Invited Review

Ulus Cerrahi Derg 2016; 32: 203-207

DOI: 10.5152/UCD.2016.3375

Evolution of management in peritoneal surface malignancies

Emel Canbay[1,2], Bahar Canbay Torun[3], Ege Sinan Torun[4], Yutaka Yonemura[1,2]

ABSTRACT

Management of peritoneal surface malignancies has gradually evolved by the introduction of cytoreductive surgery in combination with intraperitoneal chemotherapy applications. Recently, peritoneal metastases of intraabdominal solid organ tumors and primary peritoneal malignancies such as peritoneal mesothelioma are being treated with this new approach. Selection criteria are important to reduce morbidity and mortality rates of patients who will experience minimal or no benefit from these combined treatment modalities. Management of peritoneal surface malignancies with this current trend is presented in this review.

Keywords: Heated chemotherapy, peritoneal metastases, colorectal cancer, gastric cancer, ovarian cancer, mesothelioma

INTRODUCTION

Peritoneal surface malignancies (PSM) originating from the gastrointestinal tract organs, pseudomyxoma peritonei (PMP), ovaries and peritoneum have been considered as lethal diseases with dismal prognosis. The clinical course of tumors at this stage are characterized by a deterioration in quality of life and shortened life expectancy. Supportive care and systemic chemotherapy were the mainstay of treatment for these patients. However, continuous clinical research revealed that PSM treatment and even cure could be achieved with cytoreductive surgery (CRS) and hyperthermic intraoperative intraperitoneal chemotherapy (HIPEC). Appendiceal tumors or PMP (1, 2), and malignant peritoneal mesothelioma (3) have been treated successfully by CRS and HIPEC. Besides this, the role of CRS and HIPEC in the management of PSM that originates from ovary, stomach, colon and rectum is still under investigation. In this review, we summarized the results of CRS and HIPEC in the management of PSM as new treatment modalities.

Colorectal Cancer

Isolated peritoneal metastases develop in 8.5-25% of patients with colorectal cancer (CRC) (4, 5). Median survival is expected to be 6 to 12 months when peritoneal metastasis (PM) of CRC is treated with palliative intent. Systemic chemotherapy does not seem to provide better survival rates for these patients (6-8). It has been reported that prolonged survival was obtained with CRS and HIPEC in CRC patients with PM (9-17). A randomized controlled study from the Netherlands Cancer Institute supported these results (18). According to 8-years follow up results of this trial, when a complete cytoreduction was achieved, a 5-year survival rate was observed in 45% of these patients.

Completeness of cytoreduction, biological characteristics of the tumors and the extent of disease were found to be significant prognostic factors (19, 20). Similarly, a recent consensus statement on PM of CRC highlighted the importance of complete cytoreductive surgery in these patients (21). Therefore, CRC cases with PM have to be referred to a Peritoneal Surface Malignancy Center and assessed properly to evaluate the extent of the disease prior to CRS and HIPEC.

Besides the improved outcome of these patients with these combined new treatment modalities, the question that remains to be solved is whether CRS and HIPEC are the best options for CRC patients with PM. After oxaliplatin- and irinotecan- based chemotherapy, and anti- VEGF biological therapy were introduced as new treatment strategies for metastatic CRC, the overall survival and progression free survival were improved in these patients with solid organ metastases such as lung and liver (22-25). However, abdominal diffusion of systemic chemotherapy may not be sufficient to the intraperitoneal cavity and peritoneal surfaces in the presence of metastatic nodules on peritoneal surface. Plasma peritoneal barrier (PPB) is usually 90 µm and diffusion of systemic chemotherapy from subperitoneal mesothelial tissue to the peritoneum is very limited or not possible especially if the tumor nodules penetrate to the peritoneal surface deeper than 5 mm. A clinical study comparing new systemic chemotherapy with CRS and HIPEC were required to evaluate the effectiveness of this combined approach versus systemic che-

[1]NPO HIPEC Istanbul, Centermed, İstanbul, Turkey

[2]NPO to Support Peritoneal Dissemination Treatment, 1-26 Harukimotomachi, Kishiwada City, Osaka, Japan

[3]Department of General Surgery, İstanbul University İstanbul School of Medicine, İstanbul, Turkey

[4]Department of Internal Medicine, İstanbul University İstanbul School of Medicine, İstanbul, Turkey

Address for Correspondence

Emel Canbay
e-mail: drecanbay@gmail.com

Received: 12.09.2015
Accepted: 17.12.2015

motherapy. This study showed that the median survival was 64 months in CRS and HIPEC arm while it was 23 months in modern systemic chemotherapy arm. The 5-year survival rate was 51% with CRS and HIPEC, and 13% with modern systemic chemotherapy. According to this study, CRS and HIPEC can prolong survival in patients with limited peritoneal metastasis of CRC. This combined approach, however, carries a high morbidity and mortality risk even though it has promising results with respect to disease free survival and overall survival. Therefore, patient selection is important to tailor therapeutic plan in patients with short life expectancy.

Colorectal cancer patients with peritoneal dissemination might also have liver metastases. A recent systematic review and meta-analysis investigated the outcomes of liver resections combined with CRS and HIPEC in CRC patients with hepatic and PM (26). This study showed that CRC patients with isolated PM have a much longer overall survival as compared to patients with liver and PM. Besides this, the patients in this study demonstrated an increased median overall survival after CRS and HIPEC with hepatic resection as compared to treatment with modern systemic chemotherapy. Ongoing prospective randomized clinical trial results will clarify the necessity of HIPEC after curative resection in these patients (27).

Pseudomyxoma Peritonei

Pseudomyxoma peritonei is a rare condition resulting from the rupture of mucinous appendiceal or ovarian tumors, or tumors of primary peritoneal origin. Pseudomyxoma peritonei is characterized by widespread mucinous deposits within the peritoneal cavity. Serial debulking and systemic chemotherapy were conventional treatment options of PMP with a high recurrence rate (28). The 10-year survival was 63% with CRS and HIPEC in patients with PMP (29). High-grade tumor histology, and induction chemotherapy were found to be poor prognostic factors in PMP patients (30).

Extent of the prior surgeries, high peritoneal cancer index (PCI) (31), elevated levels of CA19-9 (32) and CEA (33) were identified as poor prognostic factors by multivariate analysis. Peritoneal recurrence of PMP occurs as a result of the advanced stage of the disease at the time of initial diagnosis or as the consequence of relative chemoresistance to chemotherapy. Repeated CRS and HIPEC could be recommended to prolong survival in highly selected patients (34). Even though the treatment of PMP with CRS and HIPEC seems to provide promising results with low complication and mortality rates, the effects of this combined approach require further investigation to determine its potential benefits as a therapeutic procedure.

Gastric Cancer

Peritoneal metastases may be present in 5-20% of patients undergoing a potentially curative resection for gastric cancer (GC) at the time of initial diagnosis (35). Patients with PM that originated from GC have a poor prognosis and the estimated survival is 1-3 months without systemic treatment (36, 37). The median survival time does not exceed 9 months even with palliative systemic chemotherapy in these patients (38). Peritoneal involvement represents an independent risk factor for poor prognosis. Therefore, intraperitoneal chemotherapy has been proposed in GC patients with a high risk of peritoneal recurrence. Overall survival was prolonged in patients with intraperitoneal chemotherapy (39, 40). These results were also confirmed by a prospective randomized clinical trial (41). According to this study, even though the frequency of intraabdominal abscess and neutropenia were increased in surgery and HIPEC group, no statistically significant difference in morbidity was detected between radical surgery with HIPEC group and radical surgery group. Besides these improvements, the experience with CRS and HIPEC for PM of GC is still limited (42-45). Completeness of cytoreduction, PCI index less than 6, and response to systemic chemotherapy were found to be favorable prognostic factors in patients with PM of GC. Survival advantage with CRS and HIPEC can be obtained in patients with PM of GC (46). Recently, we reported that 152 of 194 (78.3%) PM of GC patients underwent CRS and HIPEC. In this group, the mortality was 3.9% and major complications occurred in 23.6% of patients. The median survival was 15.8 months and the 5-year survival rate was 10.7%. Multivariate analysis identified pathologic response to bidirectional intraperitoneal systemic chemotherapy, low tumor burden, and completeness of cytoreduction as prognostic factors (47). This study provides an important information in selection of cases who will benefit from this challenging combined approach.

Recent ongoing prospective randomized clinical studies will clarify the exact role of HIPEC and CRS in the management of PM of GC.

Ovarian Cancer

Standard management of patients with advanced stage ovarian cancer (OC) consists of optimal cytoreductive surgery followed by adjuvant systemic chemotherapy with taxane and platinum combination (48). However, despite the improved median overall survival with this regimen (up to 50 months), recurrence occurs in 75% of patients and 20-30% of these patients might have resistance to the platinum analogues (49). A survival benefit in patients treated with intraperitoneal chemotherapy and systemic chemotherapy as compared to systemic chemotherapy alone was also reported in a phase III trial (50). Intraperitoneal chemotherapy one dose prior to surgery yielded better survival rates than those who had only adjuvant systemic intravenous chemotherapy (51). Furthermore, the five-year survival rate can be increased from 17% to 58% with CRS and HIPEC in patients with recurrent ovarian cancer (52). Additionally, CRS with HIPEC might yield long-term survival in selected patients, especially in those with primary chemoresistance, and in recurrent advanced epithelial ovarian cancer patients (53). Complete cytoreduction was found to be a significant prognostic factor according to the results of this study. It has been reported that only 10% of patients with recurrent disease can undergo a complete resection, and the median overall survival can be only prolonged for 3 months according to the results of a recent meta-analysis (54). A clinical trial with a larger study group that addresses the role of CRS and HIPEC in recurrent ovarian carcinoma needs to be performed to determine the exact role of CRS and HIPEC in these patients.

Indeed, a phase III trial to examine the role of HIPEC in recurrent ovarian carcinoma was recently completed (55). In an 8-year period, the mean survival was 26.7 months in CRS with HIPEC and systemic adjuvant chemotherapy group, and was 13.4 months in patients treated with CRS and systemic adjuvant chemotherapy. The use of HIPEC, the extent of the dis-

ease, and the degree of cytoreduction have an important role in the survival of patients with recurrent ovarian cancer.

Diffuse Malignant Peritoneal Mesothelioma

Diffuse malignant peritoneal mesothelioma (DMPM) was considered as a fatal condition. Systemic chemotherapy and surgery showed limited benefit in this entity (56). Cytoreductive surgery with HIPEC showed a clear improvement in the outcome of DMPM as compared to traditional systemic chemotherapy (57-62).

A significantly prolonged survival was achieved in 405 patients with diffuse malignant peritoneal mesothelioma using CRS and HIPEC in a multi-institutional study (61). According to this study, the overall median survival was 53 months, and 5-year survival rate was 47%. Epithelial subtype, absence of lymph node metastasis, completeness of cytoreduction, and HIPEC were found to be independently associated with improved survival. A TNM staging for diffuse malignant peritoneal mesothelioma was recently proposed, and this classification is significantly correlated with survival advantages of this technique (62). CRS with HIPEC can be considered as a standard of care for patients with DMPM if optimal cytoreduction can be achieved.

The effect of new systemic cytotoxic agents such as pemetrexed prior to surgery in the treatment of peritoneal mesothelioma is gaining attention (63). If the patients are not suitable for an immediate surgery and intraperitoneal chemotherapy, they may be potential candidates for systemic chemotherapy with these new agents prior to surgery.

CONCLUSION

Peritoneal cavity needs to be considered as a specific organ consisting of two layers that cover the intraabdominal wall and serosal surface of intraabdominal organs. Peritoneal metastases can be treated with curative intent using CRS and HIPEC as a new evolving strategy. This approach achieves cure in many patients. The past three decades presented us sufficient information for patient selection and indications for the treatment of PM. HIPEC is the standard of care for PMP and PM of CRC, mesothelioma, and ovarian carcinoma while it is in the evaluation phase for GC. HIPEC is currently under investigation for treatment of PM of sarcoma, GIST, and small round cell desmoplastic tumors. Further studies will clarify the effectiveness of CRS in combination with HIPEC in PM of other intraabdominal solid organ tumors and primary peritoneal cancers.

Peer-review: This manuscript was prepared by the invitation of the Editorial Board and its scientific evaluation was carried out by the Editorial Board.

Author Contributions: Concept – E.C.; Design – E.C.; Supervision – Y.Y.; Data Collection and/or Processing – B.C.T., E.S.T.; Analysis and/or Interpretation – E.C.; Literature Search – E.C.; Writing Manuscript – E.C.; Critical Review – Y.Y.

Acknowledgement: The authors are grateful to Professor Haluk Kiper for his technical assistance in palliative interventions of five serious cases with peritoneal metastasis in Turkey.

Conflict of Interest: No conflict of interest was declared by the authors.

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

REFERENCES

1. Sugarbaker PH. New standard of care for appendiceal epithelial neoplasm and pseudomyxoma peritonei syndrome? Lancet Oncol 2006; 7: 69-76. [CrossRef]
2. Levine EA, Stewart JH 4th, Russell GB, Geisinger KR, Loggie BL, Shen P. Cytoreductive surgery and intraperitoneal hyperthermic chemotherapy for peritoneal surface malignancy: Experience with 501 procedures. J Am Coll Surg 2007; 204: 943-953. [CrossRef]
3. Yan TD, Welch L, Black D, Sugarbaker PH. A systematic review on the efficacy of cytoreductive surgery combined with perioperative intraperitoneal chemotherapy for diffuse malignancy peritoneal mesothelioma. Ann Oncol 2007; 18: 827-834. [CrossRef]
4. Koppe MJ, Boerman OC, Oyen WJG, Bleichrodt RP. Peritoneal carcinomatosis of colorectal origin. Ann Surg 2006; 243: 212-222. [CrossRef]
5. Jayne DG, Fook S, Loi C, Seow-Choen F. Peritoneal carcinomatosis from colorectal cancer. Br J Surg 2002; 89: 1545-1550. [CrossRef]
6. Cao Y, Tan A, Gao F, Liu L, Liao C, Mo Z. A meta-analysis of randomized controlled trials comparing chemotherapy plus bevacizumab with chemotherapy alone in metastatic colorectal cancer. Int J Colorectal Dis 2009; 24: 677-685. [CrossRef]
7. Klaver YL, Simkens LH, Lemmens VE, Koopman M, Teerenstra S, Bleichrodt RP, et al. Outcomes of colorectal cancer patients with peritoneal carcinomatosis treated with chemotherapy with and without targeted therapy. Eur J Surg Oncol 2012; 38: 617-623. [CrossRef]
8. Franko J, Shi Q, Goldman CD, Pockaj BA, Nelson GD, Goldberg RM, et al. Treatment of colorectal peritoneal carcinomatosis with systemic chemotherapy: a pooled analysis of north central cancer treatment group phase III trials N9741 and N9841. J Clin Oncol 2012; 30: 263-267. [CrossRef]
9. Pilati P, Mocellin S, Rossi CR, Foletto M, Campana L, Nitti D, et al. Cytoreductive surgery combined with hyperthermic intraperitoneal intraoperative chemotherapy for peritoneal carcinomatosis arising from colon adenocarcinoma. Ann Surg Oncol 2003; 10: 508-513. [CrossRef]
10. Glehen O, Kwiatkowski F, Sugarbaker PH, Elias D, Levine EA, De Simone M, et al. Cytoreductive surgery combined with perioperative intraperitoneal chemotherapy for the management of peritoneal carcinomatosis from colorectal cancer: A multi-institutional study. J Clin Oncol 2004; 22: 3284-3292. [CrossRef]
11. Glehen O, Cotte E, Schreiber V, Sayag-Beaujard AC, Vignal J, Gilly FN. Intraperitoneal chemohyperthermia and attempted cytoreductive surgery in patients with peritoneal carcinomatosis of colorectal origin. Br J Surg 2004; 91: 747-754. [CrossRef]
12. Verwaal VJ, van Ruth S, Witkamp A, Boot H, van Slooten G, Zoetmulder FA. Long-term survival of peritoneal carcinomatosis of colorectal origin. Ann Surg Oncol 2005; 12: 65-71. [CrossRef]
13. Elias D, Lefevre JH, Chevalier J, Brouquet A, Marchal F, Classe JM, et al. Complete cytoreductive surgery plus intraperitoneal chemohyperthermia with oxaliplatin for peritoneal carcinomatosis of colorectal origin. J Clin Oncol 2009; 27: 681-685. [CrossRef]
14. Kianmanesh R, Scaringi S, Sabate JM, Castel B, Pons-Kerjean N, Coffin B, et al. Iterative cytoreductive surgery associated with hyperthermic intraperitoneal chemotherapy for treatment of peritoneal carcinomatosis of colorectal origin with or without liver metastases. Ann Surg 2007; 245: 597-603. [CrossRef]
15. Shen P, Thai K, Stewart JH, Howerton R, Loggie BW, Russell GB, et al. Peritoneal surface disease from colorectal cancer: comparison with the hepatic metastases surgical paradigm in optimally resected patients. Ann Surg Oncol 2008; 15: 3422-3432. [CrossRef]
16. Yan TD, Morris DL. Cytoreductive surgery and perioperative intraperitoneal chemotherapy for isolated colorectal peritoneal carci-

nomatosis: experimental therapy or standard of care? Ann Surg 2008; 248: 829-835.
17. Elias D, Gilly F, Boutitie F, Quenet F, Bereder JM, Mansvelt B, et al. Peritoneal colorectal carcinomatosis treated with surgery and perioperative intraperitoneal chemotherapy: retrospective analysis of 523 patients from a multicentric French study. J Clin Oncol 2010; 28: 63-68. [CrossRef]
18. Verwaal VJ, Bruin S, Boot H, van Slooten G, van Tinteren H. 8-year follow-up of randomized trial: cytoreduction and hyperthermic intraperitoneal chemotherapy versus systemic chemotherapy in patients with peritoneal carcinomatosis of colorectal cancer. Ann Surg Oncol 2008; 15: 2426-2432. [CrossRef]
19. Yonemura Y, Canbay E, Ishibashi H. Prognostic factors of peritoneal metastases from colorectal cancer following cytoreductive surgery and perioperative chemotherapy. Scientific World Journal 2013; 2013: 978394. [CrossRef]
20. da Silva RG, Sugarbaker PH. Analysis of prognostic factors in seventy patients having a complete cytoreduction plus perioperative intraperitoneal chemotherapy for carcinomatosis from colorectal cancer. J Am Coll Surg 2006; 203: 878-886. [CrossRef]
21. Esquivel J, Sticca R, Sugarbaker P, Levine E, Yan TD, Alexander R, et al. Cytoreductive surgery and hyperthermic intraperitoneal chemotherapy in the management of peritoneal surface malignancies of colonic origin: a consensus statement. Society of Surgical Oncology. Ann Surg Oncol 2007; 14: 128-33. [CrossRef]
22. Falcone A, Ricci S, Brunetti I, Pfanner E, Allegrini G, Barbara C, et al. Phase III trial of infusional fluorouracil, leucovorin, oxaliplatin, and irinotecan (FOLFOXIRI) compared with infusional fluorouracil, leucovorin, and irinotecan (FOLFIRI) as first-line treatment for metastatic colorectal cancer: the Gruppo Oncologico Nord Ovest. J Clin Oncol 2007; 25: 1670-1676. [CrossRef]
23. Kallinowski B. Indications and effect on survival of standard chemotherapy in advanced colorectal cancer. Recent Results Cancer Res 2005; 165: 245-249. [CrossRef]
24. Hurwitz H, Fehrenbacher L, Novotny W, Cartwright T, Hainsworth J, Heim W, et al. Bevacizumab plus irinotecan, fluorouracil, and leucovorin for metastatic colorectal cancer. N Engl J Med 2004; 350: 2335-2342. [CrossRef]
25. Van Cutsem E, Köhne CH, Hitre E, Zaluski J, Chang Chien CR, Makhson A, et al. Cetuximab and chemotherapy as initial treatment for metastatic colorectal cancer. N Engl J Med 2009; 360: 1408-1417. [CrossRef]
26. de Cuba EM, Kwakman R, Knol DL, Bonjer HJ, Meijer GA, Te Velde EA. Cytoreductive surgery and HIPEC for peritoneal metastases combined with curative treatment of colorectal liver metastases: Systematic review of all literature and meta-analysis of observational studies. Cancer Treat Rev 2013; 39: 321-327. [CrossRef]
27. Elias D, Delperro JR, Sideris L, Benhamou E, Pocard M, Baton O, et al. Treatment of peritoneal carcinomatosis from colorectal cancer: impact of complete cytoreductive surgery and difficulties in conducting randomized trials. Ann Surg Oncol 2004; 11: 518-521. [CrossRef]
28. Miner TJ, Shia J, Jaques DP, Klimstra DS, Brennan MF, Coit DG. Long-term survival following treatment of pseudomyxoma peritonei. An analysis of surgical therapy. Ann Surg 2005; 241: 300-308. [CrossRef]
29. Chua TC, Moran BJ, Sugarbaker PH, Levine EA, Glehen O, Gilly FN, et al. Early- and long-term outcome data of patients with pseudomyxomaperitonei from appendiceal origin treated by a strategy of cytoreductive surgery and hyperthermic intraperitoneal chemotherapy. J Clin Oncol 2012; 30: 2449-2456. [CrossRef]
30. Baratti D, Kusamura S, Nonaka D, Cabras AD, Laterza B, Deraco M. Pseudomyxoma peritonei: biological features are the dominant prognostic determinants after complete cytoreduction and hyperthermic intraperitoneal chemotherapy. Ann Surg 2009; 249: 243-249. [CrossRef]
31. Yan TD, Bijelic L, Sugarbaker PH. Critical analysis of treatment failure after complete cytoreductive surgery and perioperative intraperitoneal chemotherapy for peritoneal dissemination from appendiceal mucinous neoplasms. Ann Surg Oncol 2007; 14: 2289-2299. [CrossRef]
32. Elias D, Gilly F, Quenet F, Bereder JM, Sidéris L, Mansvelt B, et al. Pseudomyxoma peritonei: a French multicentric study of 301 patients treated with cytoreductive surgery and intraperitoneal chemotherapy. Eur J Surg Oncol 2010; 36: 456-462. [CrossRef]
33. Canbay E, Ishibashi H, Sako S, Mizumoto A, Hirano M, Ichinose M, et al. Preoperative carcinoembryonic antigen level predicts prognosis in patients with pseudomyxoma peritonei treated with cytoreductive surgery and hyperthermic intraperitoneal chemotherapy. World J Surg 2013; 37: 1271-1276. [CrossRef]
34. Brouquet A, Goéré D, Lefèvre JH, Bonnet S, Dumont F, Raynard B, et al. The second procedure combining complete cytoreductive surgery and intraperitoneal chemotherapy for isolated peritoneal recurrence: postoperative course and long-term outcome. Ann Surg Oncol 2009; 16: 2744-2751. [CrossRef]
35. Ikeguchi M, Oka A, Tsujitani S, Maeta M, Kaibara N. Relationship between area of serosal invasion and intraperitoneal free cancer cells in patients with gastric cancer. Anticancer Res 1994; 14: 2131-2134.
36. Sadeghi B, Arvieux C, Glehen O, Beaujard AC, Rivoire M, Baulieux J, et al. Peritoneal carcinomatosis from non-gynecologic malignancies: Results of the EVOCAPE 1 multicentric prospective study. Cancer 2000; 88: 358-363. [CrossRef]
37. Pyrhönen S, Kuitunen T, Nyandoto P, Kouri M. Randomized comparison of fluorouracil, epidoxorubicin and methotrexate (FEMTX) plus supportive care with supportive care alone in patients with non-resectable gastric cancer. Br J Cancer 1995; 71: 587-591. [CrossRef]
38. Bozzetti F, Yu W, Baratti D, Kusamura S, Deraco M. Locoregional treatment of peritoneal carcinomatosis from gastric cancer. J Surg Oncol 2008; 98: 273-276. [CrossRef]
39. Xu DZ, Zhan YQ, Sun XW, Cao SM, Geng QR. Meta-analysis of intraperitoneal chemotherapy for gastric cancer. World J Gastroenterol 2004; 10: 2727-2730. [CrossRef]
40. Yan TD, Black D, Sugarbaker PH, Zhu J, Yonemura Y, Petrou G, et al. A systematic review and meta-analysis of the randomized controlled trials on adjuvant intraperitoneal chemotherapy for resectable gastric cancer. Ann Surg Oncol 2007; 14: 2702-2713. [CrossRef]
41. Yu W. A review of adjuvant therapy for resected primary gastric cancer with an update on Taegu's phase III trial with intraperitoneal chemotherapy. Eur J Surg Oncol 2006; 32: 655-660. [CrossRef]
42. Hall JJ, Loggie BW, Shen P, Beamer S, Douglas Case L, McQuellon R, et al. Cytoreductive surgery with intraperitoneal hyperthermic chemotherapy for advanced gastric cancer. J Gastrointest Surg 2004; 8: 454-463. [CrossRef]
43. Yonemura Y, Kawamura T, Bandou E, Takahashi S, Sawa T, Matsuki N. Treatment of peritoneal dissemination from gastric cancer by peritonectomy and chemohyperthermic peritoneal perfusion. Br J Surg 2005; 92: 370-375. [CrossRef]
44. Glehen O, Gilly FN, Arvieux C, Cotte E, Boutitie F, Mansvelt B, et al. Peritoneal carcinomatosis from gastric cancer: a multi-institutional study of 159 patients treated by cytoreductive surgery combined with perioperative intraperitoneal chemotherapy. Ann Surg Oncol 2010; 17: 2370-2377. [CrossRef]
45. Yonemura Y, Elnemr A, Endou Y, Ishibashi H, Mizumoto A, Miura M, et al. Effects of neoadjuvant intraperitoneal/systemic chemotherapy (bidirectional chemotherapy) for the treatment of patients with peritoneal metastasis from gastric cancer. Int J Surg Oncol 2012: 2012: 1448420.
46. Yang XJ, Huang CQ, Suo T, Mei LJ, Yang GL, Cheng FL, et al. Cytoreductive surgery and hyperthermic intraperitoneal chemotherapy improves survival of patients with peritoneal carcinomatosis

from gastric cancer: final results of a phase III randomized clinical trial. Ann Surg Oncol 2011; 18: 1575-1581. [CrossRef]
47. Canbay E, Mizumoto A, Ichinose M, Ishibashi H, Sako S, Hirano M, et al. Outcome data of patients with peritoneal carcinomatosis from gastric origin treated by a strategy of bidirectional chemotherapy prior to cytoreductive surgery and hyperthermic intraperitoneal chemotherapy in a single specialized center in Japan. Ann Surg Oncol 2014; 21: 1147-1152. [CrossRef]
48. Ozols RF. Treatment goals in ovarian cancer. Int J Gynecol Cancer 2005; 15: 3-11. [CrossRef]
49. Cannistra SA. Cancer of the ovary. N Engl J Med 2004; 351: 2519-2529. [CrossRef]
50. Trimble EL, Thompson S, Christian MC, Minasian L. Intraperitoneal chemotherapy for women with epithelial ovarian cancer. Oncologist 2008; 13: 403-409. [CrossRef]
51. Armstrong DK, Bundy B, Wenzel L, Huang HQ, Baergen R, Lele S, et al. Intraperitoneal cisplatin and paclitaxel in ovarian cancer. N Engl J Med 2006; 354: 34-43. [CrossRef]
52. Mu-oz-Casares FC, Rufián S, Rubio MJ, Díaz CJ, Díaz R, Casado A, et al. The role of hyperthermic intraoperative intraperitoneal chemotherapy (HIPEC) in the treatment of peritoneal carcinomatosis in recurrent ovarian cancer. Clin Transl Oncol 2009; 11: 753-759. [CrossRef]
53. Cotte E, Glehen O, Mohamed F, Lamy F, Falandry C, Golfier F, et al. Cytoreductive surgery and intraperitoneal chemohyperthermia for chemoresistant and recurrent advanced epithelial ovarian cancer: prospective study of 81 patients. World J Surg 2007; 31: 1813-1820. [CrossRef]
54. Bristow RE, Puri I, Chi DS. Cytoreductive surgery for recurrent ovarian cancer. Gynecol Oncol 2009; 112: 265-274. [CrossRef]
55. Spiliotis J, Halkia E, Lianos E, Kalantzi N, Grivas A, Efstathiou E, et al. Cytoreductive surgery and HIPEC in recurrent epithelial ovarian cancer: a prospective randomized phase III study. Ann Surg Oncol 2015; 22: 1570-1575. [CrossRef]
56. Eltabbakh GH, Piver MS, Hempling RE, Recio FO, Intengen ME. Clinical picture, response to therapy, and survival of women with diffuse malignant peritoneal mesothelioma. J Surg Oncol 1999; 70: 6-12. [CrossRef]
57. Yano H, Moran BJ, Cecil TD, Murphy EM. Cytoreductive surgery and intraperitoneal chemotherapy for peritoneal mesothelioma. Eur J Surg Oncol 2009; 35: 980-985. [CrossRef]
58. Baratti D, Kusamura S, Cabras AD, Laterza B, Balestra MR, Deraco M. Lymph node metastases in diffuse malignant peritoneal mesothelioma. Ann Surg Oncol 2010; 17: 45-53. [CrossRef]
59. Chua TC, Yan TD, Morris DL. Outcomes of cytoreductive surgery and hyperthermic intraperitoneal chemotherapy for peritoneal mesothelioma: the Australian experience. J Surg Oncol 2009; 99: 109-113. [CrossRef]
60. Blackham AU, Shen P, Stewart JH, Russell GB, Levine EA. Cytoreductive surgery with intraperitoneal hyperthermic chemotherapy for malignant peritoneal mesothelioma: mitomycin versus cisplatin. Ann Surg Oncol 2010; 17: 2720-2727. [CrossRef]
61. Yan TD, Deraco M, Baratti D, Kusamura S, Elias D, Glehen O, et al. Cytoreductive surgery and hyperthermic intraperitoneal chemotherapy for malignant peritoneal mesothelioma: multiinstitutional experience. J Clin Oncol 2009; 27: 6237-6242. [CrossRef]
62. Yan TD, Deraco M, Elias D, Glehen O, Levine EA, Moran BJ, et al. A novel tumor-node-metastasis (TNM) staging system of diffuse malignant peritoneal mesothelioma using outcome analysis of a multi-institutional database. Cancer 2011; 117: 1855-1863. [CrossRef]
63. Deraco M, Bartlett D, Kusamura S, Baratti D. Consensus statement on peritoneal mesothelioma J Surg Oncol 2008; 98: 268-272. [CrossRef]