%	1	6.67%	15
Asian (Other)	6	22.22%	14	51.85%	7	25.93%		0.00%	27
Asian (South)	117	26.83%	251	57.57%	48	11.01%	20	4.59%	436
Caribbean	19	29.69%	30	46.88%	9	14.06%	6	9.38%	64
Caucasian	738	29.45%	1340	53.47%	264	10.53%	164	6.54%	2506
Mixed	6	37.50%	9	56.25%	1	6.25%		0.00%	16
Other	32	25.60%	67	53.60%	17	13.60%	9	7.20%	125
Unknown	44	21.05%	129	61.72%	27	12.92%	9	4.31%	209
Total	977	28.37%	1873	54.38%	380	11.03%	214	6.21%	3444

appendix (p= 0.021), but no apparent difference in odds ratios was found in the prediction of complicated or gangrenous appendicitis based on age. Similarly, male sex was found to be significantly associated with having confirmed appendicitis (p< 0.001 in all 3 categories) compared to a histologically non-inflamed appendix, but much like age did not appear to predict complicated or gangrenous appendicitis. Any associations between any of the ethnic categories with any category of appendicitis did not hold when interacted with IMD ranking-these associations were therefore deemed not independent and so their statistical significance was ignored.

DISCUSSION

This study is the first analysis to suggest that South Asian ethnicity appears to be independently associated with increased length of stay in admissions for operative management of acute appendicitis. In addition, amongst South Asian patients, social deprivation was found to be associated with increased length of stay. This study is the first to investigate possible associations between demographic variables and histological evaluation post-appendicectomy. Social deprivation was found to be associated with a greater likelihood of observing necrosis with or without perforation on histological analysis, but did not predict the presence of gangrene. In keeping with previously published datasets, male gender and age remain strong independent predictors of positive histology for appendicitis following appendicectomy. Finally, we report a negative appendicectomy rate of 27.8% over 7 years in this single center analysis, marginally higher than the historically acceptable rate of 15-25% (19).

Role of Ethnicity

The catchment area of the NHS trust investigated in this study included significant areas with large non-Caucasian communities with and without social deprivation. Also included were municipalities with largely Caucasian populations, again with varying levels of deprivation. The sample of patients obtained overall therefore was felt to be sufficiently representative of the UK population.

Diagnostic delay may lead to either or both of increased length of stay in hospital and prolonged postoperative recovery. Cultural differences between ethnicities may affect presentation behaviors and pathways to secondary care and attitudes to emergency surgery (20). Where language barriers exist between patients and healthcare professionals, the reporting of symptoms may be affected sufficiently to lead to delays in action being taken or misunderstandings regarding severity of symptoms leading to potential overtreatment. As these factors can either prolong or shorten admission duration, the data collected and analyses performed in this study are unable to differentiate whether any of them are independently important factors.

Nonetheless, the specific associations between South Asian ethnicity both alone and in combination with deprivation are surprising, particularly given that the center studied is known to have a significant South Asian population. This ethnic category in particular may have certain perioperative risk factors that may affect recovery from appendicectomy such as diabetes, obesity and cardiovascular disease. However, this may not explain the observations from this study fully given the major proportion of younger patients included, who would be expected to have minimal co-morbidities. Although not fully elucidated, the etiology of acute appendicitis may have a more severe etiology in South Asian patients-the exact reasons for this are unclear. However, no significant association was found between South Asian ethnicity and a histological diagnosis of more complicated appendicitis.

Overall, whilst an association between South Asian ethnicity and prolonged length of stay for admissions with appendicectomy has been observed in this study, no definitive conclusions can be made as to reasons why this is the case. Some of these reasons, to name a few, may be a disparity in health-related knowledge between South Asians and other ethnicities, increased prevalence of certain co-morbidities (e.g., type 2 diabetes), cultural differences in attitudes to healthcare in the perioperative period (21), differences in the pharmacokinetics of antibiotics and analgesics (22), measurement of symptoms using methods that are less appropriate for certain ethnicities (e.g., pain scales not being entirely holistic). Furthermore, the causes for South Asians having increased length of stay may be different geographically and vary by local health economy.

Role of Social Deprivation

Associations between social deprivation and longer admission duration have been observed elsewhere in the literature and in different clinical settings (6,7). With a relationship only seen in South Asian patients, this study is the first to suggest an increased length of stay due to deprivation amongst a relatively specific demographic group in a single acute NHS trust. In addition, this study is the first in general to be able to provide potential insights into the influence of social deprivation on length of stay across different ethnic categories following emergency surgery.

There may be numerous reasons for longer stays in hospital amongst the more deprived population. These may include different thresholds for patients to present themselves acutely, differences in routes of presentation either via primary or directly to secondary care and differences in health education and awareness regarding the nature of acute medical issues. Different attitudes to surgery could lead to differences between socioeconomic groups in potential attempts at non-operative management-for example there may be preferences amongst certain groups not to have surgery and therefore trial antibiotics first. Finally, there may be ethnic or cultural barriers to timely discharge from hospital following surgery, such as availability of care at home or in social care (23).

The observation that increased social deprivation raises the likelihood of normal histology following appendicectomy may be due to a vast array of factors. A key factor influencing histology will be the preferences of operating surgeons regarding the removal of the macroscopically normal 'lily-white' appendix. If there is a preference to perform an appendicectomy even when laparoscopy is negative for acute appendicitis, the pro-

portion of histopathology results reporting a non-inflamed appendix will be increased independent of any patient factors. For the three hospitals investigated in this study, the departmental policy was that if acute appendicitis was deemed the most likely diagnosis preoperatively and no other pathology to explain the patient's symptoms was identified on laparoscopy, appendicectomy was justifiable. No data regarding the macroscopic appearance of the appendix at the time of surgery was collected in this study, which precluded any investigation into surgeon-based influences on the study results. However, the data obtained in this study allowed a pragmatic investigation into histological outcomes following appendicectomy.

Despite the lack of high-level evidence in the form of randomized trials or meta-analyses, there appears to be a growing international consensus that during surgery for suspected acute appendicitis, a macroscopically normal appendix should be removed (24). Nevertheless, heterogeneity in management of the normal appendix means that patient factors affecting histological diagnosis will always remain difficult to investigate from observational studies in particular. Data from this study suggest an increased likelihood of negative histology amongst patients who are more socioeconomically deprived. Any further studies investigating demographic factors and histological outcomes following appendicectomy will need to remain pragmatic in order to accommodate differences in operative management of acute appendicitis.

Finally, many of the possible reasons for the observed influence of social deprivation and histological outcome overlap with previously mentioned factors affecting length of stay such as pathways to the operating theatre, health behaviors and attitudes affecting time to presentation from onset of symptoms and availability of healthcare resources, both perioperatively and outside of hospital.

Hospitals should ideally adapt their services according to local health needs. Where certain socioeconomic groups are more populous and with specific healthcare requirements, appropriate services should be established amongst healthcare providers to ensure patients receive the best possible care.

Role of Age & Sex

Despite the increased incidence of appendicitis in younger male patients, it has previously been reported that female patients undergo twice as many appendicectomies (25). Our analysis reported a higher rate of positive histology for appendicitis in male patients. The differential diagnosis of right-sided lower abdominal pain is much wider in the young female patient, with consideration required towards potential gynecological causes of abdominal pain. Furthermore in younger patients, there may be a greater likelihood for the operating surgeon to perform a 'prophylactic appendicectomy' in which a normal appendix is removed in order to minimize the risk of appendicitis at a later time (26).

In addition, the uptake of laparoscopy particularly for both the investigation and management of acute right sided abdominal pain continues to increase and is now becoming the standard of care for the operative management of appendicitis. Combined with pressures to increase the throughput of emergency surgical services in the NHS, the threshold for laparoscopy may be decreasing and therefore partially explain higher negative appendicectomy rates seen in some centers such as the setting of this study. However, continuing variations in practice amongst surgeons makes this a difficult conclusion to make definitively.

Also of importance is the common practice in the UK of confirming acute appendicitis radiologically in older patients before proceeding to surgery, irrespective of gender. Although not stipulated in any published UK guidelines, most patients of more advanced age undergo cross sectional imaging in order to rule out cecal pathologies such as right sided colonic malignancy before deciding on operative management. This results in a significantly lower negative appendicectomy rate within the elderly cohort.

The role of age and gender in the management of undifferentiated right lower quadrant pain was investigated as part of the UK Right Iliac Fossa Treatment (RIFT) audit (27). This cross-sectional snapshot audit took place more recently than the period of this observational study and across a more generalizable population. Prior to moving forward with further research into the age and sex associations suggested by this study, there would be utility in establishing whether a more national investigation such as the RIFT study corroborates the findings of this single center longitudinal analysis.

Study Limitations

A key limitation of this study was that data were only collected from patients who underwent appendicectomy. Patients who were successfully treated non-operatively or who presented to a healthcare professional with symptoms suggestive of appendicitis, but never reached the care of an acute surgical team, were not included.

Length of stay was measured in whole calendar days between the admission and discharge date, rounded up where required. There is potential therefore for the artifactual increase in length of stay by one day for patients who underwent surgery overnight. Nonetheless, whilst this may affect the applicability of length of stay as an absolute measure when comparing this study's dataset with that of another study, the associations observed should be unaffected as this potential systematic error would apply to all of the study population.

The reclassification of patients into one of nine predetermined ethnic categories due to such a significant heterogeneity in initial ethnicity coding resulted in a loss of more detailed information about patient's nationalities. Younger patients in particular are more likely to have been born in the UK and therefore potentially not have the same risk factors as those from their family's country of origin.

Although the study period was seven years, only the Index of Multiple Deprivation 2015 was used. New indices of multiple deprivation are not released annually however and although social deprivation is evidently difficult to quantify, the Index of Multiple Deprivation scores are considered the best method available in the UK (16). Nonetheless, measuring socioeconomic deprivation in younger patients is more difficult as some of the variables used in determining their IMD score are either not applicable to them or may not pertain to their primary residence. A typical example of this would apply to a university student who should not necessarily be classed as unemployed with no income and in addition may not normally reside in the catchment area of the studied hospital.

In this study, a negative appendicectomy was regarded as the absence of inflammation of the appendix as stated on the histopathology report, irrespective of the final diagnosis. Non-inflammatory but nonetheless pathological findings on histology were therefore regarded as normal. These included diagnoses such as neuroendocrine tumors, Meckel's diverticulitis with a non-inflamed appendix and parasitic infection without inflammation. The effects of these pathologies on length of stay in hospital and their different incidences across demographic groups may affect the results of this study. However, these pathologies are all rare and would likely not affect a sufficiently large sample size significantly.

CONCLUSION

Overall, this retrospective longitudinal analysis is the first to highlight South Asian patients as a particular demographic group at risk of increased length of stay for an admission with appendicectomy. The differential effect of social deprivation across ethnicities observed in this study has not been reported in other studies investigating the patient pathway for acute appendicitis.

Further population-based research is required in order to investigate possible causative factors that cannot be proven conclusively from observational data, both locally to establish potential region-specific inequalities and in other areas to ascertain whether similar associations are seen.

Finally, we report a higher negative appendicectomy rate amongst young female patients compared to their male counterparts, most likely due to differences in diagnostic difficulty between these two groups and surgeon specific preferences on the operative management of a normal appearing appendix.

Ethics Committee Approval: According to the results of the decision tool of NHS Health Research Authority and UK RI Medical Research Council, it is no need to have NHS REC review for this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Author Contributions: Concept - RS; Design - SB, QA; Supervision - RS; Materials - RS; Data Collection and/or Processing - SB, QA, IS; Analysis and/or Interpretation - SB; Literature Search - SB, QA; Writing Manuscript - SB, QA; Critical Reviews -SB, QA, VS, MD, RN, MR, RS.

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Appendektomi uygulanan yetişkin hastalarda hastanede kalış süresi ve histolojik tanıya ilişkin demografik faktörler

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ÖZET

Giriş ve Amaç: Appendektomi halen Birleşik Krallık'ta en sık yapılan acil cerrahi müdahalelerden biridir. Literatürde sadece potansiyel sebepleri belirtilirken apandisitin tam etiyolojisi halen bilinmemektedir. Birçok cerrahi müdalahe sonrasında sonuçları etkileyen iki mekanizma olarak düşük sosyal deney ve etnik kimlik gösterilmiştir. Apendektomi sonrası bu mekanizmaların rolünün ciddiyetini ve sonuçlarını betimleyen herhangi bir çalışma yoktur.

Gereç ve Yöntem: Tek bir Ulusal Sağlık Hizmeti bölgesi içerisinde 2010-2016 arasında apendektomi uygulanan yetişkin hastaların sağlık kayıtlarından demografik bilgilere ulaşıldı. Sosyal yoksunluğu ölçmek için Çoklu Yoksunluk İndeksleri (ÇYİ) sıralamaları kullanıldı. Histoloji raporları gözden geçirildi ve tanı önceden belirlenmiş kategorilere ayrıldı: yangılı olmayan apendiks, komplike olmayan apendisit, komplike apendisit ve gangrenöz apendisit.

Bulgular: Üç bin dört yüz kırk dört hasta belirlendi. Ortalama yaş 37,8 yıl (aralık 73 yıl) idi. Genel lineer bir model kullanarak Güney Asya etnisitesinin appendektomi sonrası daha uzun hastanede kalışı bağımsız olarak öngören bir parameter olarak bulundu ($p< 0,001$). Güney Asyalı hastalar arasında sosyal yoksunluk da uzamış hastanede kalış süresinin yordayıcısı olarak bulundu ($p= 0,005$). Sosyal yoksunluk, gangrenöz apendisitin değil komplike apendisitin yordayıcısı olarak bulundu ($p= 0,01$). Erkek cinsiyeti ve yaş, pozitif apandisit histolojisi için bağımsız yordayıcılar olarak bulundu (sırasıyla $p< 0,001$ ve $p= 0,021$).

Sonuç: Bu çalışma, tek bir Ulusal Sağlık Hizmeti bölgesi içerisinde apendektomi uygulanan hastalar da Güney Asya etnisitesi ve uzamış hastanede kalış süresi arasında bağımsız bir ilişki bulan ilk çalışmadır. Bu çalışmada bildirilen ilişkiler akut apendisit patofizyolojisindeki farklılıkların bir sonucu olabilirken etnik ve sosyoekonomik gruplar arasında sağlığa ulaşımda eşitsizlikleri de yansıtıyor olabilir.

Anahtar Kelimeler: Apandisit, genel cerrahi, yoksunluk, etnik köken

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Pay for performance system in Turkey and the world; a global overview

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ABSTRACT

Objective: This study aimed to compare the pay for performance system applied nationally in Turkey and in other countries around the world and to reveal the effects of the system applied in our country on the general surgery.

Material and Methods: Current literature and countries' programs on the implementation of the pay for performance system were recorded. The results of the Turkish Surgical Association's performance and Healthcare Implementation Communique (HIC) commission studies were evaluated in light of the literature.

Results: Many countries have implemented performance systems on a limited scale to improve quality, speed up the diagnosis, treatment, and control of certain diseases, and they have generally applied it as a financial promotion by receiving the support of health insurance companies and non-governmental organizations. It turns out that surgeons in our country feel that they are being wronged because of the injustice in the current system because the property of their works is not appreciated and they cannot get the reward for the work they do. This is also the reason for the reluctance of medical school graduates to choose general surgery.

Conclusion: Authorities should pay attention to the opinions of associations and experts in the related field when creating lists of interventional procedures related to surgery. Equal pay should be given to equal work nationally, and surgeons should be encouraged by incentives to perform detailed, qualified surgeries. There is a possibility that the staff positions opened for general surgery, as well as, all surgical branches will remain empty in the near future.

Keywords: Pay for performance, healthcare implementation practices, P4P

INTRODUCTION

Pay for performance system can be defined as a change in the additional income of medical personnel according to their efforts and interventions in line with the financial incentive. The pay for performance system is, in essence, a quality-oriented system. The first of its main goals is to improve the quality of healthcare standards. Enabling the use of existing resources and demanding success to achieve these goals by setting measurable goals are seen as the secondary goals of the system. This system is not concerned with how the set goal was made, but with how much it was made. The advantage of the system is that it is easy to control and there are rewards or sanctions for achieving the goal.

In our country, the pay for performance with regard to interventions in health practices was adopted nationally to cover Ministry of Health Hospitals in 2004 and University Hospitals in 2010. Pay for performance (P4P) is not only applied in our country but is part of the health system in many countries of the world. Before the performance system, hospitals were operating on a volume basis, and, with this system, they started working on a performance basis.

Perhaps the most important of the differences in the application of this system in our country compared to the examples in the world is that the system is not applied to a special area, disease, screening program, region, or hospital, but is applied to all health units on a national scale.

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This study aimed to compare the pay for performance system applied nationally in our country and the systems applied in other countries of the world and to reveal the effects of the system applied in our country on the general surgery branch.

MATERIAL and METHODS

Current literature was reviewed using the keywords "pay for performance, P4P, fee for performance, performance for healthcare, performansa dayalı ödeme (which means performance-based pay in Turkish), and performans sistemi (which means pay for performance system in Turkish)" on PubMed, Web of Science, Scopus, Research Gate and Google Scholar data platforms (Access 15.04.2020), and countries' programs on performance system implementation were recorded.

The results of the Turkish Surgical Association performance and HIC commission studies were examined to evaluate the performance system implemented in hospitals of the Ministry of Health of our country since 2004 and in university hospitals since 2010 in terms of the general surgery branch. In conclusion, the results of the system applied to general surgeons were discussed by comparing the current situation in our country and examples in the world.

RESULTS

PubMed, Web of Science, Scopus, Research Gate, and Google Scholar data platforms were accessed on 15.04.2020. A total of 7542 articles were found when the terms 'pay for performance, P4P, fee for performance, performance for healthcare, performansa dayalı ödeme (Turkish), performans sistemi (Turkish)' were used as keywords. Articles not related to the pay for performance system were excluded from the review. A total of 118 articles were found to have expressed views on pay for performance. These 118 articles were examined and explored how the pay for performance system was applied around the world.

When the literature was examined, it was seen that the additional pay for performance system was implemented in many countries of the world. Countries implementing the system were found to have implemented the system across the state, region, hospital or center (1). In the reviewed literature, there was no other country except Turkey, where the entire health system nationally switched to the pay for performance (P4P) system.

One of the pioneers of the pay for performance (P4P) system was seen as the United States. The eight different programs implemented in the United States aimed to increase quality parameters in health, reduce hospital re-application rates and reduce ethnic challenges in hospital healthcare services (1). In the United States, the system was implemented locally, and, in some states, it was applied only in hospitals where it was necessary for solving a problem and improving quality. Pay for performance system was found to be made in relation to specific diseases or conditions such as diabetes control, vaccination in childhood, blood pressure control, and cancer screening. Insurance companies or charity organizations often provide these payments. The purpose of this practice is to provide diabetes education to patients and to reduce the costs of diabetes that will last for years and complications that will arise later (1-8). It is understood that insurance companies in the United States are a part of the P4P system in many programs that encourage them to reduce their expenses. As an example, for reducing the long-term costs of patients with chronic back pain, programs in which the adaptation of patients is controlled with regular doctor visits are heavily sponsored (9). In addition, the pay for performance system is partially implemented in many countries of The Organization for Economic Co-operation and Development (OECD), EU member countries, Asian and African countries (1).

A study of 34 different P4P systems applied in 14 OECD countries concluded that the system was applied differently and often on a regional-basis or centralized in many countries. According to this study, two P4P systems were implemented in Australia; the first was implemented in only 22 out of 111 medical centers in Queensland region in 2007 to improve quality practices in healthcare, and the second in 2012 in 244 out of 289 hospitals nationwide to reduce waiting times for emergency and elective surgery. It is emphasized that very little success has been achieved in this program, in which the cost of the system is supplied from the hospital budget and the total cost is less than 1% of the budget (1,10,11).

In Canada, the system was implemented in 2007, 2008, and 2011 to reduce waiting times for emergency department applications in 14 hospitals in British Columbia and 74 hospitals in Ontario. In emergency department applications, CAD 100 to CAD 600 were paid for each patient if the target waiting period is provided after the appropriate triage or if the patient is discharged or hospitalization procedures are performed within the target period (12). All of the implemented programs have been reported to provide little improvement far below the government's expectations, less than 1% of the overall hospital budget in terms of cost, while in private hospitals, it is equivalent to about 20% of the manager's profit (1,12-15).

In the southern region of Denmark, in 2009, it was carried out in four hospitals for sharing cases. In this system, where the cost of the system is less than 1% of the hospital budget, there has been concern that many of the patients are not 'examined' (1,16).

In the UK, some parts of the system were implemented only in northern England in 2008, 2009, 2010, and 2011, and some parts of the system were applied nationally and were used for special

headings such as reducing mortality, providing feedback on serious side effects and not being able to reapply to the emergency department for the first 30 days after discharge (1,17-23). The pay for performance system of the UK came into force in primary health care institutions in 2004 and in second-line health institutions in 2008. A program has been created to provide family physicians with an additional increase of up to 25% of their salary to improve quality in primary health care (24). In 2010, UK implemented the good practices guide to improve quality in the healthcare system. With this application, in 2010, it established the Commissioning for Quality and Innovation (CQUIN) and provided incentive additional payments to healthcare workers by introducing pay for performance practices in emergency services, community mental health services, and ambulance systems. In 2012, the program was revised and implemented in a limited number of centers in qualified services when enough financial resources were not allocated to carry out this program. These centers are tertiary healthcare service institutions and are designated as hospitals where very rare diseases are diagnosed and treated, genetic researches are carried out and diagnosis and treatment of rare cancers are done. In addition, 14.4% of the general health budget was transferred to these centers to be operated. In these centers, employees were rewarded with an extra payment of 25%-50% to increase productivity and encourage employees, and quality of health care was improved. However, it has been observed that the desired targets have not been achieved in all programs carried out (17).

In France, a nation-wide performance system was implemented in 2014 and 2016 to improve quality and documentation (1). No research that reveals the consequences of the system cost, which corresponds to 0.5% of the general hospital budget, has been found.

A program in Tel Aviv, Israel, which began in 2009 and was terminated in 2011, aimed to reduce the cost of complications in heart and thorax surgery. It has been reported that the program has positive contributions and has reduced costs. It has also been revealed that the cost of the program is less than 1% of the general hospital budget (1,25).

In Italy, the programs, which began to be implemented in Tuscany in 2006 and Lazio in 2009, aimed at reducing waiting times for hip prosthesis in patients aged 65 and older. It has been reported that the cost of this program is less than 1% of the overall hospital budget and reduces waiting times (1,26).

In 2008, a national program to improve the health quality of stroke patients was implemented in Japan. It has been found that the cost of this program is less than 1% of the overall hospital budget, providing an improvement in the management of stroke patients, as well as increasing potential risk-taking by doctors during the management of patients (1,27).

Programs were conducted to improve the quality of health in Luxembourg in 1998 and in four regions in Norway in 2014. While it has been reported that the program costs reached up to 2% of the hospital budget, no clear information has been given in relation to the results (1,28,29).

In Sweden in 2004 and 2005, four different programs were implemented regionally, aiming at improving the quality of health, with 2-18 participating hospitals from each region. Program costs have been reported to reach up to 4% of the hospital's budget, but no clear information has been given in relation to the results (1,30,31).

The pay for performance system has also been used to correct health parameters in underdeveloped or developing countries. In a P4P program in Rwanda in 2006, supported by the world bank, it was reported that great success was achieved in mother and infant mortality rates and disease treatment thanks to the financial promotions of the medics involved in prenatal diagnosis, childbirth, pediatric intensive care and postpartum vaccination (32). Additional payment to health workers in the pay for performance program in Kenya for malaria control has been reported to be successful (33).

When we reviewed the pay for performance system implemented in our country, it was seen that the system has come into force in all public health institutions with its implementation in all health units affiliated to the Ministry of Health since 2004 and in universities since 2010. Pay for performance system is carried out together with pricing list of Healthcare Implementation Communique (HIC) and invasive procedures list. Procedures and examinations are scored in accordance with these regulations. While it is aimed to calculate the progress payment of the health institution and the physicians working in it with the issued regulations as a result of establishing the service quality indicators and targets in the healthcare sector, the determination of the amount of money to be distributed depending on the quality standards covered by the general physical conditions of the hospital distorted the evaluation of the physician's performance. The quality factor that should be evaluated should be the clinical quality indicators of the physician. In this sense, the collection of the quality indicators of the hospital and the quality indicators that are the result of the physician's work under the same 'quality' caused the evaluation purpose of the system to be completely disrupted.

General surgery branch is one of the main branches negatively affected by the current pay for performance system. To identify the disadvantages caused by this system and to take measures for problems that may develop, the Turkish Surgical Association held a large workshop in 2010, before the P4P system was come into force nationally, and shared the results of the workshop and suggestions for solutions with the officials of the Ministry of Health (34).

Since no significant improvement has been made by health authorities despite many new problems that have emerged in the system over the past 10 years, members of the Turkish Surgical Association Performance-HIC working group held various meetings in 2019 and 2020 to determine the situation and create solutions. The feedbacks were received from 3930 general surgery specialists, who are members of the association and the sub-organizations and general surgery side branch associations related to the association. The conclusions emerging as a result of these meetings and feedbacks are as follows;

1. Many general surgeons are uncomfortable with the current performance system. They believe that they cannot get the reward for their work in terms of both points and financial terms.
2. Many operations performed in daily surgical practice have no equivalent in the list of interventional procedures or are insufficient to describe the performed operation.
3. The performance system is structured in such a way as to disrupt the working peace between clinics within the hospital, or even between physicians within the same clinic. Although many non-surgical clinics can benefit from ceiling payments, general surgery clinics in many centers experience a decrease in payments because the clinical average remains below the hospital average. In performance payment in hospitals with training clinics, 70% of the clinical average and 30% of individual performance are taken as influence value, so physicians who do not/cannot produce enough performance cause the peace of work in the clinic to be broken. As of January 2021, the Ministry of Health has started to make individual contracts with doctors, and within the contract period, it wants a certain percentage of the average clinical score and hospital overall score (which may be different for each physician and is determined by the chief physician) to be produced by physicians.
4. Since the quality of the work performed in the current performance system is not given importance, the procedure scores of the general surgery branch remain very low. For this reason, a large proportion of high-risk patients experience failures in follow-up and treatment due to the defensive medicine reflex of physicians. The surgeon prefers to operate the referral mechanism rather than dealing with a risky patient without a promotive score.
5. The performance system also prevents the proper implementation of educational training activities in educational research hospitals and university hospitals. Although the primary purpose of these institutions is education and training activities, the secondary purpose is service sharing for patient diagnosis and treatment, the time allocated to education is considered as a loss of performance, which prevents these activities from working healthily.
6. The fact that research assistants present for training are involved in the performance system is against the nature of life. It is suggestive that an assistant who is not authorized to produce performance is included in the denominator in the calculation of performance. As the number of assistants in clinics increases, the number of people in the denominator increases, and the performance of the surgeons decreases by division, so their income decreases significantly.

DISCUSSION

The pay for performance system (P4P) was established to increase quality standards in healthcare, to make the use of resources effectively, and to demand success by setting measurable goals. P4P includes encouraging or punitive financial sanctions in line with measurable goals in the performance of institutions and individuals. In the current system applied in our country, about 75% of the income received by the general surgery physician comes from the performance system. A surgeon has only a salary as a fixed income. There are two important differences between the situation in Turkey and examples of other countries. First, pay for performance, which is an item of income other than salary, is the work performance produced by the person. However, this performance income they earn depending on what is produced, unfortunately, is directly proportional to what the doctors working in the clinic produce, the number of employees in the clinic, whether they provide training, whether the clinic has trained assistants, the performance produced by other branch doctors working in the hospital, and the general quality indicators of the hospital. If an example is given, if all factors are assumed the same for surgeons working in two hospitals at the same standards, and only the number of doctors working in the clinic differs, the surgeon with a large number of doctors working in the clinic will receive less pay for performance. In other words, a person's work does not have a qualitative and quantitative value. From another point of view, from two surgeons with equal competencies working in two separate hospitals, the surgeon who has an assistant in the clinic or the surgeon with a high number of assistants in the clinic gets less performance pay. This system, which allows the punishment of a situation that should be encouraged from the point of view of training clinics, reduces the quality of training and the willingness of trainers.

The second important difference in the performance system in our country from other countries is that the additional income obtained in the countries that perform this practice is about 25% of the maximum salary of the doctor; while the ceiling pay for performance obtained in our country can be more than 4-5 times the salary of the doctor. Thus, a system initiated for the purpose of encouragement and stimulation eventually became the primary economic income of the physician, and the result remained far from the goal.

Physicians have a direct effect on the performance payment of the hospital where they work. A general surgery specialist working in a second-line hospital and a colleague working in a third-line hospital receive very different fees, even if all parameters are equal. The same surgery, the same labor, but different wages arise. The resulting difference can often reach astronomical levels. The economic value of a gallbladder or hernia operation performed at Ankara City Hospital in terms of pay for performance turns into a different performance value if the same operation is performed at Hitit University Medical Faculty Hospital.

Surgical branches, especially general surgery, make many invasive interventions in accordance with the definition of the working area. All interventions made by surgeons, pre-intervention preparations, and post-intervention follow-up directly or indirectly affect the performance of not only the relevant branch but also many units of the hospital. For a patient with suspected rectal cancer, preoperative blood tests are taken, colonoscopic examination, ultrasonography, computed tomography, magnetic resonance imaging are performed, and a biopsy is taken and examined by the pathology department. After the patient is diagnosed with rectal cancer, he/she is hospitalized, his/her nutritional status is evaluated before surgery, and support is started if necessary. Before the patients are admitted to surgery, they are consulted in the relevant branches such as anesthesia, pulmonology, cardiology, etc. After surgery, they are followed up in the intensive care unit and surgical service for about 5-7 days. In the presence of a developing complication, the patient can be re-evaluated by many clinics, such as interventional radiology, cardiology, anesthesia, and pulmonology. Although the general surgery branch, which works in coordination with many branches, works as a locomotive unit, it also has to cope with low patient cycle and high bed occupation rates as a result of continuous follow-up of the patient compared to other branches performing with a short-term contribution, so they are doomed to receive less points.

In the pay for performance system, the interventions and examinations performed by the physicians are evaluated through the point system of the interventional procedures specified in the Healthcare Implementation Communiqué (HIC). The doctor is entitled to additional payment at a certain rate from the circulating capital in exchange for points obtained during the month. The list of interventional procedures is determined and updated by the commissions of the Ministry of Health. It is a fact that the members of the commission have no comprehensive knowledge of the degree of difficulty, workload, and risk of the interventions as much as the physicians who carry out the relevant process. We believe that a fair and truth-reflecting assessment will occur by taking into account the recommendations of groups that have comprehensive knowledge about the issue in scoring for interventional operations, such as non-governmental organizations, professional associations, or commissioners from the relevant branch.

When examining the current list of HIC and interventional procedures, the operation value of an abdominal wall hernia corresponds to 400 points. Although abdominal wall hernias sometimes seem like a simple surgical procedure that can be repaired in 45 minutes, complex hernias sometimes last 4-5 hours and may contain difficulties that will require organ resections and anastomoses. However, in the list of interventions, the score of both is the same. Serious morbidity and complications are sometimes inevitable in complex hernias, and the risk faced by the doctor may exceed the risk that many branches face during their professional life.

If we give another example, the equivalent of laparoscopic cholecystectomy surgery is 650 points. In an uncomplicated operation, the procedure takes between 30-45 minutes, while in complicated cases, this procedure takes hours. Such cases, which are very open to the development of complications, carry risks that can lead to serious morbidity, which the patient will deal with for life, and even death. In the face of such an unfortunate situation, the doctor does not have any support, including compulsory professional insurance. In this case, the physician is faced with a fee policy that does not cover the risk he or she is taking.

In summary, how much the surgeon does not what he does or how he does, finds a monetary response in this system. After outpatient examination, admission to the service, preoperative preparation, further examination, and interventions, which are performed to prepare a patient with a periampullary tumor for the operation, the point you will get when you perform Whipple surgery is 3150, which involves mortality of about 10% and morbidity of up to 30-40% and lasts 3-4 hours and requires good experience even in the best medical centers. After surgery, the patient is followed up in intensive care and service for about a week. The management of such a patient requires a health army such as a nurse to follow up and care in the service and intensive care unit, anesthesiologist in the operating room, anesthesia technician, and surgery nurse. However, a plastic surgeon gets 150 processing points by excising cysts or nevus from a patient under local anesthesia and can admit approximately 40-50 patients in one day by performing the same procedure. Thus, he/she gets approximately twice the score and income without almost any risk of morbidity or mortality and without hospitalizing patients. Similarly, by performing cryotherapy on the dermatology clinic, a dermatologist can achieve the same process performance without even leaving the outpatient clinic.

The scores of the general surgery branch in the list of interventional procedures in the current HIC cause loss of rights, while the resulting score devalues the labor force, risk, and effort. Surgeons are very uncomfortable in this regard. Many interventional procedures performed in the general surgery branch

have no equivalent in points. This leads to a loss of motivation in the physician performing the procedure. In addition, it causes the performing of qualified surgeries to be performed only with personal attention and professional dedication. Many physicians, quite rightly, do not want to wear themselves off and begin to practice defensive medicine. Such applications give results in the future that are difficult to compensate for, sometimes even impossible. In other words, surgery is learned through the relationship of master-apprentices, unfortunately, it cannot be taught how to operate on the patient from books, unlike internal branches. When a general surgery assistant, who is raised in an institution where his/her trainer does not perform qualified surgeries, graduates, she/he may not be able to perform a full qualified surgery, and in this case, the patient's last chance to hold on to life is taken away.

Pay for performance system can provide success with additional incentive reward when fixed income is satisfactory. A survey study has been conducted in Germany on the involvement of family doctors in the P4P system for monitoring hypertension patients and controlling blood pressure, and it has been reported that when there was an additional payment of 2.5% (€5000) as a bonus payment in the program, the participation request was 28%, and if the payment rate was increased to 20% (€40.000), the participation rate reached 50%. In the same study, it has been determined that only 33% of the participants wanted to take part in the P4P system when it was reported that payment would be made if the target value for blood pressure regulation was achieved in 90% of patients and that 40% of the participants would like to take part in the P4P system if the same target value was achieved in 80% of patients (35).

A five year follow-up study has been conducted in a surgical center in Germany to investigate the effect of the P4P system on quality for cataract surgery, various quality parameters such as hospitalization time, patient satisfaction, complications were set, and reward and penalty came into force in the criteria for achieving the goal per case. As a result of the agreement with the insurance company, a standard payment of €1000 for each cataract operation was made, while each parameter was valued between €50 and €60 as a reward and penalty. As a result of the five year of follow-up, they have reported that the P4P system did not make a significant contribution to the parameters of the study, such as quality, patient satisfaction, hospitalization time. Also their outcomes of surgical procedures were similar to the outcomes of patients who did not participate in the study (36).

In the current performance system, the individual performance of a surgeon in third line training and research hospitals affects only 30%, while the remaining 70% is achieved from the clinical average. This condition, which is contrary to the peace of work within the clinic, often reveals the chore. Doctors who do not work equally in the clinic, or even sometimes do not put any effort, obtain income from doctors who work with great seriousness and dedication.

The concept of 'qualified intervention' has been created with the arrangements made recently. In this group, pancreaticoduodenectomy and transplantation procedures were accepted as a qualified intervention for the general surgery branch. It was not appropriate that trauma and cancer surgeries of the general surgery branch were not involved in this category on the grounds that trauma and cancer surgeries were "widely performed", but these surgeries really require special attention and experience. The fact that surgery is widely performed does not mean that it is unqualified. This has disrupted the peace of social work between general surgery and other branches.

Assistant physicians, who are involved in the denominator as a divisor in the performance system, reveal one of the most distorted aspects of the system. The specialization student, who is not authorized by law to intervene patients, is included in the divisor part as a denominator, which decreases incomes. Many clinics are uncomfortable with the presence of specialization students for this reason alone. However, the main purpose of the establishment of medical schools and educational research hospitals is to train doctors and specialized students first. Generating scores from caring for patients and interventional procedures are secondary, tertiary purposes. Nevertheless, the current system poses great obstacles to educating future physicians. Especially in affiliated hospitals, faculty members are punished by reducing the number of days worked because they do not generate points in the hospital during the time they teach the students lecture.

Difficulties in assistant training have had two negative consequences. First, assistants in educational institutions have begun to stand out as the cause of economic loss. The fact that the income in exchange for performance increased significantly above the salary of the doctor and became the main item of income increased the importance of the loss of the right to be exposed at this point. While this is the current situation for educators, as a result of malpractice law applications, the content of which is empty, and pay for performance practice, which becomes a source of income ahead of the salary with unfair distribution, medical school graduates do not prefer surgical branches anymore. When the results of the recent years' exams for specialization in our country are examined, surgical branches and general surgery have been seen to be preferred after the 30^{th} rank in 36 specialized areas.

The central physician appointment system (CPAS) is an approach established in good intention, aimed at reducing the patients' waiting time and giving them the chance to choose a physician. As classical information, a patient's examination is considered to last an average of 20 minutes with anamnesis and physical examination (37). This indicates that 24 patients can be

evaluated during 8-hour shifts. If the time is reduced to an average of 10 minutes, 48 patients will be evaluated. However, in the current practice, doctors admit not only 60-70 patients with CPAS appointment in the outpatient clinic, but 100 patients are examined in an outpatient day with the addition of urgencies such as control of operated patients, patients over 65 years of age, etc. (38). During the shift period, it is necessary to care for the patient, diagnose and manage their treatment for about five minutes. If the patient's examination is detailed and the duration is slightly extended, the doctor who is harassed by the waiting patients often experiences verbal and physical assault and the seeds of violence in healthcare are sowed. An increase in cases of malpractice and doctor violence is added to the extremely low expectations of the economic and social level, and interest in the general surgery branch decreases at even the research assistant level (39). In summary, the performance system in our country has shifted away from the international goal of 'increasing in quality' to the goal of 'increasing in quantity'.

CONCLUSION

Application of an international 'physician quality improvement' system, which has been put forward to improve the quality of the situations identified in certain hospitals, to all our country's hospitals with a single regulation without regard to local and social differences between them has brought together many problems, especially the deterioration of social work peace. When the monthly income of physicians is examined, it is seen that the fixed salary remains at a very low rate compared to the income obtained based on performance. As a result of the deterioration of this income balance, pay for performance ceased to be an additional income and began to take place as the main income of the physician. Coefficient applications made to correct the problem have made the situation more complicated. The addition of medical school graduate assistants who received training and could not contribute to the process score negatively affected the training. Regulations to support trainers have been a cause of negative discrimination for physicians without academic title participating in training in teaching hospitals, resulting in different fees for the same surgery. However, the same works are produced as a service. If the academic title contributes to salary, which is their main income, not performance income, then the full equivalent of the article of the constitution on equal pay for equal work is provided in this way, so the promotion of rising in academic titles will be encouraged in return for a salary. As a result, surgical branches have ceased to be popular branches by medical school graduates and started to take part in the last preferences, so they have only been preferred to have a specialization.

The pay for performance system, which aims at quality in healthcare service, must be overhauled before irreparable consequences. Quality is kept at the forefront in countries where pay for performance system is implemented, while quantity comes to the forefront in our country. Furthermore, with regional and purposeful regulations, as well as, reasonable prioritization and qualification configurations, the social work peace between branches should be ensured immediately.

Ethics Committee Approval: For this study, it is not necessary to have the ethical approval as it is a study that does not involve human participants.

Peer-review: Externally peer-reviewed.

Author Contributions: Author Contributions: Concept - All of authors; Design - All of authors; Supervision - All of authors; Materials - All of authors;; Data Collection and/or Processing - All of authors; Analysis and/or Interpretation - İ.T.Ş., A.Ç.Y.; Literature Search - İ.T.Ş., A.Ç.Y.; Writing Manuscript - İ.T.Ş., A.Ç.Y.; Critical Reviews - All of authors.

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ORİJİNAL ÇALIŞMA-ÖZET
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Türkiye ve dünyada performansa dayalı ödeme sistemi; global bakış

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ÖZET

Giriş ve Amaç: Ülkemizde ulusal çapta uygulanmakta olan performansa dayalı ödeme sistemi ile dünyanın diğer ülkelerinde uygulanan performansa dayalı ödeme sistemlerinin karşılaştırılması ve ülkemizde uygulanan sistemin genel cerrahi branşı üzerindeki etkilerini ortaya koymaktır.

Gereç ve Yöntem: Performansa dayalı ödeme sistemi için güncel literatür gözden geçirildi ve ülkelerin performans sistemi uygulaması hakkındaki programları kayıt altına alındı. Türk Cerrahi Derneği Performans ve Sosyal Güvenlik Kurumu Sağlık Uygulama Tebliği (SUT) komisyonun yaptığı çalışmalarda çıkan sonuçlar literatür ışığında değerlendirildi.

Bulgular: Dünya üzerinde birçok ülkenin performans sistemini kalite artırmak, bazı hastalıkların tanı, tedavi ve kontrolünde hız kazanmak için kısıtlı çapta uyguladığı ve genelde sağlık sigorta şirketleri ve sivil toplum kuruluşlarının desteğini alarak finansal teşvik olarak uyguladığı görüldü. Ülkemizdeki cerrahların mevcut sistemdeki adaletsizlikten, yapılan işin niteliğinin değer görmemesinden, yaptıkları işin karşılığını alamadığından dolayı haksızlığa uğradıklarını düşündüğü ortaya çıkmaktadır. Bu durumun, tıp fakültesi mezunlarının genel cerrahi branşını tercihe olan isteksizliğin de nedeni olduğu düşünülmektedir.

Sonuç: Sağlık otoriteleri genel cerrahi branşını ilgilendiren girişimsel işlemler listelerini oluştururken derneklerin ve alanında yetkin sahadan kişilerin görüşlerine önem vermelidir. Ulusal çapta eşit işe eşit ücret verilmeli, cerrahların özellikli, nitelikli ameliyat ve tedavileri yapmaları teşvikler ile özendirilmelidir. Yakın zaman içerisinde genel cerrahi yanında cerrahi branşlar için açılan kadroların boş kalması ihtimali mevcuttur.

Anahtar Kelimeler: Performansa dayalı ödeme sistemi, sağlık uygulama tebliği, P4P

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ORIGINAL ARTICLE
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A comprehensive study of mesoappendix and arterial pattern of appendix

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ABSTRACT

Objective: The length and the attachment of the mesoappendix is important in the degree of inflammation, spread of tumor and during surgical resection of the appendix. The presence of accessory appendicular artery along with varied origin of appendicular artery may cause intra- as well as post-operative complications. Hence, the study of length of mesoappendix and the origin and branching pattern of arterial supply to the appendix was undertaken.

Material and Methods: Sixty formalin fixed appendix specimens were resected along with the intact mesopappendix and were dissected to analyze the extent of attachment, origin of appendicular arteries and the accessory branches as well.

Results: The whole length mesoappendix was seen in 76% and the half length mesoappendix was not found. The main appendicular artery originated from the ileocolic artery in 80%, and accessory appendicular artery was seen in 13% of the study specimens.

Conclusion: The mesoappendix and the branching pattern of the appendicular artery varies from person to person, and this awareness will be of use during surgeries on appendix.

Keywords: Appendix, mesoappendix, appendectomy, appendicular artery

INTRODUCTION

The vermiform appendix is located in the right lower quadrant of the abdomen and is one of the important differential diagnosis in case of pain (1,2). Its length varies from 2-20 cm, with an average length of 9 cm (2,3). The attachment of the base of the appendix to the caecum remains constant, whereas the tip can be found in a para-colic/para-caecal (11 o'clock), retrocaecal (12 o'clock), splenic (2 o'clock) position, promontoric (3 o'clock), pelvic (4 o'clock), midinguinal/subcaecal (6 o'clock) position, pre-ileal and post-ileal positions (1,2,4).

Vermiform appendix is connected by a short mesoappendix to the lower part of the mesentery of the ileum enclosing the appendicular artery and the inferior ileocaecal recess (2). The terminal part of the artery lies on the wall of the appendix and hence may be thrombosed in appendicitis, resulting in distal gangrene and necrosis. In about 50% of the cases an accessory artery of Dr. Sheshachalam (5), a branch of posterior caecal artery is present and needs separate ligation during appendectomy. Thrombosis of this artery, in acute appendicitis, inevitably results in gangrene and subsequent perforation. Appendicitis is the most common cause of acute abdomen (4,6). Identification of the normal position of the appendix is important because in appendicitis, variable positions may produce symptoms and signs related to their position, and hence can mimic other diseases (7,8). According to Lohar et al. (9), the age group of the incidence of appendicitis is 11-20 years constituting 44.6%, 21-30 years constituting 36.1%, 31-40 years constituting 11.5% while between 0 and 10 years age group, it was 3%, and between 41-50 years and 51-75 years of age group, it was 2.3% each in India in 2021. Hence, the rate of appendectomy is higher, and intra-operative and post-operative complication of hemorrhage in cases of accessory appendicular artery is more common. Short mesoappendix can cause the appendix to necrose in case of inflammation, as appendicular artery, which is as such an end artery, to be more nearer to the wall. This

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study aimed at studying the length of mesoappendix and the arterial pattern of the appendix in detail.

MATERIAL and METHODS

The present study was performed on 60 specimens of human vermiform appendices. The study was done in situ in the cadavers before the appendix was displaced by manipulation and dissection from the right iliac fossa. The abdomen was opened by a long midline incision and the flaps were reflected to give a good view of the abdominal cavity along with its contents. The appendix was studied along with its relation to the ileum and caecum. All taeniae of the caecum converge to the base and acts as the best guide for the vermiform appendix. The extent of the mesoappendix was studied. Specimens fixed with 10% formalin were initially washed with free-flowing tap water to wash away the formalin so as to avoid irritation to the eyes and nasal mucosa. It also caused softening of the fixed tissue. After clearing the mesoappendix, the appendicular artery was visualized. The number of arteries present in it was noted down. To find the branches of the artery, the tracing was done proximally, carefully observing if it was a single artery or a double artery. Then, the parental arteries were identified and recorded. When dissecting and clearing the arteries closer to the appendix, the branching pattern, anastomotic pattern and the end arteries were noted. Some arteries after supplying the tip of the appendix passed posterior to the appendix and supplied that aspect separately. All the arteries were accompanied by their respective veins and nerves.

RESULTS

The following results were obtained by observing the extent of the mesoappendix and arterial pattern of appendix in 60 vermiform appendices:

- Extension up to whole length of the appendix in 46 specimens,
- Extension up to 2/3 of length of the appendix in 14 specimens,
- Extension up to half of the length of the appendix in none of the specimens.

Vermiform appendix was supplied by single appendicular artery in majority of the cases (52), but accessory appendicular artery (8) was also found to be present in mesoappendix (Table 1).

The main appendicular artery arose from the ileocolic artery in 48 cases (Figures 1,2), ileal artery in 8 cases and posterior caecal artery in 4 cases (Table 2). The accessory appendicular artery was seen to originate in contrast from the main branch, predominantly from posterior caecal artery than the ileocolic artery (Table 3) (Figures 3,4).

Table 1. Incidence of the number of appendicular artery suppling appendix

S. No	Number of artery	Number of specimens
1	Single artery	52
2	Double arteries	8

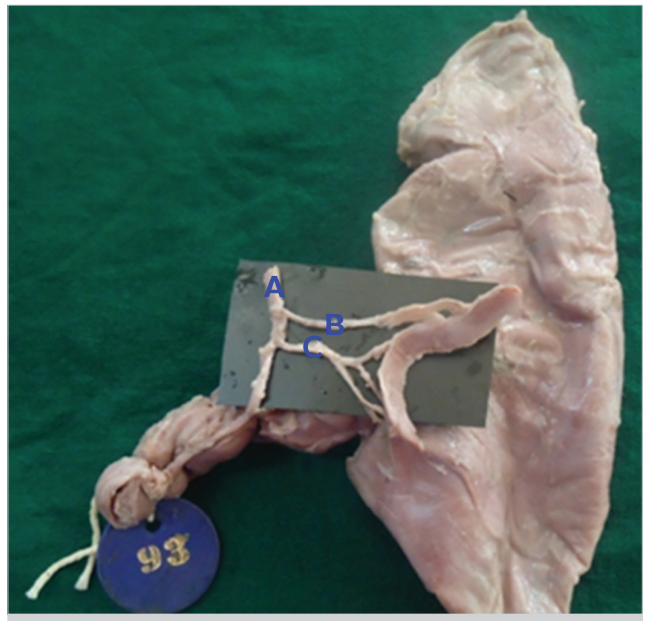

Figure 1. Accessory appendicular artery. **A.** Ileocolic artery, **B.** Appendicular artery, **C.** accessory appendicular artery.

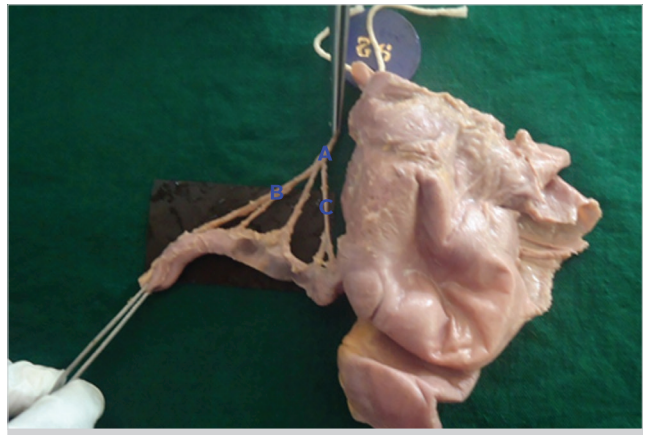

Figure 2. Accessory appendicular artery. **A.** Ileocolic artery, **B.** Appendicular artery, **C.** Accessory appendicular artery.

Table 2. Source of origin of main appendicular artery from the parental artery

S. No	Parental artery	Number of specimens	Percentage
1	Ileocolic artery	48	80%
2	Ileal artery	8	13.33%
3	Posterior caecal artery	4	6.67%
4	Anterior caecal artery	NIL	NIL

Table 3. Origin of accessory appendicular artery		
S. No	**Parental artery**	**Number of specimens**
1	Ileocolic artery	2
2	Ileal artery	NIL
	Posterior caecal artery	6
	Anterior caecal artery	NIL

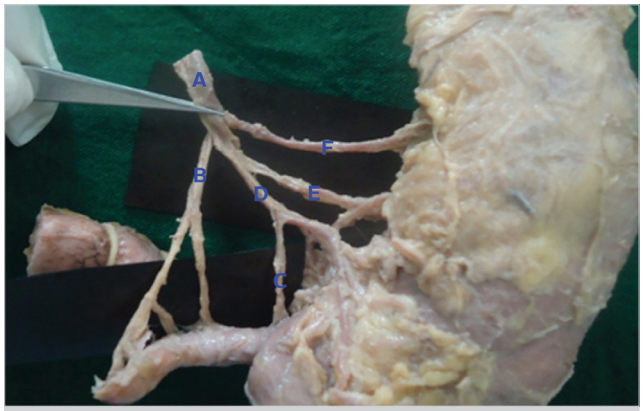

Figure 3. Accessory appendicular artery. **A.** Ileocolic artery, **B.** Appendicular artery, **C.** Accessory appendicular artery, **D.** Posterior caecal artery, **E.** Anterior caecal artery, **F.** Ascending branch.

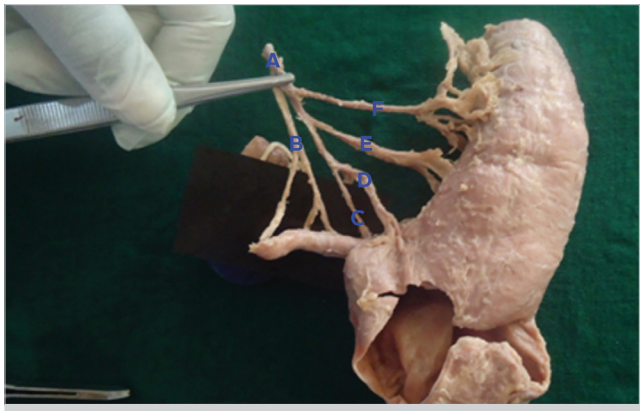

Figure 4. Accessory appendicular artery. **A.** Ileocolic artery, **B.** Appendicular artery, **C.** Accessory appendicular artery, **D.** Posterior caecal artery, **E.** Anterior caecal artery, **F.** Ascending branch.

DISCUSSION

The extension of the mesoappendix is responsible for the vascularization of the vermiform appendix and severity during inflammation, as its failure to reach the tip of the appendix may lead to gangrene and hence early perforation during inflammation (10). The latest inclusion of the spread of appendiceal tumour in the mesoappendix and elective removal of mesoappendix during appendectomy, adds to the significance of our study (11). The same mesoappendix acts as a pathway where a window is created and the stump of appendix is clamped once or twice (depending on the thickness of mesoappendix) (12).

This study aimed exclusively to get an in depth insight on the attachment of mesoappendix and the origin and branching pattern of arteries supplying the appendix. In this study, the extent of mesoappendix till the tip was found to be 76.6%. On reviewing the literature, the study done by Geethanjali in 2011 had the nearest incidence of 69.23% (13). According to the study by Anderson et.al., the mesoappendix reached the tip of the appendix in 80% of the cases (10). According to Tahir Iqbal in 2012, there was a long mesoappendix frequently extending up to the tip of the appendix and often an ileo-caecal fold (14).

In the present study, the mesoappendix extended up to 2/3rd of the length of the appendix in 23.3%. The study done by Geethanjali has had an incidence of 30.77%, which is the nearest to the present study, where the mesoappendix failed to reach the tip (13). This present study does not coincide with the study of Rahman MM in 2005, where the extension of mesoappendix was 2/3rd of the appendix in 45% cases, half and whole extension of mesoappendix were found in 31% and 24% cases, respectively (15).

Surgical interest in the appendix has been aroused since 1886 by the recognition of its inflammation by Reginald Herbeit Fitz. The different anatomical studies performed on appendix concern its localization and its vascularization with the objective of improving the techniques of its ablation. In 1980, Mitroffanof successfully used an appendix for the treatment of an incontinent bladder (Appendiculovesicostomy). Since then, vascularized appendix has been used on its pedicle, and subsequently in free transplant, with success, to rebuild ureters, urethras, the uterine tubes and extra hepatic biliary tract. According to Djibril Ouattaraa knowledge of its vascularization is indispensable to guarantee the survival of the whole of the transplant (16).

The appendicular artery is an end artery from its midpoint and as it very close to the wall, it gets easily thrombosed during acute inflammation. The distal appendix is easily necrosed and hence, perforation is common. There is no unanimity in the literature about the origin of the main appendicular artery. Some authors claim that it arises solely from the ileocolic, while others claim that it comes off from one of the branches of the ileocolic artery (17). The majority of those authors who have noted the presence of accessory appendicular arteries claim that these arteries invariably arise from the anterior or posterior caecal artery and cause significant intra-op as well as post-op bleeding (18). The systematization of the vascularization of the appendix differs according to the number and the type of arteries supplying it. The main appendicular artery is defined as one which runs in the crescentic fold of the mesoappendix to the tip of the appendix; and the accessory appendicular artery (from ileocolic artery or its branches) as one which supplies other parts of the appendix except the tip. In this study, the main artery was invariably the branch of ileocolic artery (80%), ileal artery (13.3%)

and posterior caecal artery (6.6%). We did not come across even a single artery that originated from anterior caecal artery. The main appendicular artery arises from inferior division of superior mesenteric artery in 46.88%, ileal branch 28.13%, ileocolic artery 18.75% and from arterial arcade in 6.25% of cases. 21.87% of cases showed additional appendicular artery in a study by Hosmani (19).

In this study, appendix was supplied by a single appendicular artery in 87% of the cases, but accessory appendicular artery was also found to be present in the mesoappendix, and it was seen arising from various closely related arteries. In the African population (20), the incidence is totally in contrast, as there were 80% of cases showing the presence of an accessory appendicular artery, and in 20% of cases supplied only by single appendicular artery. In this present study, the incidence of double appendicular arteries supplying the appendix was about 13%. The same has been observed by Nirmaladevi as 10% (21) and Toriola as 9% (20) but not by Ashwini Balasaheb, which has been found as 40% (22). The accessory appendicular artery was seen to originate in contrast from the main branch, predominantly from posterior caecal artery than the ileocolic artery in our study as in concordance with Ajmani et.al (23), though we differ in that, there were no accessory arteries arising from anterior caecal artery. Solanke et al. (24) have cited that there were extensive arterial anastomoses between the arteries supplying the appendix. We differ and contradict this statement, as there were nil arterial anastomoses observed in the current study, confirming that each individual branch was its own end artery, confounding the risk of gangrene. The anastomotic pattern can really be studied by injecting a suitable dye and the pattern of distribution seen by radiological examination in the living, which is the further scope of this study.

CONCLUSION

Study of the mesoappendix gives a guide to the surgeons during appendectomy. The shorter the extent of the mesoappendix, the more risk of gangrenous complications. The main appendicular artery arose from ileocolic, posterior caecal and ileal arteries but not at all from the anterior caecal artery. Knowledge of the presence of accessory appendicular artery is of utmost importance to prevent hemorrhage during surgery, and 13% of the specimens had an accessory artery. The most common origin of the accessory appendicular artery was from the posterior caecal artery, followed by the ileocolic artery. This study, hence, gives more insight to the anatomical aspects of the mesoappendix and appendicular arterial pattern for surgeons.

Ethics Committee Approval: For this study, it is not necessary to have the ethical approval because this is a cadaveric surgery.

Peer-review: Externally peer-reviewed.

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ORİJİNAL ÇALIŞMA-ÖZET
Turk J Surg 2022; 38 (1): 55-59

Mezoapendiks ve apendiksin arteriyel yapısının kapsamlı bir çalışması

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ÖZET

Giriş ve Amaç: Mezoapendiksin uzunluğu ve yapısı enflamasyonun derecesinde, tümörün yayılmasında ve apendiksin cerrahi rezeksiyonu sırasında önemlidir. Farklı apendiküler arter kökenleriyle birlikte aksesuar apendiküler arterin varlığı, intra ve postoperatif komplikasyonlara neden olabilir. Bu nedenle mezoapendiksin uzunluğu ve apendiksin arteriyel beslenmesinin kökeni ve dallanma modeli üzerine çalışma yapılmıştır.

Gereç ve Yöntem: Altmış formalinle sabitlenmiş apendiks örneği, sağlam mezoapendiks ile birlikte rezeke edildi ve ekin kapsamını, apendiküler arterlerin çıkışını ve ayrıca aksesuar dallarını analiz etmek için diseke edildi.

Bulgular: Yüzde 76 oranında tam boy mezoapendiks görüldü ve yarım boy mezoapendiks bulunamadı. Çalışma örneklerinin %80'inde ileokolik arterden çıkan ana apendiküler arter ve %13'ünde aksesuar apendiküler arter görüldü.

Sonuç: Mezoapendiks ve apendiküler arterin dallanma şekli kişiden kişiye değişir ve bu farkındalık apendiks ameliyatlarında faydalı olacaktır.

Anahtar Kelimeler: Apendiks, mezoapendiks, apendektomi, apendiküler arter

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ORIGINAL ARTICLE
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Expression of vascular endothelial growth factor in follicular cell-derived lesions of the thyroid: Is NIFTP benign or precancerous?

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ABSTRACT

Objective: Vascular endothelial growth factor (VEGF) is an angiogenic factor that plays an important role in physiological and pathological angiogenesis of the thyroid. The aim of the current study was to determine the expression characteristics of VEGF in follicular cell-derived lesions of the thyroid and to assess whether a new entity noninvasive follicular thyroid neoplasm with papillary-like nuclear features (NIFTP) is precancerous.

Material and Methods: Patients diagnosed with 33 follicular adenomas (FA), 41 invasive follicular variant papillary thyroid cancer (IN-FVPTC), and 40 NIFTP in surgical resection materials were evaluated retrospectively. Immunostaining was performed on 5-µm paraffin tissue sections. The percentages of immunostaing for VEGF were evaluated on pathological materials. We used a percentage of labeled thyrocytes score (0, no labeling; 1, <30%; 2, 31-60%; 3, >60%) and an intensity score (0, no staining; 1, weak; 2, intermediate; 3, strong). The sum of two scores were accepted as the total score.

Results: Mean ages of the FA, IN-FVPTC, and NIFTP groups were 44.7 ± 11.7 years, 46.9 ± 13.6 years, 43.2 ± 15.4 years, respectively and the mean VEGF immunostaining scores were 44.7 ± 29.3, 50.2 ± 32.54, 4 ± 26.3 respectively. Although there was no statistically significant difference (p= 0.347), the total score of the NIFTPs was higher than the scores of the FA (mean= 3.9 ± 1.8) and IN-FVPTC(mean= 4.3 ± 1.9) groups with a mean value of 4.6 ± 1.7. This result was remarkable. There was no statistically significant difference between tumor diameters and staining percentages (p= 0.750).

Conclusion: Even if there were no statistical differences for VEGF immunostaining, it was high in NIFTPs. Since we know the role of VEGF in tumorigenesis, we can hypothesize that NIPTP can be precancerous. Our argue should be corroborated by a large prospective study.

Keywords: VEGF, NIFTP, thyroid follicular lesions

INTRODUCTION

Thyroid neoplasms have different histological types and biological behaviors. Follicular adenoma (FA) and the follicular variant of papillary thyroid carcinoma (FVPTC) are follicular cell-derived lesions of the thyroid. Pathologic interpretation and definition of these lesions vary with increasing clinical experience, resulting in a decrease in the diagnosis of follicular adenoma while an increase is seen in the diagnosis of FVPTC (1). Noninvasive follicular thyroid neoplasm with papillary-like nuclear features (NIFTP) has recently become the main topic of conversation among these lesions. A follicular adenoma is a benign and mostly solitary tumor of the thyroid. Its incidence is 3-4.3% in autopsy series. It is a well-demarcated, encapsulated monoclonal lesion and does not display nuclear changes specific to invasion or papillary thyroid cancer (PTC) like follicular cancer (2). However, it is not exactly known whether some follicular nodules defined as adenomas will be precancerous. It has been shown that some of these lesions can undergo clonal proliferation and carry molecular changes in follicular cell-derived cancers (2). Moreover, a large number of aneuploid cells have been identified in these lesions. In light of this information, there is still an ongoing debate on whether follicular adenoma may be precancerous (2,3). FVPTC is the second most prevalent subtype of PTC, accounting for 10-25% of papillary thyroid carcinomas. According to Tallini's latest update, FVPTC is classified into three subtypes:

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1. Infiltrative (non-encapsulated) FVPTC: Infiltrative tumor with partial or absent tumor capsule. It is similar to classical PTC with its focal papillary structure and extrathyroidal extension and lymph node metastasis (LNM).

2. Non-invasive encapsulated follicular variant of PTC: It is well-demarcated, partially or completely encapsulated, non-invasive, indolent and carries RAS mutation.

3. Invasive encapsulated FVPTC (IN-FVPTC): It has features of capsular, vascular, intrathyroidal invasion. It can metastasize via hematogenous route and carries RAS mutation (4). Of these, noninvasive encapsulated FVPTC has a very good clinic course and prognosis. Nikiforov et al. have evaluated this remarkable feature by retrospectively reviewing 109 patients. While there was no recurrence, metastasis or death in the follow-up of these cases, they were seen in a small number of patients with invasive FVPTC. As a result of the analysis based on their own results and literature data, they have proposed the use of the name 'noninvasive follicular thyroid neoplasm with papillary-like nuclear features' instead of noninvasive encapsulated FVPTC. They have emphasized that the disappearance of the term 'cancer' would thus have clinically and psychologically positive consequences (5,6). However, the definition of 'less than 1% papillae' criterion was changed to 'no well-formed papillae' in 2018 upon need (7). Angiogenesis is effective in many physiological processes and plays a role in pathological conditions such as wound healing, tumor development, and inflammation. Many molecules such as growth factors, cytokines, prostaglandins are among the angiogenic factors. Vascular endothelial growth factor (VEGF) is an angiogenic factor that has a potent effect on angiogenesis. VEGF is a 45kD glycoprotein from the platelet-derived growth factor (PDGF) family, which is secreted from many cells. It was first described as a vascular permeability factor by Senger in 1983 (8,9). VEGF induces and increases angiogenesis/vasculogenesis, vascular permeability, endothelial cell (EC) proliferation, migration, and adhesion of leukocytes. Angiogenesis plays a central role in the development and function of thyroid follicular cells, and in the pathogenesis of benign and malignant diseases of the thyroid (10). Thyroid cancer cells have high mitotic activities and intensely contain VEGF mRNA and protein (11,12). During the malignant transformation process, events such as hypoxia and Ras-activated signal transduction pathway have been shown to regulate VEGF expression (13). Hypoxia is one of the most effective stimuli that initiate angiogenesis by inducing the production of VEGF and its receptors. The expression of VEGF increases in the hypoxic tumoral environment and neovascularization develops (14). The VEGF family consists of A, B, C, D, E forms (15). Of these, VEGF-A is one of the most potent growth factors. It plays a role in physiological vascular growth and pathological angiogenesis, and also modulates tumor proliferation and metastasis process (16,17). There are a few studies that assess the importance of VEGF in only papillary thyroid cancer. As to the best of our knowledge, there are no other studies that compare VEGF immunostaining features of other lesions originating from follicular cells. There isn't any other study evaluating the features of VEGF in NIFTP specifically, whose pathologic significance is unclear. Our study is unique in this regard. We presented VEGF immunostaining features of lesions originating from follicular lesions like follicular adenoma, IN-FVPTC and NIFTP. For this purpose, we used VEGF A, which is a potent stimulant of angiogenesis. We aimed to establish the position of NIFTP regarding these VEGF expression features among these lesions.

MATERIAL and METHODS

A total of 114 consecutive patients who underwent thyroid surgery in our thyroid clinic between December 2016 and June 2020 were retrospectively evaluated. The patients were operated by the same thyroid surgery team. All preparations were evaluated by two experienced pathologists using the diagnostic criteria of WHO Classification (4th edition) (18). According to this classification; encapsulated, non-invasive neoplasms consisting of thyroid follicular cells that do not contain the nuclear features of papillary thyroid carcinoma were diagnosed as follicular adenoma. The diagnosis of NIFTP was based on the revised criteria (7). Primary criteria;

1. Encapulation or clear demarcation,
2. Follicular growth pattern with all of the following no well-formed papillae, no psammoma bodies, <30% solid, trabecular, or insular growth pattern,
3. Nuclear features of papillary carcinoma (i.e. nuclear score of 2-3),
4. No lympho-vascular or capsular invasion,
5. No tumor necrosis or high mitotic activity (<3 mitoses per 10 high-power fields). Secondary criteria;

1. Lack of BRAFV600E mutation detected by molecular assays or immunohistochemistry

2. Lack of BRAFV600E-like mutations or other high-risk mutations (TERT, TP53). Molecular studies were not performed on any of the cases. The tumor which was consisted of follicular structures containing nuclear features of papillary carcinoma but showed infiltration or invasion was diagnosed as follicular variant papillary carcinoma.

Immunohistochemistry (IHC): Formalin-fixed-paraffin-embedded tissue blocks of the cases were sectioned into 3 µm and placed at positively charged slides. After deparaffinization, antigen retrieval was performed. VEGF (Clone VG1, Thermo Fisher Scientific, Fremont, USA) antibody was studied on the Ventana staining platform automated with the Ventana Benchmark Ultra OptiView Universal DAB kit (Ventana Medical Systems, Inc, Tuscon, Ariz). All steps were done using standard and validat-

ed immunohistochemical protocols. Positive control was used for each preparation. All slides were analyzed and evaluated the percentage of immunostaining. They were analyzed under a microscope (Olympus CX41) with 400× magnifications and scored using a semi-quantitative scoring based on the proportion score. The proportion score is the estimation of the proportion of the positive cells within the tissue on the entire slide. The VEGF immunoreactivity was always confined to the cytoplasm of epithelial cells.When interpreting VEGF immunostaining, we modified the assessments used in previous studies (11). We evaluated the immunohistochemical staining of VEGF in thyrocytes using two different scorings. In the first one, the staining intensity score was ranked as 0: no staining; 1: weak; 2: intermediate; 3: strong, and in the other was percentage of labeled thyrocytes score, as 1= <%30; 2: 30-60%; 3: >60%. We used the sum of these as the total score, ranging from 0-6.

This study was conducted in accordance with the Declaration of Helsinki. Ethics Committee Approval was obtained for this study (Acıbadem University, Faculty of Medicine's Ethics Committee; 31.12.2020/Report no: 2020-27/06)

Statistical Analysis

Statistical analysis was performed using SPSS. Continuous data were expressed as mean ± SD, and categorical variables were expressed as percentages. Mann-Whitney U test was used to compare the nonparametric data of the two groups. Relationships among the categorical variables were investigated by the Chi-square test. Spearman's correlation tests were used to measure the degree of association between variables. P values less than 0.05 were considered as statistically significant.

RESULTS

We evaluated 33 follicular adenomas, 41 IN-FVPTC, and 40 NIFTP thyroidectomy specimens. Mean ages of the FA group, IN-FVPTC group, and NIFTP group were 44.7 ± 11.7 years, 46.9 ± 13.6 years, and 43.2 ± 15.4 years, respectively, and similar among the groups. Sex (female to male) distributions were 25/8, 29/12, and 25/15 in the FA, IN-FVPTC, NIFTP groups, respectively (Table 1). Given the VEGF immunohistochemical staining scores, mean scores did not differ significantly among the groups in terms of both intensity and percentage (Table 2). However, although there was no statistically significant difference, the total VEGF immunohistochemical staining score of the NIFTP group was higher than the scores of the FA (mean= 3.9 ± 1.8) and IN-FVPTC (mean= 4.3 ± 1.9) groups with a mean value of 4.6 ± 1.7, which was notable. When the FA, IN-FVPTC, and NIFTP groups were evaluated separately, there was no statistically significant difference between the tumor diameters (22.7 ± 13.9, 16.9 ± 9.6, 20.2

Table 1. Descriptive features of patients for folliculer adenoma (FA), invasive follicular variant thyroid papillary carcinoma (IN-FVPTC) and noninvasive follicular thyroid neoplasm with papillary-like nuclear features (NIFTP)

	FA (n= 33)	IN-FVPTC (n= 41)	NIFTP (n= 40)	p
Female/Male	25/8	29/12	25/15	
Mean age ± SD*	44.7 ± 11.7	46.9 ± 13.6	43.2 ± 15.4	0.480
Mean tumor size ± SD	22.7 ± 13.9	16.9 ± 9.6	20.2 ± 12.4	0.125

*SD: Standard deviation.

Table 2. The expression characteristics of VEGF in all groups

	FA n %	IN-FVPTC n %	NIFTP n %	P
VEGF staining*				
0 (No staining)	4 12.1	3 7.3	2 5.0	
1 (Weak)	8 24.2	12 29.3	9 22.5	0.604
2 (Intermediate)	6 18.2	3 7.3	4 10.0	
3 (Strong)	15 45.5	23 56.1	25 62.5	
VEGF staining count (%)**				
<%30	10 30.3	12 29.2	8 20.0	
%30-60	13 39.4	9 22.0	12 30.0	0.313
>%60	10 30.3	20 48.8	20 50.0	
Scoring 1 (mean ± SD)	2.0 ± 0.8	2.2 ± 0.9	2.3 ± 0.8	0.269
Scoring 2 (mean ± SD)	1.9 ± 1.1	2.1 ± 1.1	2.3 ± 1.0	0.383
The sum of scores (mean ± SD)	3.9 ± 1.8	4.3 ± 1.9	4.6 ± 1.7	0.231

*Scoring 1: An intensity score.
**Scoring 2: A percentage of labeled thyrocytes score.

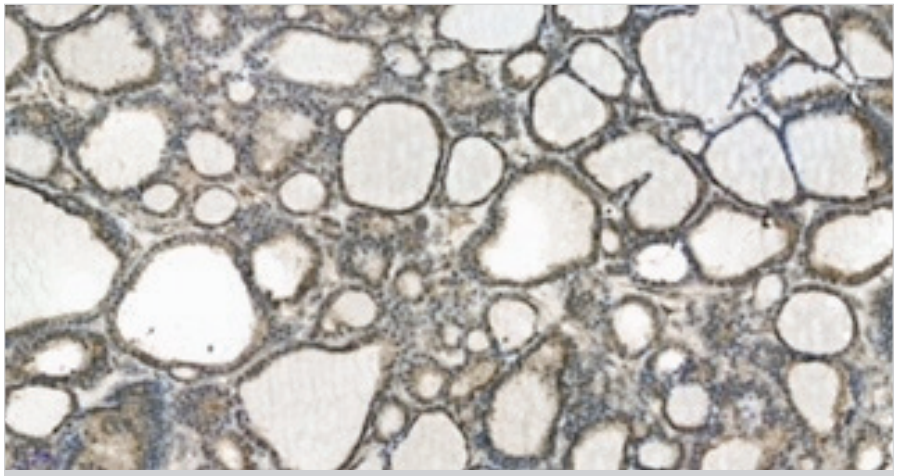

Figure 1. Strong expression of VEGF in cytoplasm of thyrocytes in NIFTP. Tumour cell staining 80%.

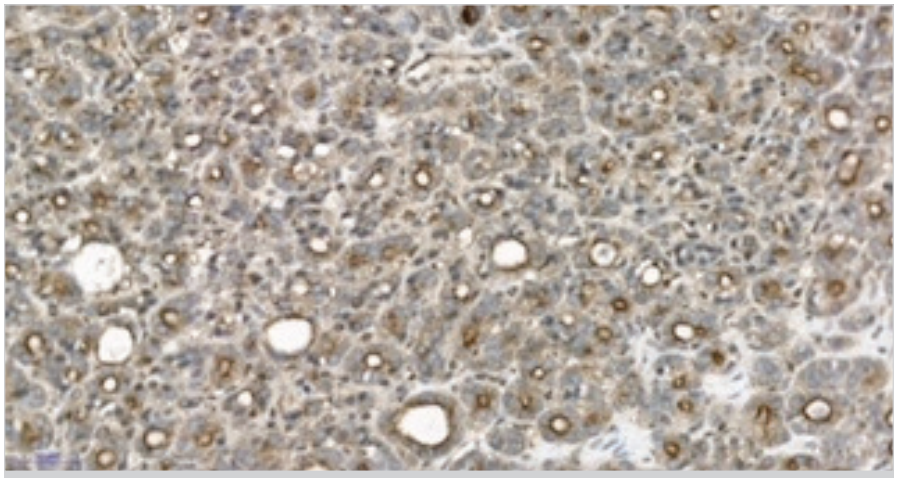

Figure 2. Strong expression of VEGF in cytoplasm of thyrocytes in FA. Tumour cell staining 80%.

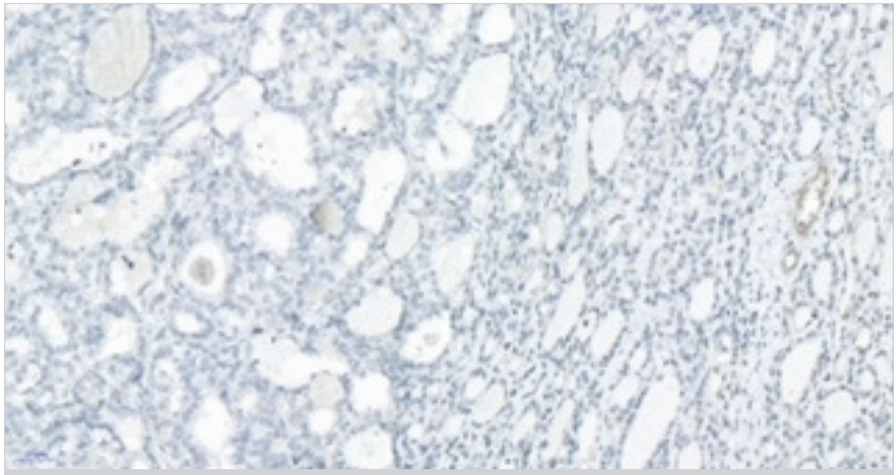

Figure 3. No expression of VEGF in NIFTP with positive internal control.

± 12.4, respectively) and the staining percentages. When evaluated based on tumor diameter regardless of the subgroup, mean percentage of VEGF immunohistochemical staining was 48.75 ± 29.46 in those with a tumor diameter of ≤10 mm and was 50.67 ± 29.92 in those with a tumor diameter of >10. Large tumors displayed more immunohistochemical staining, but this difference was not statistically significant. (p= 0.750).

DISCUSSION

Since the definition of NIFTP, the debates on its diagnosis, clinical behavior, treatment, and follow-up continue. As a matter of fact, the discussion of its papillary structure, BRAF V600E mutation and the presence of LNM in studies conducted after 2016 has led to a revision (7). Activating mutations of the RAS gene have been detected in 30-67% of NIFTP cases, which is one of the reasons that keep the debate on whether NIFTP may be a precursor lesion of invasive FVPTC alive. There is a hypothesis that NIFTP is actually a precursor lesion for cancer, and transformation occurs when it reaches a suitable size (19-22). It is known that a cytologically benign lesion has a very low probability of transforming into thyroid cancer in a long period of time. However, the debates on whether follicular adenoma and NIFTP may be precancerous lesions remain on the agenda. In our study, we participated in the discussions from a different perspective by demonstrating the immunostaining characteristics of VEGF-A, a potent stimulator of angiogenesis, in these three lesions. The question of whether NIFTP could be a precancerous lesion emerged with the results of two studies. One of these is the study of Parente. Parente et al. have retrospectively evaluated 102 patients previously diagnosed with PTC with a mean follow-up period of 5.7 years (range 0-11 years) (23). Of these patients, 2.1% were identified with NIFTP. They have reported LNM in 5% and distant metastasis (lung) in 1% of these patients who were identified with NIFTP. In another study, Cho et al. have evaluated their cohorts consisting of 152 encapsulated FVPTCs according to the revised criteria and found a central LNM rate of 3% when they interpreted it as NIFTP (24). There are studies showing a correlation between the expression level of VEGF and the aggressiveness of the tumor. It has been suggested that an idea can be obtained about tumor behavior in advance, considering this (25). In their studies, Klein et al. have shown that the VEGF immunostaining score was higher in those with LNM and systemic metastases (26). On the other hand, in their study conducted this year, Ria et al. emphasized that the serum level of VEGF, one of the angiogenic markers, was preoperatively higher in patients with PTC than those with benign goiter, and that its postoperative level decreased (27). In our study, more than 70% of the patients in the FA, IN-FVPTC and NIFTP groups showed a high percentage of VEGF immunostaining (>30%) (Table 2). This intense staining was more significant in the NIFTP group, although it was not statistically significant. This result may support the hypothesis that NIFTP may be a precancerous lesion for PTC whom has been emphasized to show high VEGF expression in studies. With another comment, it can be suggested that VEGF increases neovascularization in the early stage of PTC (lesion stage defined as NIFTP today). We are of the opinion that the result we obtained in our study would be statistically significant when studied with a larger number of patients, yielding an answer to this question. In another study on the place of NIFTP in the development process of PTC, Giannini et al. have analyzed mRNA expression and evaluated the difference of NIFTP from FA and infiltrative FVPTC (IFVPTC) (22). In this study, samples were divided into two groups on the basis of FA and IFVPTC expression types, NIFTPs were equally distributed in these groups with their mRNA expression characteristics. Since RNA expression types were similar to those of FA in some of the NIFTPs, while others were similar to those of IFVPTC. They also performed mutation analysis for their patients with NIFTP and found mutations with low oncogenic potential. Interestingly, they identified BRAFV600E mutation in one patient. They interpreted that NIFTP could indeed be a precancerous lesion for IFVPTC or classical PTC, except that this could be a technical error. If BRAFV600E is detected again in future studies, the precancerous lesion option will surely come to the fore. Thus, if NIFTP lesion exhibiting mRNA expression and genetic heterogeneity carries BRAF, RAS or other mutations, it may be a precursor of IFVPTC or PTC, while those without mutation will be FA-like benign lesions. We thought that VEGF-A immunohistochemical staining characteristics observed among the groups in our study might have a similar meaning to the results of this study. There was a significant VEGF-A expression in all three groups, but the distribution characteristic in the NIFTP group made us interpret that it could turn into a benign or malignant characteristic. Another result that drew our attention in our study was that the VEGF immunohistochemical staining scores of follicular adenoma, which is considered a benign lesion, were not much lower than those of the other two lesions. Contrary to other studies, this may suggest that VEGF, hence angiogenesis, is not always sufficient to evaluate the aggressiveness of the tumor, as well as brings to mind the question of whether follicular adenoma is a precancerous lesion, which has been discussed for years (28). The answers to these questions will be found with the increase in studies in this respect.

In conclusion, we observed that the total VEGF immunohistochemical staining score was higher in the NIFTP group than in the FA and IN-FVPTC groups in our study. There is no current literature about VEGF expression of NIFTP. Our study is the first study in the literature analyzing malignancy potential of NIFTP with VEGF analysis. Therefore, we think that with this point of view, we contributed to the debates that NIFTP is not a benign lesion but a precancerous lesion for PTC. Studies with an in-

creased number of patients will give a better idea. There are no definitive recommendations for follow-up and treatment due to the question marks about NIFTP. The American Thyroid Association does not require but recommends follow-up with serum thyroglobulin and cervical ultrasound, especially for high-risk patients (6). We think that there is a need for a large series of patients with long-term follow-up for the diagnosis of NIFTP to reassure surgeons and endocrinologists in terms of the patient's clinical course and treatment. It would be an appropriate approach to be careful in the follow-up and treatment of NIFTP, which is thought to be a borderline RAS lineage tumor between follicular adenoma and invasive FVPTC since its definition.

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ORİJİNAL ÇALIŞMA-ÖZET
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Folikuler hücreden kaynaklanan tiroid neoplazilerinde 'Vascular Endothelial Growth Factor' ekspresyonu: NIFTP benign mi prekanseröz mü?

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ÖZET

Giriş ve Amaç: Vasküler endotelyal büyüme faktörü (VEGF) tiroidin fizyolojik ve patolojik anjiyogenezinde önemli rol oynar. Çalışmamızın amacı tiroidin folikuler hücre kaynaklı lezyonlarının VEGF ekspresyon özelliklerini belirleyerek papiller yapıda çekirdek özellikleri gösteren noninvaziv foliküler tiroit neoplazi (NIFTP) lezyonlarının prekanseröz olup olmadığını bu yolla değerlendirmek.

Gereç ve Yöntem: 33 folikuler adenom (FA), 41 invaziv folikuler varyant papiller tiroid kanseri ve 40 NIFTP tanısı olan hastanın tiroidektomi materyali retrospektif olarak değerlendirildi. 5-µm parafin kesitlerde VEGF immun boyama yapıldı. Belirlenen yüzdesel orana (boyanma yok; 0, %<30; 1, %31-60; 2, %>60; 3) ve boyanma yoğunluğuna göre (boyanma yok; 0, zayıf; 1 orta; 2, yoğun; 3) skorlama yapıldı. İki farklı skor kategorisinden total skor elde edildi.

Bulgular: FA, İN- FVPTK ve NIFTP gruplarında ortalama yaş sırasıyla 44,7 ± 11.7, 46,9 ± 13,6, 43,2 ± 15,4 yıldı. VEGF immun boyanma yüzdesi ise sırayla 44,7 ± 29,3, 50,2 ± 32, 54,4 ± 26,3 bulundu. İstatistiki olarak anlamlı olmasa da (p= 0,347) NIFTP grubunda total skor ortalama 4,6 ± 1,7 değeri ile FA (ort= 3,9 ± 1,8) ve İN-FVPTK (ort= 4,3 ± 1,9) daha yüksekti. Bu sonuç dikkat çekiciydi. Tümör çapları ile VEGF boyanma yüzdeleri arasında istatistiki anlamlılık yoktu.

Sonuç: İstatistiki anlamlılık olmasa da VEGF immun boyanma NIFTP lezyonlarda yüksek saptandı. VEGF'nin tümörogenezdeki rolü dikkate alındığında bu sonuç 'NIFTP lezyonlar papiller tiroid kanserinin öncüsü olabilir mi?' hipotezini desteklemektedir. Geniş kapsamlı çalışmalar yapılması NIFTP lezyonların patolojik yerini anlamada bu hipoteze katkı sağlayabilecektir.

Anahtar Kelimeler: VEGF, NIFTP, tiroidin folikuler lezyonları

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ORIGINAL ARTICLE
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Injury mechanisms and injury severity scores as determinants of urban terrorism-related thoracoabdominal injuries

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ABSTRACT

Objective: Improving the care of injuries resulting from terrorist attacks requires understanding injury mechanisms in armed conflicts. The aim of this study was to identify injury characteristics in military personnel with thoracoabdominal combat injuries resulting from terrorist attacks in urban settings.

Material and Methods: A retrospective study of military personnel with thoracoabdominal injuries who were referred to a tertiary center after treating and stabilizing at a primary healthcare organization due to terror-related injuries in various urban regions of Turkey between June 2015 and December 2016 was performed.

Results: A total of 70 patients were included in this study, of whom 87.1% were injured by explosives and 12.9% (n= 9) had gunshot wounds (GSWs). Mean injury severity score (ISS) was 21, blood transfusion amount was 3.7 units, and mortality rate was 8.5%. Patients injured by explosives had most commonly abdominal and extremity injuries (31.1%), whereas isolated abdominal injuries (55.6%) were observed among patients with GSWs. There were no significant differences between the mechanisms of injuries and the ISS, blood transfusion, and mortality (p= 0.635, p= 0.634, and p= 0.770, respectively). A significant correlation was observed between the ISS and transfusion amounts (r= 0.548, p< 0.001). Mortality was significantly higher in those with a high ISS and those undergoing massive blood transfusions (p= 0.004 and p< 0.001, respectively).

Conclusion: Explosive injuries, concomitant vascular injuries, high ISS, and the need for massive transfusions increased the mortality rate in urban combat injuries. To quickly identify high-risk patients and improve the care of injuries, it is essential to use predictive models or scoring systems.

Keywords: Combat injury, injury severity score, thoracoabdominal injury, terrorism, urban

INTRODUCTION

Urban warfare is combat that takes place in urban environments, such as towns and cities, and is mostly against terrorism threats. Urban combat is different from conventional warfare because of the presence of civilians and peculiar features related to the urbanized area, such as a three-dimensional environment, enhanced concealment for terrorists, limited fields of view, and spheres of engagement (surface, high-rise, and subsurface) (1). In many parts of the world, especially in the Middle East, combat injuries are ever-increasing due to ongoing regional wars, armed conflicts, and terrorist attacks. Thanks to technological advances, more complex and high-energy weapons have been developed that increase the severity of trauma, which ultimately results in a high number of fatal injuries (2).

Combat injuries, either due to gunshot or explosives, cause high rates of mortality and morbidity worldwide, as well as in Turkey. Recently, it has been shown that injuries caused by explosives are more common than gunshot wounds (GSWs) (3). In urban terrorism, an enemy or a sniper, usually concealed for an ambush, shoots a weapon or uses a booby-trapped improvised explosive device, which can increase the severity of injuries (4). Thus, combatants often have to fight at very close range, particularly in streets and buildings where they are confronted with machine guns and sniper fire. In the data reported by military trauma centers receiving survivors from Iraq and Afghanistan, the incidences of combat-related abdominal, thoracic, and extremity injuries have been reported to be about 11%, 6%, and 54%, respectively (5,6).

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Mortality in civilian and military trauma patients occurs mostly in the prehospital period; deaths can be reduced by increasing prehospital resuscitative care and taking protective and preventive measures. However, to a certain extent, the main cause of mortality in the-posthospital period has been suggested to be an insufficiency of hospital care services and trauma systems (7). Therefore, improving injury care resulting from terrorist attacks in urban areas requires an understanding of the mechanisms of the injury. The aims of this study were to describe injury characteristics of military personnel who had sustained thoracoabdominal injuries from terrorist attacks in urban settings.

MATERIAL and METHODS

Approval for this study was granted by the Ethics Committee of the University of Health Sciences with the registration number 17/22. The study was designed as an observational cross-sectional study and included 70 military personnel with abdominal or thoracoabdominal injuries. The patients were among the patients who were referred to Gulhane Training and Research Hospital, a tertiary healthcare organization (role 3 hospital), for further treatment. They were referred after they had been treated and stabilized at a primary healthcare organization due to terror-related injuries in various urban regions of Turkey between June 2015 and December 2016.

The patients' demographic details, mechanisms of injury, distribution of wounds by body region, total blood transfusions, and outcomes were obtained from the medical records. ISS is an anatomic scoring system that provides an overall score for patients with multiple injuries and is associated with trauma severity. It was calculated by identifying the patients' injured anatomical regions obtained by surgical records, physical examinations, and imaging findings. ISS is the sum of the squares of the highest abbreviated injury scale (AIS) code in each of the three most severely injured ISS body regions. The six body regions defined in the AIS are the head or neck; face; thorax; abdomen and pelvic contents; extremities, shoulder, and pelvic girdle; and external. ISS is categorized as minor to moderate (<16) and severe to very severe (≥16) (8).

The study group consisted of patients with major abdominopelvic organ injuries, or with accompanying thoracic and extremity injuries, which were followed up and treated in the general surgical intensive care unit. For this reason, since there were no patients with severe injuries from other anatomical regions (head/neck), these were not included in ISS calculation. The injury mechanism classifications were by penetrating injuries, such as those caused by GSW or explosives (improvised explosive devices, grenade, or shrapnel). No other blunt injury mechanisms were present except in the thoracic regions.

Data were analyzed using commercial computer software (SPSS ver. 14.0, SPSS Inc. Chicago, IL, USA). The resulting values are presented as mean ± standard deviation and percentages where suitable. Numerical data were analyzed using Student's t tests for normally distributed variables or Mann-Whitney U tests for non-normally distributed continuous variables. Categorical variables were compared with Chi-square tests and Fisher's exact tests, if necessary. Correlations between categorical data were investigated using Spearman correlation coefficients. A p value <0.05 was considered statistically significant.

RESULTS

Seventy patients were referred to our department with diagnoses of various thoracoabdominal injuries between June 2015 and December 2016. All patients were males and were mostly injured by explosives rather than GSWs. Mean ISS of the trauma patients was 21.0 ± 9.6. Two-thirds of the patients having multiple-organ injuries. More than half of the patients required blood transfusions with only a 15.7% requiring massive transfusions (>10 units). There were six deaths resulting from the injuries. Demographic, injury, and treatment data are presented in Table 1.

Patients injured by explosives had higher ISSs than those injured by gunshot; however, this was not statistically significant. Moreover, with regard to the mechanism of injury, there were no significant differences between the groups in terms of age, red blood cell transfusions, and mortality rates (Table 2). With regard to ISS, 44.3% of the patients suffered severe injuries. Table 3 details the distribution of ISS by blood transfusion amount, mechanism of injury, and outcome. Both mortality and blood transfusions of more than 10 units were significantly associated with an ISS≥ 16 (p= 0.011 and p= 0.004; respectively). In addition, a significant correlation was identified between the ISS and transfusion amounts (r= 0.548, p< 0.001). When patients were divided into groups based on blood transfusions, ISS for those who received blood was higher than for those who did not receive blood (31.0 ± 10.3 vs. 21.1 ± 7.6; p= 0.006). Mortality rate was significantly higher in patients in need of massive blood transfusions (p< 0.001) (Table 4).

Of the 11 patients who underwent massive blood transfusions, four (36.3%) were given blood transfusions in accordance with the massive transfusion protocol (MTP). No significant difference was found between MTP and mortality. Among all patients included in this study, three (4.2%) had abdominal vascular injuries and two of these resulted in death. Median ISS of the six deaths was 36 (25-41). Of the patients who died, five (83.3%) were injured by explosives and five (83.3%) had multiple organ injuries and underwent massive blood transfusions. Moreover, in 60% of those who underwent massive blood transfusions, the transfusions were carried out in accordance with MTP.

Table 1. Demographic and injury-specific data of the patients (n= 70)		
Variables		
Age, mean ± SD	31.9 ± 6.9	
Injury severity score, mean ± SD	21.0 ± 9.6	
Mechanism of injury, n (%)		
Explosive	61 (87.1)	
Gunshot	9 (12.9)	
Anatomical area of the injuries, n (%)	Explosive	Gunshot
Isolated abdomen	17 (27.9)	5 (55.6)
Abdominal and extremity	19 (31.1)	3 (33.3)
Thoracoabdominal	12 (19.7)	1 (11.1)
Thoracoabdominal and extremity	13 (21.3)	0 (0)
Injured organs, n (%)		
Single organ	23 (32.8)	
Multiple organ	47 (67.2)	
Abdominal organ injuries, n (%)	123	
Colon	36 (29.2)	
Small intestine	21 (17.1)	
Liver	18 (14.6)	
Spleen	12 (9.8)	
Kidney	7 (5.7)	
Gall bladder	6 (4.9)	
Vascular	3 (2.4)	
Others	20 (16.3)	
Thoracic injuries, n (%)	26	
Lung contusion/laceration requiring tube	13 (50.0)	
Diaphragm injury	6 (23.1)	
Multiple injuries	7 (26.9)	
Red blood cell transfusion (units), mean ± SD	3.7 ± 4.9	
Red blood cell transfusion, n (%)		
No transfusion	25 (35.7)	
1–10 units	34 (48.6)	
>10 units	11 (15.7)	
Mortality, n (%)	6 (8.5)	

Table 2. Comparison of the groups in terms of the mechanism of injury			
	Explosive (n= 61)	**Gunshot (n= 9)**	**P**
Age, mean ± SD	32.3 ± 6.9	29.8 ± 9.3	0.083
Injury severity score, mean ± SD	23.0 ± 12.5	20.5 ± 9.2	0.635
Red blood cell transfusion, n (%)			
No transfusion	23 (37.8)	2 (22.2)	0.634
1–10 units	29 (47.5)	5 (55.6)	
>10 units	9 (14.7)	2 (22.2)	
Mortality, n (%)	5 (8.1)	1 (11.1)	0.770

Table 3. Comparison of the groups in terms of injury severity scores (ISSs)

	ISS< 16 (n= 39)	ISS≥ 16 (n= 31)	P
Age, mean ± SD	31.8 ± 7.3	32.6 ± 6.4	0.785
Red blood cell transfusion, n (%)			
No transfusion	18 (46.2)	7 (22.6)	0.011
1–10 units	19 (48.7)	15 (48.4)	
>10 units	2 (5.1)	9 (29.0)	
Mechanism of injury, n (%)			
Explosive	34 (87.2)	27 (87.1)	0.991
Gunshot	5 (12.8)	4 (12.9)	
Mortality, n (%)	0 (0)	6 (19.3)	0.004

Table 4. Comparison of the groups in terms of blood transfusions

	1–10 units (n= 34)	>10 units (n= 11)	P
Age, mean ± SD	31.1 ± 6.5	30.7 ± 10.3	0.785
Injury severity score, mean ± SD	21.1 ± 7.6	31.0 ± 10.3	0.006
Mechanism of injury, n (%)			
Explosive	29 (85.3)	9 (81.8)	0.782
Gunshot	5 (14.7)	2 (18.2)	
Injured organs, n (%)			
Single organ	9 (26.5)	3 (27.3)	0.958
Multiple organs	25 (73.5)	8 (72.7)	
Concomitant vascular injury, n (%)	1 (2.9)	2 (18.2)	0.078
Mortality, n (%)	1 (2.9)	5 (45.4)	<0.001

DISCUSSION

The incidence of combat injuries related to regional armed conflicts and acts of terrorism is increasing in many regions of the world. In 2010, 32 wars or serious conflicts were reported worldwide, and since 2003, 80.000 to 110.000 people have been killed every year due to combat-related injuries under war conditions (9). Between June 2015 and December 2016, 750 wounded military personnel were transferred to our hospital due to terrorist-related injuries in urban areas in Turkey. This suggests that, given the strategic position of our country and the geography of where it is located, injuries related to terrorist acts have a particular importance.

The effects of civilian and military weapons are very different, and the resulting injuries can vary. Although most of the current research concerns injuries related to civilian weapons and sharp objects, our study only covers gunshot and explosive injuries caused by terrorist acts occurring in urban areas. Considering the military injury-producing mechanisms in urban settings in recent years, injuries caused by explosives are now at the forefront, followed by gunshot injuries (5,6). This corresponds to our findings in which almost 90% of injuries were the result of explosive devices. Research on combat injuries in wars and rural areas shows that GSWs are more common than explosive injuries (10). The frequency of multiple organ injuries in both mechanisms of injury, whether explosives or GSWs, is almost identical; however, in explosive injuries, extremity injuries are more common (11,12). Abdominal or thoracoabdominal injuries were also accompanied by extremity injuries in the patients in our study. For this reason, orthopedic and vascular surgeons, as well as the main surgical branches, should be present in trauma centers or hospital emergency departments closest to conflict zones.

Total mortality rates vary between 1.8-6.9% in studies investigating military cases (11,13). Our results had a slightly higher mortality rate of 8.5%. In this study, there was no significant difference between the mechanisms of injury and mortality rates. In a study related to post-hospital admissions, mortality due to explosive injuries was 72.5% and mortality due to GSWs was 25%, but most of these patients had brain injuries with low probabilities of survival (13). Mortality in those likely to survive was mostly caused by acute bleeding from truncal and peripheral extremities. Mortality is expected to be higher in high-speed GSWs and those injuries caused by strong blast effects. However, more than one shrapnel tends to strike the body in shrapnel injuries due to explosives. This leads to an increased

number of injured organs and extremity injuries throughout the body and explains why explosives increase mortality rates more than bullets.

Blood loss amounts and ISS come to the forefront in studies examining the factors affecting mortality in combat injuries (14). The terms trauma score and trauma severity have been used since 1971. The most widely used trauma scoring system for assessing patients with multiple traumas in recent years has been ISS (15). ISS was first developed by Baker et al. (8) from AIS. ISS is directly proportional to mortality, morbidity, length of hospitalization, and trauma severity, regardless of how the trauma occurred. In a post-hospital study, mainly on explosive injuries, ISSs in 27% of the patients were between 15 and 25, 51% of the patients were between 26 and 55, and 86% of the patients who died had an ISS greater than 16 (13). Similarly, median ISSs corresponding to explosive-related injuries have been reported to be greater than those corresponding to GSWs (16). In our study, the average ISS was 21.0 ± 9.6, and the mortality rate (19.3%) in explosive injuries, in which the ISSs were high (≥16), was significantly higher than in the patient group in which ISSs were smaller than 16. Median ISS of the six casualties resulting in death was considerably higher than the non-fatal casualties. The main disadvantage of the ISS is that it ignores areas other than those with the most severe injuries and other injuries in the same area. This may not offer a completely reliable outcome, especially for combat injuries that cause multiple injuries in a single body location (17,18). Nevertheless, ISS still plays an important role in combat injuries by offering the ability to make appropriate triage decisions, to distinguish high-risk patients, and to determine and shape treatment priorities. It has recently been suggested that the trauma and ISS (TRISS), the new ISS (NISS), and especially the military ISS (mISS) may predict mortality more effectively than the original ISS for complex combat injuries (18,19). Such data will help improve the quality of treatment and enhance clinical success.

One of the most significant causes of death after combat injuries is bleeding (20). Bleeding and coagulopathy are among the most common causes of death in patients admitted to hospital emergency departments due to trauma in the first 24 hours and are the cause of approximately 50% of deaths (10). Blood transfusions should be considered at an early stage in patients with hemorrhagic shock to prevent and correct the traumatic coagulopathy that occurs after combat injuries. Current military data show that about 25% of wounded personnel need blood transfusions, of which 4-8% undergo massive transfusions (21). However, in our study, blood transfusions were needed in almost two thirds of the patients, while massive transfusions were given to only 15.7% of patients. When compared to the rates cited in the literature, in urban combat injuries, the rate of blood transfusions was almost twice as high, while that of massive blood transfusions was nearly three times as high. Moreover, the mortality rates were significantly higher in patients who underwent massive blood transfusions, and ISSs were moderately correlated with the amount of blood given to the patients. In a study by Niles et al. (22), the authors reported that the incidences of early coagulopathy in transfused military personnel were 25-38%, which correlated with the ISS. In all type injuries, a high ISS and a high transfusion volume have been considered independent predictors of coagulopathy and increased mortality (18). In a study conducted to predict massive transfusion needs in combat casualties, the rate of massively transfused patients had significantly higher transfusion requirements, higher ISS, and greater in-hospital mortality rates than those not given massive transfusions (23). ISS cannot be used as a predictor of need for a massive blood transfusion during the prehospital period. Therefore, a useful model for massive transfusions in trauma settings must be based on information that is rapidly available, concrete, and simply applicable through physiologic and laboratory variable. Massive transfusion rates and aggressive resuscitations in American trauma Level I hospitals are higher than those in Level II hospitals where more seriously injured patients are treated. Although there is no difference between the blood and plasma products given at both levels, platelet use in Level II centers has been shown to be higher than that in Level I centers, and platelet administration has increased survival rates. It has also been shown that there is a difference in mortality rates between hospitals where massive transfusions occur and those that do not readily perform them (24).

The present study is subject to several limitations. First, most of the patients were hemodynamically stabilized to a certain extent by initially being treated in local hospitals in conflict zones, so there was no common transfusion strategy. Second, injury severities were evaluated anatomically with ISS; no other physiologic or anatomic scoring systems were used. However, the fact that the cases were monitored by a single surgical discipline is a strong aspect of our study.

In our study, the average amount of blood needed by patients due to urban combat injuries was almost four units, with over 60% of patients requiring a transfusion. Therefore, blood banks should be founded in trauma centers or those hospitals closest to the regions where conflicts occur, and blood banks should stock adequate amounts of blood and blood products. Previous research has shown that damage control or hemostatic resuscitation can reduce mortality rates from 38% to 20% in seriously injured patients who required due to massive transfusions (25). Thus, it is necessary to develop hemostatic techniques, such as freeze-dried plasma and novel topical/systemic agents, that can reduce the need for massive transfusions.

In conclusion, thoracoabdominal injuries due to urban combat are caused to a large extent by explosives. These injuries

are often accompanied by extremity injuries. In urban combat injuries, the need for blood transfusions has increased, regardless of the mechanism of injury (explosives or gunshot), and patients with higher ISS may require more transfusions. Explosive injuries, concomitant vascular injuries, high ISSs, and massive transfusion requirements were found to increase mortality. To reduce mortality in urban combat injuries, greater importance should be given to the prehospital period. High-risk patients with penetrating trauma in need of massive blood transfusions should be identified rapidly using predictive models, and bleeding should be stopped by performing damage control surgery as soon as possible.

Ethics Committee Approval: The ethical approval for this study was obtained from the Non-invasive Clinical Researches Ethics Committee of the University of Health Sciences (Date: 16.01.2018, Decision No: 17/22).

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ORİJİNAL ÇALIŞMA-ÖZET
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Kentsel terörizmde görülen torakoabdominal yaralanmaların belirleyicileri olarak yaralanma mekanizmaları ve yaralanma ciddiyeti skorları

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ÖZET

Giriş ve Amaç: Terörist saldırılardan kaynaklanan yaralanmaların bakımını iyileştirmek, silahlı çatışmalardaki yaralanma mekanizmalarının anlaşılmasını gerektirir. Bu çalışmanın amacı, kentsel ortamlarda terörist saldırı sonucu ortaya çıkan torakoabdominal savaş yaralanması olan askeri personeldeki yaralanma özelliklerini belirlemektir.

Gereç ve Yöntem: Haziran 2015-Aralık 2016 tarihleri arasında Türkiye'nin çeşitli kentsel bölgelerinde teröre bağlı yaralanmalar nedeniyle bir birinci basamak sağlık kuruluşunda tedavi ve stabilizasyonu sağlanarak üçüncü basamak bir merkeze sevk edilen torakoabdominal yaralanmalı askeri personelin retrospektif bir çalışması yapıldı.

Bulgular: Bu çalışmaya %87,1'i (n= 61) patlayıcılarla yaralanan ve %12,9'u (n= 9) ateşli silah yaralanması (ASY) olan toplam 70 hasta dahil edildi. Ortalama yaralanma ciddiyet skoru [injury severity score (ISS)] 21, kan transfüzyon miktarı 3,7 ünite ve ölüm oranı %8,5 idi. Patlayıcılarla yaralanan hastalarda en sık karın ve ekstremite yaralanmaları (%31,1) görülürken; ASY'li hastalarda izole karın yaralanmaları (%55,6) görüldü. Yaralanma mekanizmaları ile ISS, kan transfüzyonu ve mortalite arasında istatistiksel olarak anlamlı fark yoktu (sırasıyla p= 0,635, p= 0,634 ve p= 0,770). ISS ile transfüzyon miktarları arasında anlamlı bir korelasyon gözlendi (r= 0,548, p= 0,001). Ölüm oranı yüksek ISS olanlarda ve masif kan transfüzyonu yapılanlarda anlamlı olarak daha yüksekti (sırasıyla p= 0,004 ve p= 0,001).

Sonuç: Patlayıcı yaralanmalar, eşlik eden vasküler yaralanmalar, yüksek ISS ve yoğun transfüzyon ihtiyacı, şehir içi savaş yaralanmalarında ölüm oranını arttırmıştır. Yüksek riskli hastaları hızlı bir şekilde belirlemek ve yaralanmaların bakımını iyileştirmek için öngörücü modelleri veya puanlama sistemlerini kullanmak önemlidir.

Anahtar Kelimeler: Kentsel, savaş yaralanması, terörizm, torakoabdominal yaralanma, yaralanma ciddiyet skoru

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ORIGINAL ARTICLE
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Knowledge survey regarding blast wound education of student doctors at a local academic medical university in Japan

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ABSTRACT

Objective: To improve knowledge about blast injury for medical student doctors or surgeons. In the modern uncertain era, education and training programs for blast injuries for medical student doctors or surgeons are recently necessary worldwide.

Material and Methods: To understand primary corresponding ability to treat blast injuries, leading to improvement of the trauma education curriculum, a retrospective study by a knowledge survey was performed between 2018 and 2019. The subject had the title of Student Doctor (SD) at university.

Results: The answers of 183 participants who answered the interview questionnaire with 16 questions were summarized. Although most SDs received basic lectures for trauma medicine and majority of SDs knew about mass casualty incidents and primary treatment, the existence of knowledge on soft targets is limited. One-fourth of the SDs knew the characteristics of blast wounds. Most SDs understood priority triage for a conscious person with massive bleeding from a limb with hemostasis to save lives. The 17% selected cardiopulmonary resuscitation first and 72% of SDs could explain hemorrhagic shock; however, only four could explain adequate hemostatic procedures. Most had no interest regarding necessity of their knowledge in the field of serious blast trauma wounds.

Conclusion: Experience in trauma surgery training from stages in SDs and authorized education are important for raising students' knowledge of unexpected serious blast incidents.

Keywords: Surgical education, medical university, student doctors, blast surgery, trauma team

INTRODUCTION

Trauma surgery used to be a common specialization for medical physicians worldwide. However, such an education by a point of surgery seems to be generally neglected in Japan because of few experiences and opportunities after World War II (1), resulting in a significantly low level of awareness or knowledge among general surgeons. Recently, indiscriminate blast injuries occurred as a result of the Boston bombing in 2013 (2), the Las Vegas shooting in 2017 (3) and the Lebanon explosion in 2020 (https://www.facs.org/International/webinar/mass-casualty-management) (4). Urgent primary treatments for wounds by citizens or emergency room (ER) departments seem to be well recognized from primary education among ordinary people in many countries (https://www.stopthebleed.org/) (5). However, in Japan, usually only classical resuscitation or defibrillator training is still performed, even in medical teaching institutes. Globalization and government inbound policies in the last decade have resulted in an increase in foreign visitors, information and industrial equipment. It is speculated that unexpected or unusual accidents have occurred in Japan.

For the faculty lecturers of medical universities, a high degree of basic education for medical students who have the title of student doctor (SD) after clinical examinations is necessary during lectures on clinical practice before internships. Not only ER specialists but also trauma surgeons must establish practically useful curricula in the near future, even in local or regional universities, because our city, Miyazaki, has many special sports facilities and some military bases and was designated

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an expected tsunami hazard area after the expected Nankai megathrust earthquake (6). Furthermore, even in Japan, there were approximately 380 cases of terror attacks between 1990 and 2010. Although mass injuries were rare, recognition in Japanese citizens seems to be less common (7). We hypothesize that efforts for such a specific education may lead to the recruitment of trauma surgeons and the improvement of the clinical ability of general physicians in case of a crisis. Some special attractive programs initiated in the last decade still seek to improve the recruitment system of physicians from rural areas of Japan (8,9). Thus, education on trauma surgery will be included in the recent program under the development of the macrochair system of the Department of Surgery at the University of Miyazaki Faculty of Medicine since 2015 (http://www.med.miyazaki-u.ac.jp/home/english/departments/surgery/) (8).

Considering this situation, we first surveyed the knowledge and awareness of 183 recent SDs in the present study to complete the effective teaching and training education model in next step. To show our pilot effort, the outcomes of this program were preliminarily analyzed.

MATERIAL and METHODS

The present survey was conducted between October 2018 and December 2019. The questionnaire participants included 183 curriculum Phase I (equivalent to 4th-year grade, n= 129) and Phase II (equivalent to 5th-year grade, n= 54) medical students who had a title of SD after completing the Japan medical common achievement examinations such as the national computer-based test and the objective structured clinical examination at the University of Miyazaki Faculty of Medicine. The teaching staff included several experienced trauma team surgeons from the thoracic, cardiovascular and digestive groups from the Department of Surgery. After institutional ethical approval was obtained (acceptance number #C-0049, 2018), documents for permission regarding human subject protection for this survey and student' and instructors' agreement were obtained before the study.

The specific 16 questions related to interests regarding blast wound surgery were the following: Q1) sex; Q2) did or did not take a lecture regarding trauma surgery in the 4th grade; Q3) did or did not finish clinical practice in the ER department; Q4) did or did not take the nationwide Basic Life Support (BLS) lecture; Q5) knowledge regarding mass casualty incidents; Q6) which of the following is a mass casualty incident? (choices: a) derailment of an express train, b) indiscriminate shooting, c) large earthquake, d) indiscriminate bombing terror attack, and e) indiscriminate chemical weapon terror attack); Q7) knowledge regarding soft and hard targets in indiscriminate terror attacks; Q8) explanation of the characteristics in gunshot wounds and bomb wounds; Q9) the best selection of the SD in case encountering a gunshot or bomb wound accident (choices: a) capture the perpetrator, b) life-saving focusing on serious injured persons, c) ensuring your own safety and d) request support); Q10) the first treatment priority in a mass casualty incident with many injured persons (choices: a) an unconsciousness young girl not responding after many gunshot wounds to her chest after intubation, b) a middle-age male who had massive bleeding from a blast wound on a lower limb without pulsation of the radial artery, c) a disabled person who is speaking well and has stable vital conditions but difficulty walking due to contusions on limbs, and d) an elderly person with many abrasions who is able to walk autonomously); Q11) selection of the priority treatment for dismemberment by blast wounds (choices: a) resuscitation, b) hemostasis, c) infection prevention and d) collection of injured pieces); Q12) explanation of hemorrhagic shock; Q13) received a lecture on hemostasis after trauma; Q14) explanation of adequate hemostatic procedures in trauma patients; Q15) necessity of own knowledge regarding severe trauma injuries; and Q16) the method of using a combat application tourniquet.

Before training in hemostasis, we first gave a lecture on gunshot and blast injuries and terrorist attacks (Figure 1A). In this lecture, we did not only mention the pathophysiology and treatment of gunshot and blast injuries but also explained the initial response in the event of such an accident in more detail. Hemostasis training was performed using Stop the Bleed course materials (https://www.stopthebleed.org/). The first training step was to follow this manual and understand how to ensure personal safety and the ABCs of controlling bleeding in an emergency. The second step was basic hemostatic training using gauze pressure and wound packing. The third step was dry training of the Combat Application Tourniquet (CAT) method (Figures 1B-D). The rapid triage, repeated training and morals of surgeons were emphasized by the staff surgeons during these programs.

Training was started in curriculum phase I and II for SDs after the questionnaire and lecture. All phase I SDs performed surgical practices for four weeks in our department. During this period, students first performed basic surgical procedures such as surgical knot tying, sutures, and resuscitation in the field of trauma surgery. The curriculum phase II SDs who selected surgical programs practiced for 4 wk. and learned more actual clinical practices.

We conducted special wet laboratory training called the Miyazaki Advanced General Surgery of University "MANGOU" project in the vacation period by calling for participation. Trainees practiced suturing techniques using experimental use animal organs.

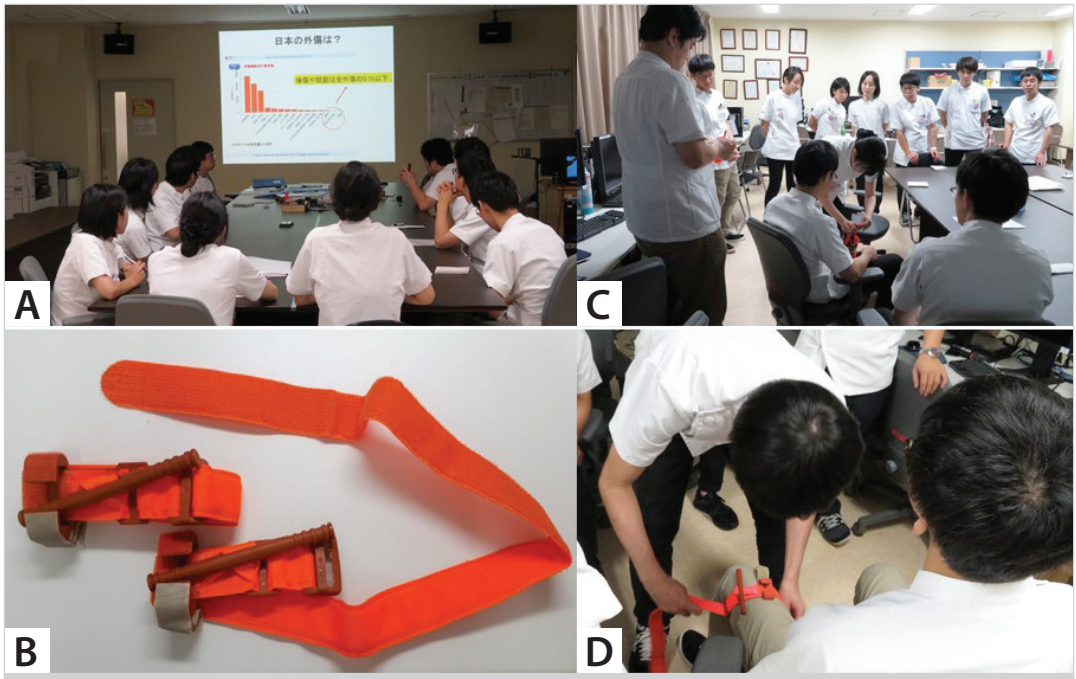

Figure 1. The specific lecture of blunt traumas **(A)** and hemostatic Combat Application Tourniquet (CAT). **(B)** Tourniquet installation and the method of use on a limb **(C-D)**.

RESULTS

The results and answers of the 183 participants who answered the interview questionnaire with 16 questions were summarized. Of the 183 participants, 118 (65%) were males and 65 (36%) were females. Figure 2 (Q2-Q4) shows the status of the lectures or practice regarding trauma surgery and emergencies. Although trauma surgery and BLS lectures were optional, most SDs received the basic lectures. As the clinical practice curricula in the departments of ER and surgery were built in the same period, 21% of SDs did not have prior ER experience. Figure 3 (Q5-Q7) shows the results of knowledge about mass casualty incidents (MCIs). Only half of SDs knew about MCIs, but the prevalence of selective queries seemed to recognize natural disasters, large-scale traffic disasters, and terrorism as MCIs. Furthermore, knowledge on the existence of soft targets in MCIs is hardly known among SDs.

Figure 4 (Q8-Q11) shows knowledge about gunshots or bombings, including the first action choice or the first treatment for injured persons. One-fourth of SDs knew a little about the characteristics of blast wounds, and the majority had no knowledge. In blast incidents, most selected securing their own lives, which was recognized as most SD understanding the important of self-defense in such a situation. Most SDs selected treating a conscious person with massive bleeding from a limb, and many selected the treatment option of hemostasis of the limb. However, 17% of SDs selected cardiopulmonary resuscitation.

Figure 5 (Q12-Q16) shows the results of knowledge regarding massive bleeding and hemostasis. Seventy-two percent of SDs could explain hemorrhagic shock while 28% could not. In fact, only 23% of SDs received specific lectures on hemostatic procedures in trauma. Therefore, only four could explain adequate hemostatic procedures and 61% of SDs were indifferent. Most

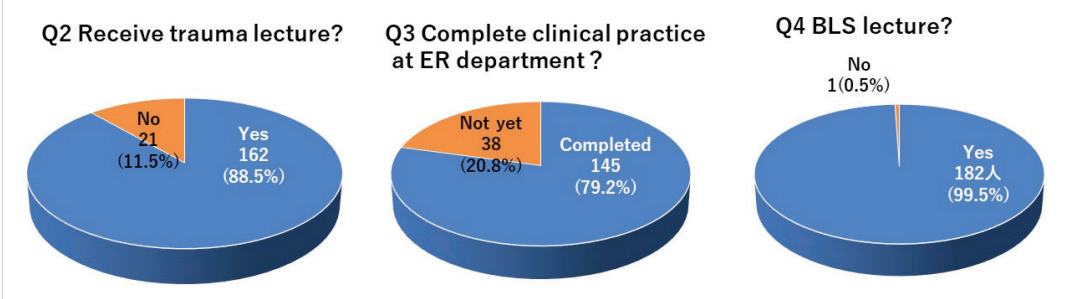

Figure 2. Questionnaire responses (Q2-Q4) by SDs regarding the experience of trauma lectures before clinical examination.

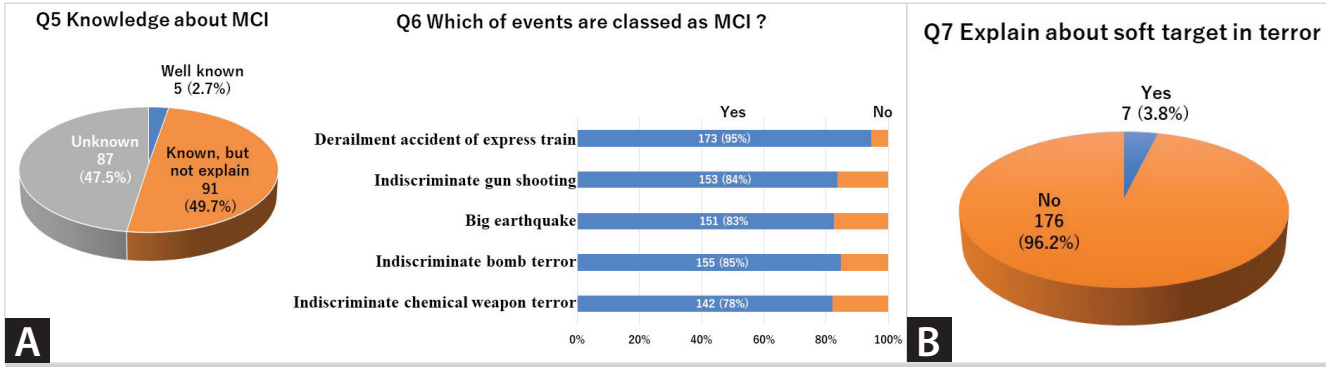

Figure 3. Questionnaire responses (Q5-Q7) by SDs regarding knowledge of mass-casualty incidents and their targets.

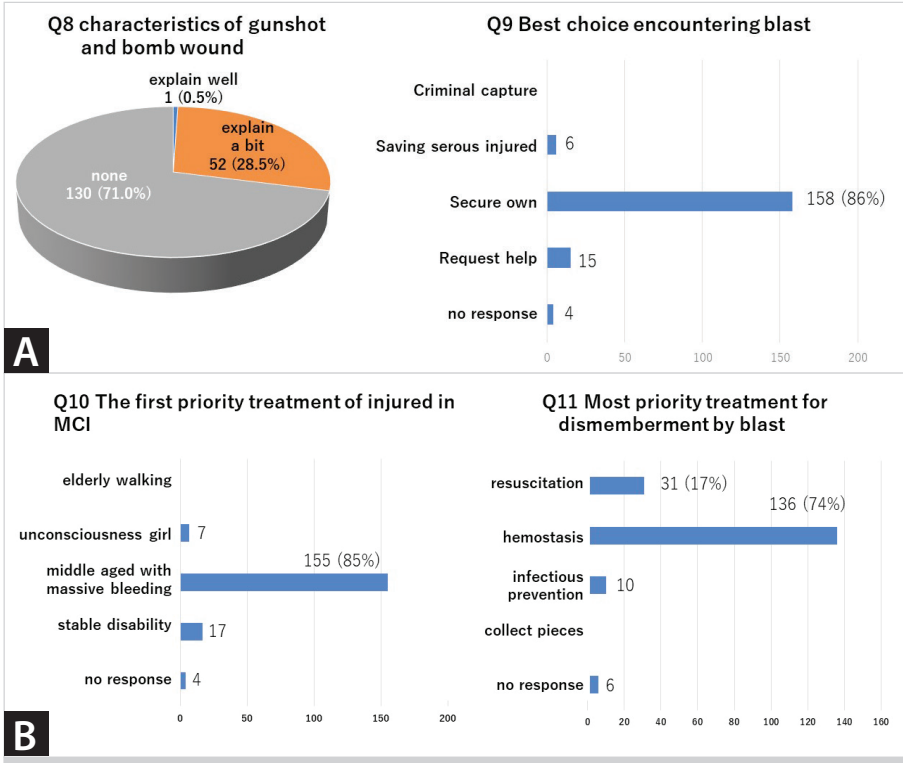

Figure 4. Questionnaire responses (Q8-Q11) by SDs regarding knowledge of gunshot and bomb wounds, primary treatment in blasts, and triage.

SDs had no interest in improving their own knowledge in the field of serious trauma injuries including blast wounds.

Approximately 20% of SDs know about hemostatic tourniquets and their use, which is well known in ordinary people worldwide. However, no SD could apply a tourniquet correctly in practical training and answer the presented questions.

DISCUSSION

Surgical education programs regarding trauma surgery have been increasingly reported worldwide in recent years (10,11). Adequate education, increasing the number of young surgeons, improving surgical techniques, and encouraging instructors among future generations may be beneficial for the field of surgery (12, 13). The importance of a systematic education system was not recognized in Japan two or three decades ago because the traditional apprentice system was used as the main method of education. As described above, most Japanese physicians are not currently concerned with MCIs; however, currently, explosives or guns can be purchased over the internet to conduct personal terror attacks in any region (https://www.start.umd.edu).

Surgical outcomes were monitored by our trauma team starting in 2012 at the time the department of emergency medicine began in our region, Miyazaki. The preventable trauma death

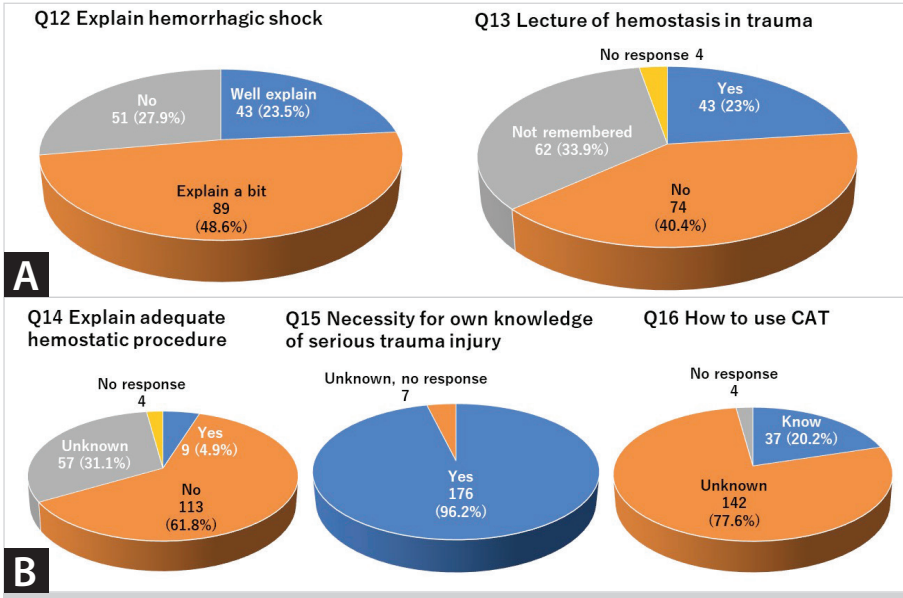

Figure 5. Questionnaire responses (Q12-Q16) by SDs regarding knowledge of massive bleeding by blast wounds and treatment strategy.

rate until 2019 was not dramatically decreased, but the organization and related awareness of surgeons regarding trauma surgery were gradually shaped by hard work (8). Some staff members can teach first-class instruction at the present. In fact, large disasters or mass casualties have not occurred previously, and traffic accident injuries are still the main cause of emergency operations. However, due to the globalization of tourism, our region and urban cities may also be influenced. Our land cannot maintain a single racial nation under the same culture as previous times. Based on experience with the 2019 Rugby World Cup and the planned 2020 Tokyo Olympic Games, our region is adequate for camp training; therefore, the possibility of worldwide terrorism or attacks is not low. However, the possibility of a disaster is always shared in the local media. In fact, however, awareness of blast injury incidents among young medical students, general surgeons and physicians is still low. Although we attempt to hold lectures on acute care surgery including trauma surgery, the rate of participation among all surgery curriculum is not high. Limited short lectures can be given to all medical students at this time.

Our 16 knowledge questions are not professional but seem to address popular topics among ordinary people from the United States government (14). Due to the classroom trauma, BLS and emergency medicine lectures before clinical examinations, the present results revealed that the knowledge, definition and concept of triage in mass-casualty incidents might be known among the majority of SDs. However, most SDs did not recognize an actual target of a blast injury in an MCI. A soft target in an MCI usually means private or civilian buildings or places in which an unspecified large number of people gather such as restaurants, hotels, halls, parks, roads, and etc. (15). Therefore, urgent medical treatments tend to be late for survivors who have serious wound injuries, and adequate primary treatment of the surrounding civilians is required to save lives. In the next step, physicians or co-medical persons tend to encounter primary medical care until an ER specialist or trauma surgeon treats patients. All doctors or co-medical staff have to possess basic knowledge and training including that on cardio-pulmonary resuscitation. This knowledge of complicated world affairs must be emphasized in preclinical lectures. It is very difficult to understand the mechanism of gunshot or bomb wounds for Japanese individuals because of their limited experiences; therefore, SDs' low interests are understandable. A few coauthors had some experience treating gunshot wounds and no experience treating bomb wounds in Japan. In 2020, the American College of Surgeons held a web seminar regarding blast injuries in Lebanon, which was very useful to understanding primary care and problems via the graphic video (https://www.facs.org/International/webinar/mass-casualty-management). The introduction of such an international webinar may provide more knowledge for many physicians. With respect to triage in MCIs, the present results showed that the understanding of SDs was almost satisfactory. As some SDs considered systemic resuscitation first in awake injured persons, triage in any case pattern should be discussed in lectures. SDs had already completed hemorrhagic shock in animal practice in the second and third year grades; however, one-third did not have adequate knowledge on it. As we do not have enough lesson time for general surgical remarks, a combined lecture with physiology is necessary to solve the time limits in the modern era of medical schools (8,9). To

understand the hemostatic procedures of blast surgery, dry laboratory training (16) or animal laboratories are now scheduled while in medical school at our institute. Defibrillators has been fully spread in our country, but few of hemostatic tourniquet installations have been established, although both installations had been already spread in the USA after the Boston terror attack in 2013 (17). At our institute, only the department of ER has established this system at the present. The latest webinar lecture by Dr. J. Doucet, US San Diego Health trauma surgery, is also important to know the latest system (https://www.youtube.com/watch?v=mhBe7Q6mH3U). The hemostatic tourniquet technique can be applied using a man's ratchet belt according to our idea.

The goal of the present study in our project MANGOU is to improve the knowledge and practical skills of young surgeons in general; however, it is too late to start when they select their specialty. Thus, it is important to begin training and education since medical students are in higher grades. The limitations of this study include a limited period of curriculum system of surgery, a lack of validation set analysis after the questionnaire and reevaluation of the instruction by the staff. Based on this pilot study, we will instruct actual dry and wet laboratory training, which was indicated in the latter of the results. In the next step, by implementing novel instruction, an additional questionnaire for both the fifth and sixth grade SDs and the internship doctors who answered these 16 questions will be scheduled.

CONCLUSION

We reported the results of our questionnaire survey on blast injuries for medical students with the title of student doctor conducted between 2018 and 2019. By providing classroom lectures before clinical examinations, primary treatment in mass casualty incidents was almost recognized. However, the problem of understanding rare blast wounds and knowledge of hemostatic procedures remained limited. To motivate students or internship doctors to become trauma surgeons, improved educational systems, including instruction in surgical techniques or international webinar lectures led by expert surgeons, are needed in order to prepare doctors for unexpected blast injuries from disasters or terror attacks, even in regional academic institutions.

Ethics Committee Approval: The ethical approval for this study was obtained from Local Ethics Committee (Date: 13.11.2017, Decision No: C-0049).

Peer-review: Externally peer-reviewed.

Author Contributions: Author Contributions: Concept - F.K.; Design - K.N.; Supervision - A.N.; Materials - S.M., K.T., M.I.; Data Collection and/or Processing - S.M., F.K.; Analysis and/or Interpretation - F.K.; Literature Search - A.N.; Writing Manuscript - F.K.; Critical Reviews - K.F.

Conflict of Interest: The authors declare that they have no conflict of interest.

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ORİJİNAL ÇALIŞMA-ÖZET
Turk J Surg 2022; 38 (1): 74-80

Japonya'daki yerel bir tıp fakültesinde doktor adaylarının patlamaya bağlı yaralanmalar hakkındaki bilgi düzeyleri üzerine bir anket çalışması

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ÖZET

Giriş ve Amaç: Bu çalışmanın amacı, tıp öğrencisi doktorların veya cerrahların patlama kaynaklı yaralanmalar hakkındaki bilgilerini geliştirmekti. Bu modern fakat belirsizliklerle dolu çağda, tıp fakültesi öğrencisi doktor adayları veya cerrahlar için patlamaya bağlı yaralanmalar üzerine eğitim ve öğretim programlarının yürütülmesi son zamanlarda dünya çapında gerekli hale gelmiştir.

Gereç ve Yöntem: Travma eğitimi müfredatının iyileştirilmesine sebep olan patlama kaynaklı yaralanmalarda birincil tedavi becerisini anlamak amacıyla 2018 ve 2019 yılları arasında bir bilgi anketi kullanılarak geriye dönük bir çalışma yapıldı. Çalışmanın katılımcılarının sahip olduğu unvan Doktor Adayı (DA) idi.

Bulgular: On altı sorudan oluşan anketi yanıtlayan 183 katılımcının cevapları özetlendi. DA'ların çoğunun travma tıbbı için temel dersler almasına ve çoğunluğunun kitle zayiatı ile sonuçlanan eylemler ve birincil tedavi hakkında bilgi sahibi olmasına rağmen, yumuşak hedefler hakkında bilginin varlığı sınırlıdır. DA'ların dörtte biri patlama kaynaklı yaralanmaların özelliklerini biliyordu. Çoğu DA, hayat kurtarmak için hemostazlı bir uzuvdan aşırı kanaması olan bilinci açık bir kişi için öncelikli triyajın ne olduğunu biliyordu. Yüzde 17'lik bir kesim ilk olarak kardiyopulmoner resüsitasyonu seçti ve %72'si hemorajik şokun açıklamasını yapabiliyordu; ancak, sadece dördü yeterli hemostatik prosedürleri açıklayabildi. Çoğu DA, ciddi patlama kaynaklı travmatik yaraların tedavisi ile ilgili bilgilerini artırmaya merak duymuyordu.

Sonuç: Tıp fakültesindeki eğitim aşamalarından travma cerrahisi eğitimi konusunda deneyim ve otoritelerden alınacak eğitimler, öğrencilerin beklenmedik ciddi patlama kaynaklı travmalar hakkındaki bilgilerini artırmak için önemlidir.

Anahtar Kelimeler: Cerrahi eğitim, tıp fakültesi, tıp öğrencisi doktorlar, patlamaya bağlı yaralanmalar, travma ekibi

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ORIGINAL ARTICLE
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Setting up a surgical complex gallstone service in a non-HPB unit

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ABSTRACT

Objective: Complex gallstone disease is associated with a higher risk of complication during laparoscopic cholecystectomy than biliary colic and simple cholecystitis. It is traditionally managed in a hepatopancreaticobiliary (HPB) unit where there is expertise for common bile duct exploration and repair. We developed a mentorship scheme for a busy upper gastro-intestinal (UGI) unit, with support from a specialist HPB unit to treat complex gallstone disease, to reduce the burden on the HPB unit and enable local treatment of patients.

Material and Methods: Through the creation of a service level agreement, the specialist HPB unit were commissioned to provide mentorship for two surgeons at a large UGI unit with an interest in providing a complex gallstone service to their local population. Eight sessions of mentored operating were supported, with the provision for additional support if complications occurred.

Results: There were 14 patients included in the mentorship phase of the programme from November 2015 to May 2017. Cholecystectomies were performed on patients with previously complex histories, which included: previous cholecystostomy; CBD stones and multiple ERCPs; suspected choledochoduodenal fistula; suspected cholecystoduodenal fistula; suspected Mirrizzi's syndrome; previous significant intra-abdominal operation; and significant medical co-morbidities. There was one post-operative complication requiring a return to theatre, and one minor wound infection associated with the complex gallstone lists.

Conclusion: We demonstrated a method to reduce the burden on specialist HPB unit for the operative management of complex gallstone disease and safely implement such a service at large UGI unit with an interest in providing a complex gallstone service.

Keywords: Complex gallstone disease, laparoscopic cholecystectomy, mentorship, hepatobiliary surgery

INTRODUCTION

Gallstone disease is common, being present in 10-20% of the adult population in Europe and the United States (1). Clinical manifestations of gallstone disease are also common, with 1-2% of adults becoming symptomatic from their gallstones within a year (2). Symptomatic gallstone disease represents a significant healthcare burden with 60.000 cholecystectomies performed in the UK in 2011 (3). However, not all cholecystectomies can be performed as straightforward day-case procedures as there is a considerable spectrum in gallstone disease and variation in the age and comorbidity profile of patients.

The UK population is ageing, and with this brings a patient population with increasing number and severity of comorbidities. Increasing age and co-morbidity can lead to repeated trials of conservative management, with patients developing increasingly complex gallstone disease, with for example: multiple attacks of cholecystitis; CBD stones with multiple ductal instrumentation procedures; gallbladder drainage procedures and gallbladder fistulation. With an increasingly aged and co-morbid population, treatment of gallstone disease carries a higher risk, with age, co-morbidity and multiple episodes of acute cholecystitis being independently associated with bile duct injury (4). Treatment of complex gallstone disease in these patients should therefore only be performed by appropriately trained surgeons.

Bile duct injuries during cholecystectomy have a significant impact on patient survival and quality of life. Patients who experience a bile duct injury during cholecystectomy are three times more likely to die within 10 years after cholecystectomy

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compared to non-injured patients (5). Patient's quality of life is also significantly negatively impacted following bile duct injury, with poorer mental and physical quality of life after major bile duct injury (6). Furthermore, bile duct injury is associated with significant litigation costs, varying from £2.500 to £216.000 in the UK, and $628.138 to $2.891.421 in the USA (6).

The normal pathway for patients with complex gallstone disease is referral to specialist hepatopancreaticobiliary (HPB) unit where there is expertise for common bile duct exploration and repair. The requirement for specialist HPB units to manage complex biliary disease can unnecessarily stretch resources in a system where cancer operations are a time- and resource-dependent priority. In addition to adding considerable operative burden to the HPB unit, it also underutilizes the skills of UGI surgeons in referring centers who also have extensive experience with gallstone disease.

To address these issues, a mentorship scheme was developed for a busy UGI unit, with support from the specialist HPB unit.

MATERIAL and METHODS

A complex gallstone service was set up through a service level agreement with a specialist HPB unit and a large UGI unit with an interest in providing this service to their local population. The HPB unit was commissioned to provide mentorship for two UGI surgeons locally at the UGI unit for eight sessions of mentored operating. The cases for inclusion in the mentorship phase of the programme were identified by the UGI unit as complex gallstone disease requiring operative management from the outpatient clinic environment. Two consultant surgeons at the UGI unit participated in the mentorship phase, acquiring skills to independently undertake complex gallstone operations by the end of the programme.

Requirements for the collaboration:

- HPB unit would provide a surgeon to support operating on complex gallstone disease for up to eight sessions (four days) per annum. This would equate to one day of operating every three months.
- The operating sessions would take place on the local UGI site.
- The patients would be identified by the local Upper GI consultants and remain under their care.
- A provision for emergency service by the HPB unit to support when unexpected complications arose at the local UGI site.
- An expectation that two local UGI surgeons can be signed off by the HPB unit to carry out this work independently after a suitable period of mentorship.

Patients were identified for inclusion on the complex gallstone lists if they fulfilled one of the following criteria:

- History of significant degree of gallbladder inflammation, such as multiple episodes of acute cholecystitis resulting in fistulation to adjacent organs or requiring intervention (cholecystostomy)
- Multiple ERCPs
- ERCP with incomplete ductal clearance

Patients were excluded if they had obvious Mirizzi's syndrome grade II-IV requiring biliary reconstruction (7).

Prior to each operating list, the UGI surgeons liaised with the HPB surgeons regarding case selection. On the day of surgery, an extended pre-operative briefing was performed with the UGI surgeon, HPB surgeon and theatre team, reviewing all investigations and discussion of operative strategy.

RESULTS

There were 14 patients identified with complex gallstone disease for inclusion in the mentorship phase of the programme from November 2015 to May 2017 (Table 1). These included eight females and six males, with a median age of 67 years (range 28-77 years). There were a range of indications for inclusion into the complex gallstone disease operating list, including: previous cholecystostomy (six cases); CBD stones and multiple ERCPs (six cases); suspected choledochoduodenal fistula (one case); suspected cholecystoduodenal fistula (one case); suspected Mirrizzi's syndrome (one case); previous significant intra-abdominal operation (four cases); and significant medical co-morbidities (six cases).

The median time from referral to operation was 18 months; however, in one case, the patient had waited 73 months for operative management by an appropriately qualified team (see case 1).

Nine operating sessions (over three operating lists) were mentored by two HPB surgeons during the collaboration. A range of procedures were undertaken, including: open cholecystectomy with CBD exploration (six cases); laparoscopic cholecystectomy (five cases); laparoscopic subtotal cholecystectomy (1); laparoscopic converted to open cholecystectomy and repair of choledochoduodenal fistula (one case); and laparoscopic converted to open cholecystectomy (one case). The indication for each patient, and operation performed are displayed in Table 1.

Post-operatively, one patient returned to the theatre with a bile leak from the gallbladder bed and a small bleed from a peripheral branch of middle hepatic vein in liver bed following open cholecystectomy and CBD exploration. With the support of the HPB unit consultant the patient underwent an emergency laparotomy for control of bile leak and bleeding and placement of T-tube. The patient was subsequently discharged from hospital without further complication. One further patient had a superficial wound infection following open cholecystectomy with

Table 1. Operation performed with respective indications for each patient

Case No.	Operation	Indication
1	Laparoscopic converted to open cholecystectomy	Acute cholecystitis complicated by liver abscess requiring percutaneous cholecystostomy, and drainage of liver abscesses. Previous gastric bypass.
2	Laparoscopic cholecystectomy	Gallbladder perforation and cholecystostomy.
3	Open cholecystectomy with CBD exploration and T-tube insertion	Cholangitis secondary to CBD stones. ERCP not possible due to previous subtotal gastrectomy (via rooftop incision). Previous PTCs. Alcohol-related cirrhosis.
4	Laparoscopic cholecystectomy	Recurrent gallbladder empyema and cholecystitis requiring cholecystostomy.
5	Laparoscopic converted to open cholecystectomy and repair of choledochoduodenal fistula	Emphysematous cholecystitis x 2 requiring cholecystostomy with choledochoduodenal fistula, suspicious calculi in CBD.
6	Laparoscopic cholecystectomy	40-year history of pain. Choledocystoduodenal fistula, previous abandoned lap chole by another surgeon.
7	Laparoscopic cholecystectomy	History of acute cholecystitis and gallbladder perforation requiring cholecystostomy. Previous laparotomy for suspected oesophageal perforation.
8	Open cholecystectomy with CBD exploration	5X ERCPs, impacted stones in CBD, CBD stone not amenable to ERCP removal.
9	Open cholecystectomy with CBD exploration	Pancreatitis. Known CBD stones, 3X ERCPs (duct presumed clear, normal LFTs).
10	Laparoscopic subtotal cholecystectomy	Empyema with cholecystostomy.
11	Open cholecystectomy with CBD exploration	Impacted CBD stone not amenable to ERCP removal (4X ERCP), stent in situ, previous PTC. History of acute cholecystitis.
12	Laparoscopic cholecystectomy	ERCP for CBD stone Possible Mirrizzi's on EUS.
13	Open cholecystectomy with CBD exploration	Gallstone pancreatitis. CBD stone not amenable to 2X ERCP removal. Biliary stent in situ. Cholecystitis, associated with portal vein thrombosis. Previous 2 laparotomies.
14	Open cholecystectomy with CBD exploration	12X ERCPs with incomplete ductal clearance and stent in situ.

CBD exploration and T-tube insertion and this was managed conservatively with antibiotics.

DISCUSSION

Developing local expertise in the operative management of complex gallstone disease though a mentorship-based service level agreement with a specialist HPB unit and a UGI unit is a pragmatic approach to improving patient care and NHS efficiency. We demonstrated that complex gallstone disease can be safely treated in non-HPB units through the creation of a mentorship scheme using a service level agreement with defined and achievable objectives. This is a financially viable option for the UGI and HPB units both for the mentoring phase, and in the future treatment of patients with complex gallstone disease. Not only does it increase the range of biliary procedures that can be delivered locally, but it also reduces the clinical burden of complex gallstone disease on specialist HPB units. This enables HPB units to concentrate more time and resources into cancer care, which is a top priority of the '*The NHS Five Year Forward View*', especially as cancer waiting time standards have not been met for several years (8). Furthermore, developing this service will in turn reduce waiting times in local centers for operative management of complex gallstone disease, and enable the delivery of local treatment for patients, a key NHS target.

Laparoscopic cholecystectomy is a potentially high-risk operation, with devastating outcomes in the presence of severe complication. Multiple episodes of acute cholecystitis, gallbladder drainage procedures, and bile duct instrumentation have been shown to increase the length of operation for laparoscopic cholecystectomy, conversion rate to open surgery and complication profile (9). Furthermore, the occurrence of extreme vasculobiliary injuries have been identified as being related to severe inflammation and fundus-first cholecystectomy (10). The recent '*Tokyo Guidelines 2018 Surgical Management of Acute Cholecystitis*' describes safe steps in laparoscopic cholecystectomy for acute cholecystitis through expert review and Delphi process. They recognize the potential difficulty of laparoscopic cholecystectomy in the setting of acute cholecystitis and describe strategies to prevent vasculobiliary injury and complica-

tions (11). Previously, Grade III (severe) acute cholecystitis was a contraindication to laparoscopic cholecystectomy in the acute setting, unless a gallbladder drainage procedure had been performed. However, in the 2018 guidelines it is propose[d] that '*some Grade III acute cholecystitis can be treated by laparoscopic cholecystectomy when performed at advanced centers with specialized surgeons experienced in this procedure and for patients that satisfy certain strict criteria related to favorable organ system failure and ASA score less than or equal to 2*' (12). This emphasizes the importance of a mentored programme whilst competence is acquired for the treatment of Grade III cases.

Complex gallstone disease represents a significant healthcare burden to the NHS. Bile duct injuries have significant impact on patient's quality of life and financial penalty through litigation to organisations. Furthermore, general surgeons have the highest risk of litigation following laparoscopic cholecystectomy compared to all other general surgery procedures in the UK (13). Treatment of complex gallstone disease is therefore a high-risk operation that should only be undertaken by appropriately trained surgeons.

This model for mentored local expertise development can be translated to other conditions with considerable waiting list with patients currently being referred to specialist centers for treatment. For example, in our unit, this model is now being used to develop laparoscopic day-case anti-reflux surgery in referring hospitals, sharing and developing expertise for local populations. This represents an innovation in service delivery that can be utilized for many different conditions.

CONCLUSION

Using a service level agreement with a specialized HPB unit, with appropriate mentorship, a complex gallstone service can be safely developed in referring hospitals, relieving operative burden from specialized HPB units.

Ethics Committee Approval: The current work was accessed by Medical Research Council (MRC) and Health Research Authority (HRA) tool (http://www.hra-decisiontools.org.uk/research/question1.html) and was deemed not to be clinical research but instead classified as a clinical audit of outcomes. I can confirm that the current work was registered and approved as an audit at University Hospitals Birmingham NHS Foundation Trust by the Governance/ Ethical committee (CARMS Ref. No: 16827).

Peer-review: Externally peer-reviewed.

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ORİJİNAL ÇALIŞMA-ÖZET
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HPB birimi olmayan bir ünitede kompleks safra kesesi taşı cerrahisi servisi kurmak

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ÖZET

Giriş ve Amaç: Kompleks safra kesesi taşı hastalığı, biliyer kolik ve basit kolesistite kıyasla laparoskopik kolesistektomi esnasında daha yüksek riske sahiptir. Genellikle, müşterek safra kanalı eksplorasyonu ve onarımında uzman hepatopankreatikobiliyer (HPB) cerrahi ünitelerinde tedavi edilir. Kompleks safra kesesi taşı hastalığını tedavi etmek, HPB ünitesinin üzerindeki yükü azaltmak ve hastaların lokal tedavi alabilmelerini sağlamak amacıyla uzman bir HPB ünitesinden destek alarak yoğun üst gastro-intestinal (UGI) ünitesi için bir mentorluk programı oluşturduk.

Gereç ve Yöntem: Servis seviyesinde bir anlaşmanın yapılmasıyla birlikte uzman HPB ünitesi, büyük bir UGI ünitesinden iki cerraha kendi hastalarına kompleks safra kesesi taşı hizmeti verebilmeleri amacıyla mentorlük görevi verildi. Mentor denetiminde sekiz cerrahi seans yapıldı ve komplikasyon oluşması durumunda ek destek sağlandı.

Bulgular: Kasım 2015-Mayıs 2017 arasında programın mentorluk safhasında toplam 14 hasta dahil edildi. Önceden kompleks öyküleri bulunan hastalara kolesistektomi uygulandı. Bu kompleks öyküler arasında önceden geçirilmiş kolesistektomi, müşterek safra kanalı taşları ve çoklu ERCP, şüpheli koledokoduodenal fistül, şüpheli kolesistoduodenal fistül, şüpheli Mirrizzi sendromu, önceden geçirilmiş ciddi intra-abdominal cerrahi ve ciddi tıbbi komorbiditeler vardı. Bir hastada, ameliyathaneye dönmeyi gerektiren post-operatif bir komplikasyon oluşurken bir hastada da kompleks safra kesesi taşları ile ilişkili minör yara enfeksiyonu görüldü.

Sonuç: Biz bu çalışmamızda, kompleks safra kesesi taşı hastalığının cerrahi yönetimi açısından uzman HPB ünitesindeki yükü azaltmak adına bir metot geliştirdik ve kompleks safra taşı cerrahisi servisini büyük bir UGI ünitesinde güvenle yürüttük.

Anahtar Kelimeler: Kompleks safra kesesi taşı hastalığı, laparoskopik kolesistektomi, mentorluk, hepatobiliyer cerrahi

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Smartphone applications (apps) in general surgical practice: An insight into their reliability and usefulness

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ABSTRACT

Objective: In today's day and age with the advent of smartphones along with the handy apps available for download, there is increasing opportunities for surgeons to integrate such technology into clinical practice with great ease. This study aims to provide a systematic classification of apps in order to provide dependable data for choosing the right app by both surgeons and trainees.

Material and Methods: A series of methodical searches were carried out on "Google Play Store" and "Apple's App Store" with pre-decided keywords. The results were then sorted and segregated into relevant categories like core surgery, apps related to surgical practice, patient utility apps and other surgical branches. Thereafter, the apps that met with our cut-offs, were assessed for their credibility and utility, based on predefined parameters.

Results: There were a lot of variations in between the categories we segregated the apps into. Using predefined cutoff criteria, (rating >3 and reviews >30), 48 of the apps were assessed finally for their utility and credibility. Out of these 48 apps, 42 were on android platform while the remaining 6 were on iOS. Ten apps were found to be having high credibility and 15 apps have high utility.

Conclusion: The role of smartphone apps in surgery and surgical training appears highly promising and using apps with high credibility and utility will provide dependable and updated information for the surgeons and trainees.

Keywords: Smartphone applications, surgical apps, surgical learning

INTRODUCTION

Technological advancements have always had a major impact in the medical field. The smartphone is a shining example. It is a ubiquitous and dynamic device and has a myriad of functions (1). Smartphones have the potential to enhance many aspects of the continuum of surgical care by not only providing a systematic and methodical means of communication amongst surgeons, healthcare workers and patients but also to conduct consultations (telemedicine), clinical learning, research and e-learning, medical referencing etc. to name a few (2). The ease of use of smartphone, it's easy accessibility, mobility and connectivity provides the potential to improve the quality of surgical care from pre-rehabilitation to rehabilitation stage (3). This article aimed to analyze different smartphone surgical applications (apps) available in the popular online application stores (app store) and to provide a systematic classification of apps in order to provide a dependable data for choosing the right app by both surgeons and trainees.

MATERIAL and METHODS

A systemic search of two most widely used smartphone app online store "Google Play Store" which runs on android operating system (OS) and "Apple App Store" which runs on Apple operating system (iOS) was done using the keywords "Surgery" or "Surgical" or "Operative Surgery" till July 2021. Cross search with suggested apps was also done for apps related to surgical practice which are not general surgical apps but are related to surgical practice and are being used by surgeons/residents frequently for clinical purpose. These apps were then categorized into 5 groups: core general surgery apps, apps related to surgical practice, patient utility apps, apps related to other surgical branches and irrelevant apps (or others). After

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Table 1. Parameters used for assessment of credibility

Parameters	Points
Rating	
>3	1
3.1-4	2
>4.1	3
Reviews (number)	
30-100	1
101-500	2
501-1000	3
>1000	4
Updates (number)	
None	0
≥2 years ago	1
≥1 years ago	2
1 per year	3
2 per year	4
>2 per year	5
Quality of content (assessed by the investigator)	1-5
Owner of app	
Single/multiple individual/company	1
Established institute/authorised body	3
Total score	20

Table 2. Parameters used for assessment of credibility

Parameters	Points
Rating	
>3	1
3.1-4	2
>4.1	3
Interface	
Difficult	1
Intermediate	2
Easy	3
Cost of app	
Paid	1
Free	2
In app purchase	
Yes	1
No	2
Quality of content (assessed by the investigator)	1-5
Downloads	
<10,000	1
10,001-50,000	2
50,001-1 lakh	3
>1 lakh	4
>10 lakh	5
Total score	20

Table 3. Divisions of credibility and utility based on total score

Total score (20)	Credibility and utility
<11	Low
12-15	Medium
>15	High

excluding 'apps related to other surgical branches' and 'irrelevant apps (or others)', remaining three categories of apps were sorted on the basis of ratings and reviews. Apps with rating >3 and ≥30 reviews were included in this study. Their utility and credibility were then assessed based on predefined criteria (Table 1,2). The scoring system took into consideration the ratings, reviews, app updates, developers' credibility and the quality of the app content to ascertain the credibility of an app. Utility of the app was adjudged based on its ratings, user interface, cost of app, in-app purchases, number of downloads and the quality of the app's content. The total score was 20 for both credibility and utility. Minimum score was four for credibility and six for utility. The apps were then categorized as low, moderate or high credibility and utility based on their total score (Table 3).

Utility: Utility was assessed for the usefulness of the app. It gives an objective assessment about how user friendly the app is.

Credibility: Credibility was assigned according to the authenticity of the app. An Institution/University/Association/Journal developing an app was given higher level of credibility as compared to individual owned or company owned apps.

RESULTS

The systemic search in "Google Play Store" and "Apple App Store" respectively resulted in a total of 667 hits till July 2021. Out of these 667 apps, 420 apps were on android platform and 247 were found on the iOS.

436 apps were excluded for its irrelevancy or repetitions. Sixty-seven apps (11.4%) related to other surgical branches were also excluded. Rest of 164 apps were assessed and categorized as core surgical apps, apps related to surgical practice and patient utility apps. One app belonging to core surgical app group was excluded to avoid conflict of interest with one of the authors (owner of the app). Among the 164 apps, 91 (55.48%) fell into core surgical apps, 62 (37.8%) were apps were related to surgical practice and 11 (6.7%) were patient utility apps.

Next, the apps were segregated based on their ratings and reviews. It was found that 116 apps had either <3-star rating or had <30 reviews (Figure 1). 48 of the remaining apps were assessed based on our pre-defined criteria to check their utility and credibility. Out of these 48 apps, 42 were on android platform while the remaining six were on iOS. Lack of important information required for assessment of iOS apps (number of downloads) led to exclusion of all six apps.

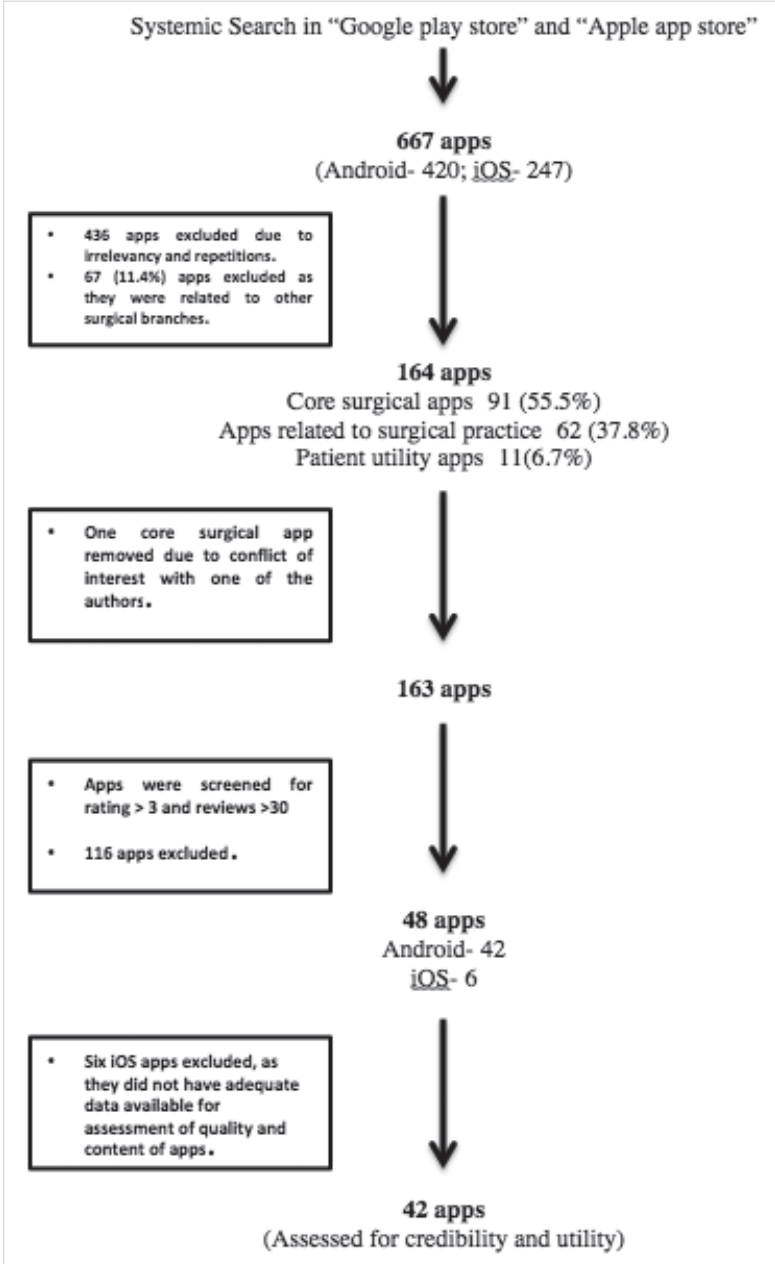

Figure 1. Flowchart showing the search methodology.

Finally, 42 apps were included in our study, which were assessed for their utility and credibility (Figures 2,3). It was found that 20 apps belonged to the core surgical group, and the rest 22 were related to apps for surgical practice group. Ten apps were found to be having high credibility and 15 apps have high utility (Table 4,5).

Core surgery apps: Out of the 20 core surgery apps, two apps were deemed highly credible, 10 were moderately credible and eight were low on credibility. Noteworthy apps like Touch Surgery has an amazing interface that allows its users to practice surgeries on anatomically accurate 2D and 3D models. This app also allows medical professionals from authorized countries to complete their surgical training modules and bag CPD (continuing professional development) credits. Other highly credible app was the NCCN Guidelines®, in oncology consist of recommendations for the prevention, diagnosis and management of malignancy across the continuum of care. These incorporate real-time updates in keeping with the rapid advancements in the field of cancer research and management. Few other remarkable apps in this category were the Tokyo Guidelines (TG18), SimuSurg and General Surgery Instruments. These were graded as moderate on credibility.

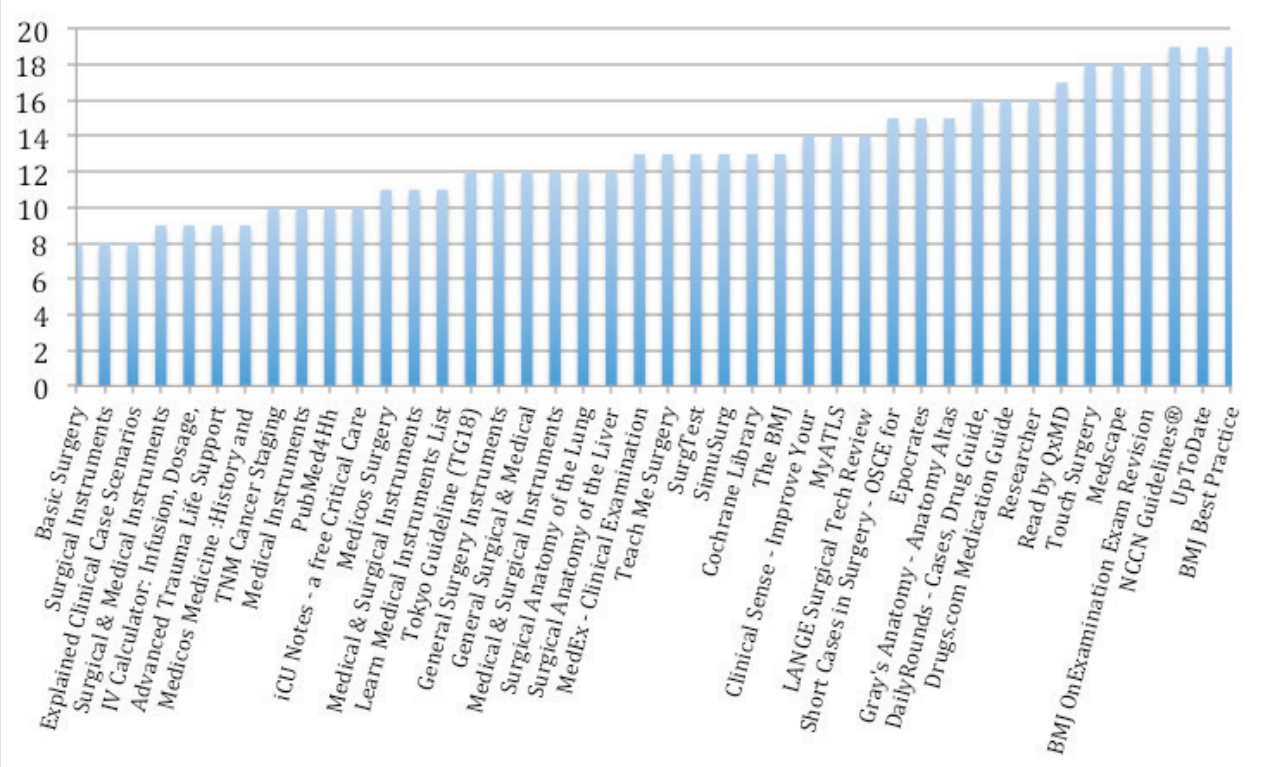

Figure 2. Bar diagram showing credibility score of surgical apps.

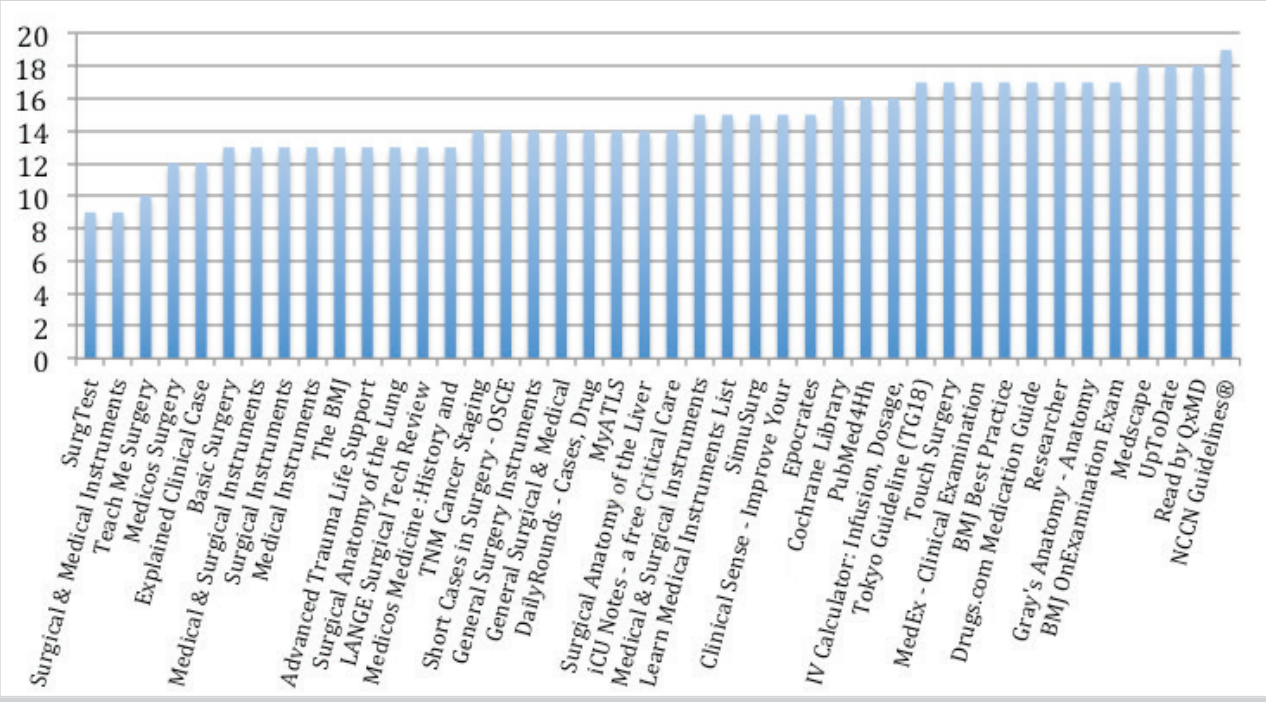

Figure 3. Bar diagram showing utility score of surgical apps.

Table 4. Credibility scoring and grading of the apps

S. No.	App Name	Developer	Credibility Score	Grade
1	Basic Surgery	Salina Akter	8	Low
2	Surgical Instruments	Koby Apps	8	Low
3	Explained Clinical Case Scenarios With Answers	Radioapps	8	Low
4	Surgical & Medical Instruments	Kadira Apps	9	Low
5	IV Calculator: Infusion, Dosage, Drug, Drip Rate	iMedical Apps	9	Low
6	Advanced Trauma Life Support	Current Clinical Strategies	9	Low
7	Medicos Medicine: History and Clinical Exam	Medicos	9	Low
8	TNM Cancer Staging	PGquest	10	Low
9	Medical Instruments	Alpesh Patel	10	Low
10	PubMed4Hh	NLM OHPCC	10	Low
11	iCU Notes-a free Critical Care Medicine	dev@doc-notes.com	10	Low
12	Medicos Surgery	Medicos	11	Low
13	Medical & Surgical Instruments Images & Uses	NassApp	11	Low
14	Learn Medical Instruments List	GIF Developer	11	Low
15	Tokyo Guideline (TG18)	株式会社C2 (C2, Inc.)	12	Medium
16	General Surgery Instruments	K.S.M. Studios	12	Medium
17	General Surgical & Medical Instruments-All in 1	First-rate-apps	12	Medium
18	Medical & Surgical Instruments	Dagana Apps	12	Medium
19	Surgical Anatomy of the Lung	Emory University	12	Medium
20	Surgical Anatomy of the Liver	Emory University	12	Medium
21	MedEx-Clinical Examination	Bharath Reddy	13	Medium
22	Teach Me Surgery	TeachMeSeries Ltd	13	Medium
23	SurgTest	SurgTest	13	Medium
24	SimuSurg	Royal Australasian College of Surgeons	13	Medium
25	Cochrane Library	The Cochrane Collaboration	13	Medium
26	The BMJ	BMJ	13	Medium
27	Clinical Sense-Improve Your Clinical Skills	Medical Joyworks LLC	14	Medium
28	MyATLS	American College of Surgeons	14	Medium
29	LANGE Surgical Tech Review	Higher Learning Technologies Inc	14	Medium
30	Short Cases in Surgery-OSCE for Medical	RER MedApps	15	Medium
31	Epocrates	Epocrates, Inc.	15	Medium
32	Gray's Anatomy-Anatomy Altas 2020	SEStudio	15	Medium
33	DailyRounds-Cases, Drug Guide, ECG for Doctors	Neuroglia Health	16	High
34	Drugs.com Medication Guide	Drugs.com	16	High
35	Researcher	Researcher	16	High
36	Read by QxMD	QxMD Medical Software, Inc.	17	High
37	Touch Surgery	Digital Surgery Limited	18	High
38	Medscape	WebMD, LLC	18	High
39	BMJ OnExamination Exam Revision-Free Questions	BMJ	18	High
40	NCCN Guidelines®	National Comprehensive Cancer Network (NCCN)	19	High
41	UpToDate	Wolter Kluwer Health	19	High
42	BMJ Best Practice	BMJ	19	High

Table 5. Utility scoring and grading of the apps

S.No.	App Name	Developer	Utility Score	Grade
1	SurgTest	SurgTest	9	Low
2	Surgical & Medical Instruments	Kadira Apps	9	Low
3	Teach Me Surgery	TeachMeSeries Ltd	10	Low
4	Medicos Surgery	Medicos	12	Medium
5	Explained Clinical Case Scenarios With Answers	Radioapps	12	Medium
6	Basic Surgery	Salina Akter	13	Medium
7	Medical & Surgical Instruments Images & Uses	NassApp	13	Medium
8	Surgical Instruments	Koby Apps	13	Medium
9	Medical Instruments	Alpesh Patel	13	Medium
10	The BMJ	BMJ	13	Medium
11	Advanced Trauma Life Support	Current Clinical Strategies	13	Medium
12	Surgical Anatomy of the Lung	Emory University	13	Medium
13	LANGE Surgical Tech Review	Higher Learning Technologies Inc	13	Medium
14	Medicos Medicine: History and Clinical Exam	Medicos	13	Medium
15	TNM Cancer Staging	PGquest	14	Medium
16	Short Cases in Surgery-OSCE for Medical	RER MedApps	14	Medium
17	General Surgery Instruments	K.S.M. Studios	14	Medium
18	General Surgical & Medical Instruments-All in 1	First-rate-apps	14	Medium
19	DailyRounds-Cases, Drug Guide, ECG for Doctors	Neuroglia Health	14	Medium
20	MyATLS	American College of Surgeons	14	Medium
21	Surgical Anatomy of the Liver	Emory University	14	Medium
22	iCU Notes-a free Critical Care Medicine re	dev@doc-notes.com	14	Medium
23	Medical & Surgical Instruments	Dagana Apps	15	Medium
24	Learn Medical Instruments List	GIF Developer	15	Medium
25	SimuSurg	Royal Australasian College of Surgeons	15	Medium
26	Clinical Sense-Improve Your Clinical Skills	Medical Joyworks LLC	15	Medium
27	Epocrates	Epocrates, Inc.	15	Medium
28	Cochrane Library	The Cochrane Collaboration	16	High
29	PubMed4Hh	NLM OHPCC	16	High
30	IV Calculator: Infusion, Dosage, Drug, Drip Rate	iMedical Apps	16	High
31	Tokyo Guideline (TG18)	**株式会社**C2 （C2, Inc.)	17	High
32	Touch Surgery	Digital Surgery Limited	17	High
33	MedEx-Clinical Examination	Bharath Reddy	17	High
34	BMJ Best Practice	BMJ	17	High
35	Drugs.com Medication Guide	Drugs.com	17	High
36	Researcher	Researcher	17	High
37	Gray's Anatomy-Anatomy Altas 2020	SEStudio	17	High
38	BMJ OnExamination Exam Revision-Free Questions	BMJ	17	High
39	Medscape	WebMD, LLC	18	High
40	UpToDate	Wolter Kluwer Health	18	High
41	Read by QxMD	QxMD Medical Software, Inc.	18	High
42	NCCN Guidelines®	National Comprehensive Cancer Network (NCCN)	19	High

Furthermore, under the core surgery category, four apps were graded high on utility, 13 apps were moderate on utility while only three apps were graded as low on credibility. Tokyo Guidelines (TG18), Touch Surgery, NCCN Guidelines® along with MedEx-Clinical Examination were found to be highly useful for surgeons and surgical trainees. Many apps that dealt with surgical instruments or clinical case scenarios in surgery or those that simply dealt with the common surgical conditions and clinical examinations fell under moderate utility. Medicos Surgery, Basic Surgery, SurgTest, Clinical Sense-Improve Your Clinical Skills are examples of such apps. The TNM Cancer Staging app also fell under moderate utility.

Apps related to surgical practice: Out of the total 22 apps that fell under this category, eight were highly credible, eight were moderately credible, whereas six apps were graded as low on credibility. DailyRounds claims to be India's largest academic network of doctors with more than five lakh active users in India and more that 10 lakhs across the globe. It is a platform to discuss clinical cases and keep oneself updated with the latest practice-relevant journal articles, and treatment guidelines etc. This app was categorised as high under credibility and moderate under utility. One of the most popular and comprehensive apps for drug information is drugs.com and it was rated high under both credibility and utility. Other noteworthy apps were, Medscape, Researcher, UpToDate, Read by QxMD, and BMJ On-Examination, BMJ Best Practice and The BMJ that offer a plethora of uses to its users ranging from intensive topic searches to access to latest journals to practice revision for standardized examinations. All these apps were graded high on credibility.

Under the apps related to surgical practice category, out of the total 22 apps, half of the apps (11 apps) were graded as high on utility while the other half fell into the moderate utility. The Cochrane Library app contains a collection of high-quality independent evidence to inform the healthcare workers decision making. The Cochrane Database of Systemic Reviews is one of the leading resources of systematic reviews in healthcare and is continuously being updated for its users. This was categorized as high on utility. Gray's Anatomy-Anatomy Atlas 2020 is a free application that can be used in offline mode to view and learn anatomy using brilliant illustrations. It also has quizzes to test oneself. This app was also graded high on utility.

DISCUSSION

There has been a revolution in the mobile phone industry in the last three decades that involves both the hardware and software development (4). With the continuous improvement in hardware there has been increased processor performance, better display screens with increased resolution and display quality, increased random access memory and storage memory, widely available long and short-range wireless data communication capabilities, improved camera quality, better battery life and last but not the least miniaturization of the hardware size. With hardware development, mobile software has become more complex and diverse leading to replication of functions of a computer in a phone what we call as smartphone (4).

As mobile platforms become more user friendly and readily available, innovators have begun to develop highly complex mobile apps to leverage the portability that mobile platforms offer. Some of these new software functions are specifically targeted at assisting individuals with their own health and wellness management (5). Other software functions are targeted at health care providers as tools to improve and facilitate the delivery of patient care and improved medical education (6), especially in resource-constrained environments (like the COVID-19 pandemic). There has been significant increase in the number of surgical apps in past decade (7-9). However, there is a need for classification of apps based on their purpose and the audience that they are intended for. We suggest that the surgical apps may be further divided into apps for clinicians and students and apps suitable for patients. Apps for clinicians and students can further be divided into core surgery apps (apps for clinical learning, surgical simulation and practice management) and apps related to surgical practice (apps for journal reading, research, clinical database, medical networking, tele-communication, online teaching, digital note taking and drug prescription).

Concerns have been raised and reported about the unreferenced content of smartphone apps, lack of qualified professional involvement, absence of surgical society endorsement and lack of regulation by clinical or governing bodies (10). The United States Food and Drug Administration (FDA) had issued recommendations in the form of "Policy for Device Software Functions and Mobile Medical Applications" in 2013 and it was modified later in 2019 (11). However, it does not include majority of surgical applications and has only included certain software applications that meet the definition of a 'medical device' and identified specific regulatory requirements that apply to them.

FDA regulation applies to only those software/apps that are 'medical devices' and whose functionality could pose a risk to a patient's safety if the device does not perform as intended (11). So, the intended use of a mobile app determines whether it will come under FDA regulation or not. Mobile medical apps, according to FDA, include only those mobile apps that meet the definition of a 'device' (by FDA) and either intended to be used as an accessory to a regulated medical device or to transform a mobile platform into a regulated medical device. In simple terms, if an app is intended to be used for performing a medical device function (for diagnosis, treatment or prevention of disease) it is a 'medical device'. For example, mobile apps intended to run on smart phones to interpret ECG waves in order to detect cardiac rhythm abnormalities.

There is also a group of software or apps, which are not considered as 'medical devices' by FDA such as apps that are intended to provide access to electronic copies (e.g., e-books, audio books) of medical textbooks or other reference materials (PubMed, UpToDate etc.). So both of these two groups of app doesn't need FDA approval (11). Hence, many of the apps used in the field of surgery will not fall into the FDA regulation (e.g., simulations, surgical database etc.). The lack of medical professional involvement, evidence-based content and peer review makes it challenging for even an experienced consumer in choosing the right app. In this study, we have tried to sub classify the surgical apps into groups (low, moderate and high) based on both utility and credibility, in order to make it easy for the students, clinicians and patients to choose the right apps for their purpose.

One of the drawbacks of our study is that we have excluded apps with lesser than three rating and 30 reviews, in order to remove all applications with very poor quality and unreliable content. However, in order to do so, we had to exclude few apps which are noteworthy. Many apps, which we came across during our search, but they lacked adequate reviews as well as ratings, due to fewer number of downloads. So, they have not been assessed for utility and credibility but they might benefit the trainees and surgeons because of their rich content. "3D skull Atlas", "surgery on call" were amongst those few to mention. Similarly, few iOS apps which were also deserve to be mentioned because of their content. However, we could not include them in our study due to lack of important data needed to classify the apps based on the predefined criteria. "LapGuru-Surgery Training" which is one of a kind app that enables its users to view and learn about laparoscopic surgery. It has a step-by-step description of various laparoscopic (lap) surgeries from various disciplines. It has more than 6500 videos of lap surgeries in its library. "Journal of Surgical Oncology" an iOS app by Wiley Publications is one of the reputed sources of information in the field of surgical oncology. It not only has the latest updates, articles and developments in its field, but also allows its users to download various articles for offline reading/review. However, they were excluded from our study in view of adequate reviews as well as ratings.

CONCLUSION

Using surgical smartphone apps have their own set of drawbacks. App dependency of trainees for complex classifications or guidelines, lack of clinical skill development (especially in the middle of COVID-19 pandemic), lack of updated content of highly credible apps are a few worth mentioning. However, their benefits surpass these drawbacks. Incorporation of author details, a greater number of surgical societies endorsed apps, periodic updates and increased regulation should help maintain the credibility and utility of the apps in future.

Ethics Committee Approval: For this study, it is not necessary to have the ethical approval.

Peer-review: Externally peer-reviewed.

Author Contributions: Author Contributions: Concept - S.V.G., W.F.K.; Design - S.V.G., W.F.K.; Supervision - P.A.; Data Collection and/or Processing - A.S., W.F.K.; Analysis and/or Interpretation - A.S.; Literature Search - A.S., W.F.K.; Critical Reviews - P.A., S.V.G.

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ORİJİNAL ÇALIŞMA-ÖZET
Turk J Surg 2022; 38 (1): 86-94

Genel cerrahi pratiğinde akıllı telefon uygulamaları (apps): Güvenilirlikleri ve kullanışlılıkları üzerine bir çalışma

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ÖZET

Giriş ve Amaç: Akıllı telefonların icadı ve bu telefonlarda kullanılabilen indirmeye hazır faydalı uygulamalar ile birlikte bu çağımızda cerrahlar, bu tür teknolojileri kolaylıkla cerrahi pratiklerine entegre etmek için her geçen gün daha çok fırsat ile karşılaşmaktadır. Bu çalışma, hem cerrahlar hem de cerrah adaylarının doğru uygulamayı seçmesi için güvenilir veriler sağlamak adına uygulamalar için sistematik bir sınıflama sunmayı amaçlamıştır.

Gereç ve Yöntem: Önceden karar verilen anahtar kelimeler kullanılarak "Google Play Store" ve "Apple App Store" üzerinde bir dizi metodolojik araştırma yapıldı. Daha sonra sonuçlar, ilgili kategorilere ayrıldı: ana cerrahi branşlar, cerrahi pratik ile ilgili uygulamalar, hastaların fayda sağlayacapı uygulamalar ve diğer cerrahi branşlar. Daha sonra, eşik değerlerimiz ile uyuşan uygulamalar, önceden belirlenmiş parametreler doğrultusunda güvenilirlikleri ve kullanışlılıkları açısından değerlendirildi.

Bulgular: Uygulamaları ayırdığımız kategoriler arasında çok fazla varyasyon vardı. Önceden belirlenmiş eşik kriterlerini kullanarak (derecelendirme >3 and değerlendirme >30), kullanışlılığı ve güvenilirliği için 48 uygulama değerlendirildi. Bu 48 uygulamadan 42'si android platformdayken 6'sı İOS platformundaydı. On uygulamanın yüksek güvenilirliği ve 15 uygulamanın yüksek kullanışlılığı olduğu bulundu.

Sonuç: Cerrahide ve cerrahi eğitiminde akıllı telefonların rolü yüksek oranda ümit verici gözükmekte ve yüksek güvenilirliğe ve kullanışlılığa sahip uygulamaların kullanılması hem cerrahlara hem de cerrah adaylarına güvenilir ve güncellenmiş bilgiler sağlamaktadır.

Anahtar Kelimeler: Akıllı telefon uygulamaları, cerrahi uygulamalar, cerrahi eğitim

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CASE REPORT
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Median arcuate ligament syndrome noticed during pancreaticoduodenectomy

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ABSTRACT

Median arcuate ligament syndrome (MALS) occurs as a result of compression of the celiac artery by a fibrous band called the median ligament, which originates from the diaphragmatic crus. The prevalence of MALS has been reported as 10-24% among patients. The etiology is not clear. The components of the clinical triad are a chronic post-prandial pain, epigastric murmur and weight loss. Diagnosis is based on clinical and radiological findings. MALS has been reported in a small portion of patients undergoing pancreaticoduodenectomy. Most of the patients have been diagnosed prior to surgery.

Keywords: Pancreaticoduodenectomy, median arcuate ligament syndrome, celiac artery occlusion

INTRODUCTION

Median arcuate ligament syndrome (MALS), also known as celiac artery compression syndrome, is characterized by gastrointestinal ischemia occurring as a result of compression of the proximal part of celiac trunk by the median arcuate ligament that originates from the diaphragm (1). The etiology is not clear. The majority of patients are asymptomatic under normal conditions. However, it can lead to life-threatening organ ischemias when collateral circulation from the superior mesenteric artery is interrupted during surgery such as in pancreaticoduodenectomy operation (2-4).

In this report, we wanted to present a case with MALS diagnosed intraoperatively during pancreaticoduodenectomy.

CASE REPORT

The forty-three-year-old male patient presented to our hospital with complaints of jaundice and itching. His laboratory results showed a serum bilirubin level of 3.2 mg/dL. Abdominal ultrasonography and computed tomography (CT) revealed a mass lesion with a size of 3 x 2.5 cm at the head of the pancreas, which raised suspicion of pancreas cancer. Contrast-enhanced abdominal CT did not show any pathology associated with the arterial structures or any sign of arterial invasion. A fine needle aspiration biopsy was performed from the mass lesion at the head of the pancreas under endoscopic ultrasonography guidance. The biopsy result was reported as malignant cytology. The patient was taken into operation. After liberating the pancreatic head with Kocher maneuver and ligating the gastroduodenal artery, it was observed that there was no flow in the hepatic artery, left gastric artery or splenic artery. During surgery, the radiology clinic was requested to re-evaluate the patient's abdominal CT images. As a result of this re-evaluation, complete occlusion was noticed in the celiac trunk, caused by compression by a median arcuate ligament (Figure 1). Following excision of the median arcuate ligament, pulsatile flow was observed in the hepatic artery, left gastric artery and splenic artery. Pylorus-preserving pancreaticoduodenectomy operation was performed. A control CT was performed postoperatively. Celiac trunk and its branches were observed filling with contrast (Figure 2). The patient was discharged on a postoperative 8th day without any problems.

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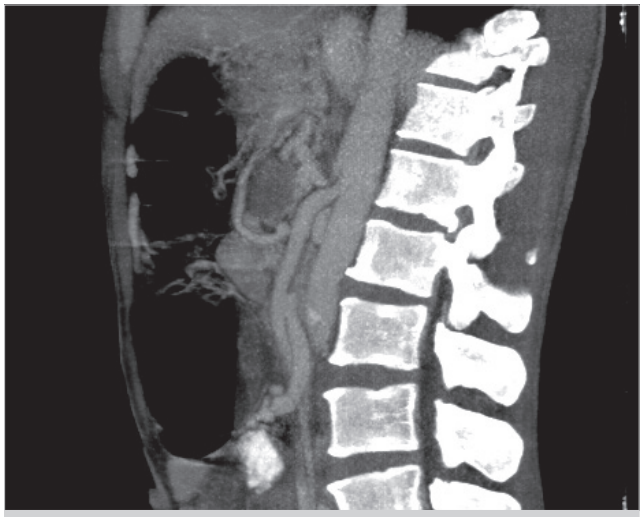

Figure 1. Compression of celiac trunk caused by median arcuate ligament.

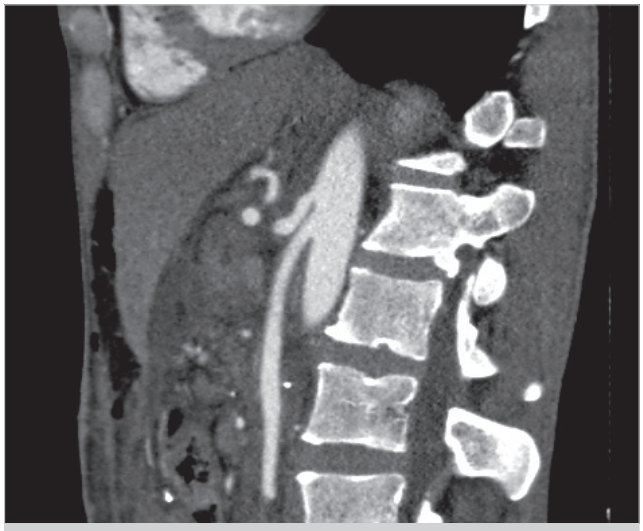

Figure 2. Postoperative image.

DISCUSSION

Compression of the celiac artery by the median arcuate ligament was first reported in 1917 by Lipschutz. Later in 1963, Harjola described compression of the celiac artery as a clinical syndrome, in which there is a post-prandial abdominal pain, nausea, vomiting and occasionally diarrhea with accompanying malabsorption and a systolic murmur that is always present during auscultation of the abdomen (1).

Diagnosis is based on clinical and radiological findings. Radiologically, its diagnosis can be made with Doppler ultrasonography or CT angiography. Lateral projection in CT angiography is highly sensitive in detecting obstruction in the celiac axis (1,3,4). The clinical triad consists of chronic post-prandial pain, epigastric murmur, and weight loss. MALS can be detected in 10-24% of patients. Patients are usually asymptomatic. It is often seen in young adult patients. The classical findings are not present in the majority of patients due to the presence of collateral circulation coming from the superior mesenteric artery (2). The classical treatment of MALS is surgical excision of median arcuate ligament fibers.

It has been reported that median arcuate ligament syndrome is observed in a minority of patients undergoing pancreaticoduodenectomy and that diagnosis is often made preoperatively in these patients (4). Our case was not diagnosed preoperatively and during the operation, the lack of pulsatile flow in the hepatic artery following ligation of gastroduodenal artery raised the suspicion of MALS or celiac artery occlusion due to atherosclerosis, and the diagnosis was made after re-evaluation of patient's CT images. As laparoscopic pancreaticoduodenectomy operations become more common, it becomes more difficult to diagnose the complications caused by MALS intraoperatively. During preoperative radiological evaluation of tumors of the periampullary region, attention is mostly focused on the tumor's relation with vascular structures and its operability, while conditions that can cause occlusion in the celiac artery can be overlooked. It should be kept in mind that, although rare, celiac artery occlusion caused by atheroma plaque or MALS can accompany these tumors. Therefore, careful preoperative radiological assessment of patients who are planned to undergo pancreaticoduodenectomy will aid to reveal MALS and to reduce its vascular complications and the associated morbidity and mortality. In all patients, pulsation in the hepatic artery should always be checked after clamping the gastroduodenal artery (3,4).

CONCLUSION

It should be kept in mind that in patients with celiac artery stenosis or occlusion, ligation of the gastroduodenal artery during pancreaticoduodenectomy operation will lead to impairment in the blood supply of upper abdominal organs, which can possibly result in mortality. Therefore, celiac trunk and its branches should be carefully evaluated before pancreaticoduodenectomy operations.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - S.U.; Design - S.U.; Supervision - K.K.; Materials - S.U.; Data Collection and/or Processing - S.U.; Literature Search - S.U.; Writing Manuscript - S.U., H.A.; Critical Reviews - K.K.

Conflict of Interest: The authors have no conflicts of interest to declare.

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OLGU SUNUMU-ÖZET
Turk J Surg 2022; 38 (1): 95-97

Pankreatikoduodenektomi sırasında fark edilen median arkuat ligaman sendromu

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ÖZET

Median arkuat ligaman sendromu (MALS) diyafram krusundan köken alan median ligaman adı verilen fibröz bir bandın çölyak artere basısı sonucu oluşur. MALS hastalarda %10-24 aralığında bildirilmiştir. Etiyolojisi tam olarak bilinmemektedir. Klinik triadı, yemek sonrası oluşan kronik ağrı, epigastrik bölgede üfürüm ve kilo kaybıdır. Tanı, klinik ve radyolojik bulgular ile konulur. MALS, pankreotikoduodenektomi yapılan hastaların küçük bir kısmında bildirilmiştir. Hastaların çoğunda tanı ameliyat öncesinde konmuştur.

Anahtar Kelimeler: Pankreatikoduodenektomi, median arkuat ligaman sendromu, çölyak arter tıkanıklığı

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CASE REPORT
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A rare adult morgagni hernia mimicking lobar pneumonia

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ABSTRACT

Morgagni hernia is the rarest form of congenital diaphragmatic hernia and is commonly found either in the first few hours of life or in antenatal period. It is less common in adult and is mostly diagnosed incidentally in an asymptomatic patient. Symptomatic adult cases are even rarer with a wide variety of symptoms. Here we report a patient with a one year history of chronic recurrent cough and dyspnea, who had been misdiagnosed as recurrent pneumonia before being recognized and treated as Morgagni hernia.

Keywords: Adult, morgagni hernias, misdiagnosis

INTRODUCTION

Morgagni hernia is the rarest form of congenital diaphragmatic hernia with 2-3% of prevalence. Herniation occur due to defect on the anterior part of diaphragm, which allows abdominal organs penetrate thoracic cavity (1). It is commonly found in the first few hours of life or in antenatal period (2). This condition can be detected during fetal life by routine ultrasonography, when the abdominal organs are demonstrated in thoracic cavity (3). Late findings of this condition in adults are less common with only 81 asymptomatic cases reported between 1955 and 2002. Symptomatic adult cases are even rarer with only 12 cases described (4).

Adult patients who present with diaphragmatic hernias complain a wide variety of non-specific symptoms and the diagnosis may be difficult (2). The majority describe abdominal pain due to strangulation of the viscera (1). However, very few also complain about respiratory symptom such as cough, dyspnoea, and chest pain depending on the severity of the defect (5). Here we report an adult male with chronic recurrent cough, who had been treated as recurrent pneumonia before being diagnosed as Morgagni hernia.

CASE REPORT

A 22 year old male was admitted to the emergency department with a one year history of chronic recurrent cough and dyspnea. He had been treated as recurrent pneumonia in several hospitals. Two days before admission, productive cough and dyspnea were developed. Simple chest X-ray showed a non-specific opacity at the right lower hemi-thorax and the left hemi-diaphragm was not clearly visible (Figure 1). The patient was diagnosed with lobar pneumonia and treated by other department. After two days in the hospital, the patient was consulted to our department with aggravated dyspnea and vomiting. Computed tomography (CT) scan of the chest was performed. Ascending colon and small intestine were demonstrated at the right hemi-thorax (Figure 2).

Furthermore, the patient underwent reduction of hernia contents via laparotomy approach and evaluated for any sign of intestinal injury or ischemic. The hernia sac was left unresected. Thoracotomy approach was used to expose the diaphragm defect, there was a 5 x 6 cm defect on the right anterolateral of right hemi diaphragm. The defect was closed using dacron patch. A thoracic drain was placed

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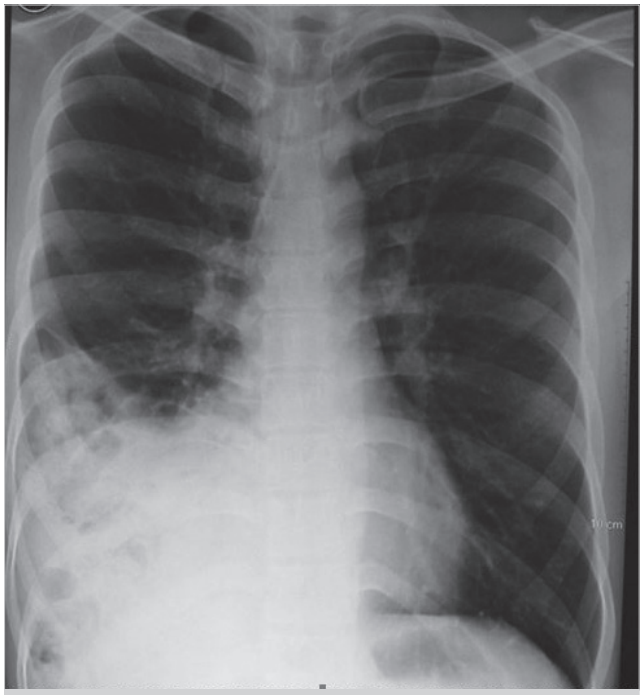

Figure 1. Simple chest X-ray showing a non-specific opacity at the right lower hemi-thorax.

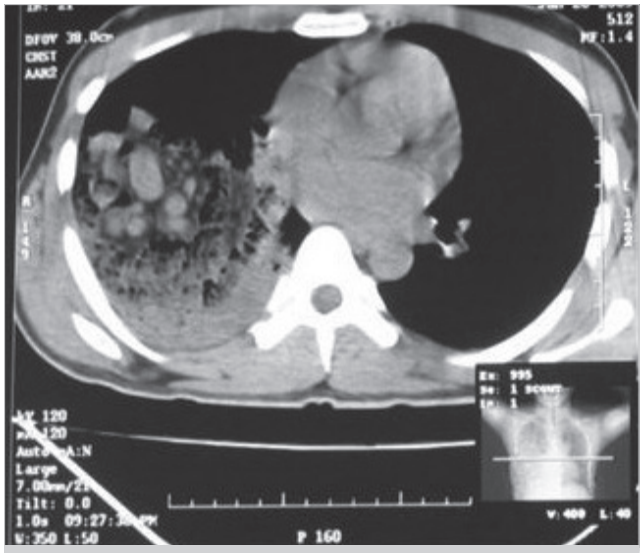

Figure 2. CT scan of chest showing ascending colon and small intestine at the right hemi-thorax.

to be evaluated for any secret later, and then the operation was terminated.

Three months after the surgery, the patient was completely recover without symptoms. A follow-up chest X-ray revealed normal pulmonary vasculature without residual hernia (Figure 3). Written informed consent was obtained from patient who participated in this case.

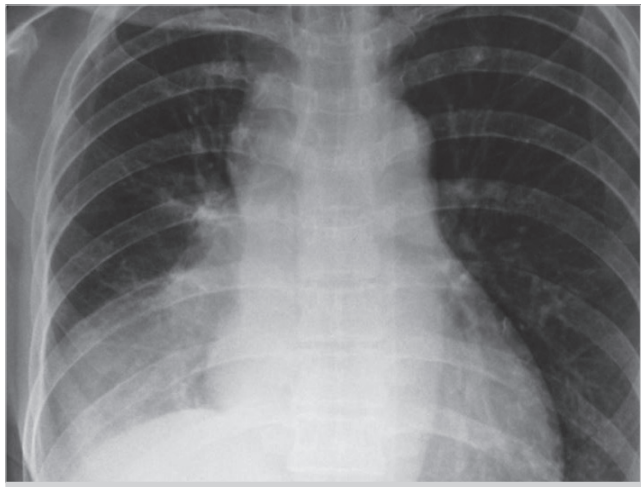

Figure 3. A follow-up simple chest X-ray showing normal pulmonary vasculature without residual hernia.

DISCUSSION

Majority of adult Morgagni hernia cases are asymptomatic due to plugging of the defect by the underlying liver or omentum, which prevent other abdominal organs herniation into thoracic cavity (6). Therefore, most patients were diagnosed incidentally by a routine chest X-ray. In symptomatic cases, the patients may complain a wide variety of non-specific respiratory and gastrointestinal symptoms and the diagnosis might be difficult. Respiratory symptoms of chest pain, dyspnea and recurrent respiratory infection are commonly found in pediatric patient (4). In adult, majority of cases are presented with non-specific gastrointestinal symptoms due to intestinal obstruction or strangulation of abdominal organs (1,4). Our case was unique, that the patient had predominant respiratory symptoms for one year and had been treated as recurrent pneumonia in several hospitals before diagnosed and treated as Morgagni hernia. This case illustrates the difficulty in diagnosis of adult Morgagni hernia, which is rare and presented with non-specific symptoms.

Radiological investigation can be performed to confirm the diagnosis of Morgagni hernia. Plain chest X-ray are usually conclusive for diagnosing Morgagni hernia in pediatric or asymptomatic adult patients (4). The opacity can be seen in right, left, or bilateral pericardiophrenic area due to herniation of omentum. In the presence of transverse colon, small intestine, or gastric herniation, air fluid level may present (7). However, in our case, plain chest X-ray only is inconclusive and causing previous misdiagnosis. Respiratory symptoms of productive cough and dyspnea accompanied with opacity on plain chest X-ray in this case are suggestive for lobar pneumonia (Figure 1).

In symptomatic or clinically suspected adult patients, CT scan is preferred to confirm the diagnosis. It is the most sensitive diagnostic tools as it provides anatomical details of hernia contents and its complication (1). In this case, CT scan provides essen-

tial information regarding ascending colon and small intestine herniation at the right hemi thorax to confirm the diagnosis of Morgagni hernia (Figure 2).

Because of the rarity of the case, there is no exact guidelines for Morgagni hernia treatment. Our case was managed with thoracic-abdominal approach. The most common surgical approach is open laparotomy, due to the convenience to reduce hernia content and evaluate the intestine for any sign of injury or complication such as strangulation and ischemia (8,9) Thoracotomy approach is preferable for its extensive exposure and easier repair of the diaphragm defect (9). Thoracic-abdominal approach is used in patient with huge Morgagni hernia (10). We use thoracic-abdominal approach for its convenience to reduce the hernia content and repair of the diaphragm defect. The usage of prosthetic patch to close the defect is not a mandatory. Patch is used when the defect is more than three cm (11).

Hernia sac excision was not done in our case. Hernia sac excision in Morgagni hernia case is still a controversy, however it is considered to be safer to left the hernia sac unresected due to possibility to cause pneumomediastinum and injury to the lung, pericardium, or other mediastinal organ (12).

CONCLUSION

Symptomatic adult cases of Morgagni hernias are rare, non-specific in symptoms, and difficult to diagnose. Radiologic investigation using CT scan can be used to confirm the diagnosis. The thoracic abdominal approach is preferable due to better exposure for defect repair and easier hernia content reduction.

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Author Contributions: Concept - S.S., H.D.; Design - S.S., H.D.; Supervision - S.S.; Materials - S.S.; Data Collection and/or Processing - S.S., H.D.; Analysis and/or Interpretation - S.S., H.D.;Literature Search - S.S., H.D.; Writing Manuscript - H.D.; Critical Reviews - S.S., H.D.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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OLGU SUNUMU-ÖZET
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Lobar pnömoniyi taklit eden seyrek morgagni hernia

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ÖZET

Morgagni fıtığı, konjenital diyafragma fıtıklarının nadir bir formudur, yaşamın ilk birkaç saatinde ya da doğum öncesi dönemde bulunur. Yetişkinlerde çok yaygın değildir ve çoğunlukla asemptomatik bir hastada tesadüfen teşhis edilir. Semptomatik yetişkin vakaları, çok çeşitli semptomlarla bile daha nadirdir. Burada bir yıllık kronik tekrarlayan öksürük ve dispne öyküsü olan, Morgagni fıtığı tanısı konmadan ve tedavi edilmeden önce tekrarlayan pnömoni olarak tedavi edilen bir hasta sunuyoruz.

Anahtar Kelimeler: Yetişkin, konjenital diyafragma hernia, pnömoni

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