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The parameters to estimate postoperative severe complications classified through Clavien-Dindo after upper abdominal surgery in patients with primary and recurrent ovarian cancer

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ABSTRACT

Objectives: The more surgical effort and performing extensive upper abdominal surgery (UAS) are often required to accomplish the highest rates of optimally cytoreduction in patients with ovarian cancer. Nonetheless, the rate of complications increases with extensive surgery. We have studied the upper abdominal surgery complications by Clavien-Dindo Classification (CDC) and analyzed parameters affecting post-operative severe complications classified through Clavien-Dindo.

Material and methods: A retrospective cohort of patients diagnosed with epithelial ovarian cancer from January 1st 2009 to April 30th 2016 was evaluated. Patients who underwent at least one UAS procedure with or without optimal cytoreduction for epithelial ovarian cancer (stage IIIC–IV or recurrent) were included. Postoperative complications were recorded according to the Clavien-Dindo Classification.

Results: In total, 58 patients were included. There were 120 UAS procedures performed on the 58 patients. Diaphragm peritonectomy was the most performed surgery (50%, 29/58), and then the other UAS procedures were liver surgery (39.7%, 23/58), cholecystectomy (24.1%, 14/58), splenic surgery (24.1%, 14/58), full-thickness diaphragm resection (22.4%, 13/58), pancreatic surgery (19%, 11/58), resection of tumor from porta hepatis (17.2%, 10/58), celiac lymph node excision (8.6%, 5/58), partial gastrectomy (1.7%, 1/58), respectively. Thirteen patients (22.4%) had post-operative grade 3–5 complications according to CDC within 30 days after surgery.

Conclusions: This current study demonstrated that the addition of extensive upper abdominal surgery procedures were not associated with increased postoperative severe complications in patients with recurrent or advanced ovarian cancer. These procedures are safe and feasible for patients in need and also can be performed with acceptable mortality and morbidity.

Key words: upper abdominal surgery; Clavien-Dindo; ovarian cancer; postoperative complication

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INTRODUCTION

Ovarian cancer is the second most common malignancy of reproductive tract in women and epithelial ovarian cancer (EOC) is the most fatal gynecologic cancer; the number of new cases of ovarian cancer is 11.9 per 100,000 whereas the number of deaths is 7.5 per 100,000 [1]. Despite the devastating survival statistics compared to other gynecologic cancers, there has been a decline in the mortality rate of EOC. Death rates have been falling on average 2.2% each year between 2004–2013 and the 5-year survival rate has an upward trend, increasing from 33.7% in 1977 to 46.2% in 2008, although the majority of ovarian cancer patients have metastasis to upper abdominal organs at diagnosis and found to have stage III or stage IV disease [1]. Progress in life expectancy of ovarian cancer patients can mainly be attributed to advances in cytoreductive surgery and implementation of platin based chemotherapy [2, 3].

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Major developments in medical treatment of EOC are: introduction and combination of paclitaxel to platin based chemotherapy in 1996 [4]; the emergence of intraperitoneal chemotherapy in 2006 [5]; and targeted chemotherapies and poly [adenosine diphosphate (ADP)] ribose polymerase (PARP) inhibitors recently [6]. The evolution of surgical treatment of EOC was towards more radical, extensive procedures that consisted of radical oopherectomy, pelvic peritonectomy, bowel resections and anastomosis, and then upper abdominal procedures were added to armory of gynecologic oncologists [7]. The concept of optimal cytoreduction was changing and brought to an end at maximal cytoreduction in order to improve overall survival, despite the new medical treatment modalities [8]. There has been afierce debate over extensive maximal debulking surgery versus neoadjuvant treatment. However, many studies have shown that primary cytoreductive surgery (CRS) aiming no residual disease was the most important modifiable prognostic factor affecting survival [9–11]. A dedicated gynecologic oncology team performing extensive upper abdominal surgery (UAS) such as diaphragm stripping and/or resection, liver resection, cholecystectomy, splenectomy, distal pancreatectomy, resection of tumor from porta hepatis, celiac lymph node excision and partial gastrectomy is required to accomplish the highest rates of optimally cytoreduction or complete resection [11–13]. The comprehension of CRS and the biology of a tumor was established by many reports on the impact of CRS and upper abdominal surgery on oncological outcomes. However, systematic evaluation of complications of upper abdominal surgery is seldom studied. Additionally, standardization is required for classification of surgical complications. There is no consensus among gynecologic oncologist on how to report surgical complications.

Clavien-Dindo Classification (CDC), mainly used by general surgeons, has been proposed to rank a complication in an objective, reliable and reproducible manner [14]. The point of CDC is mainly on the therapeutic consequences of a complication. Therefore, we have studied the upper abdominal surgery complications by CDC and analyzed parameters affecting post-operative severe complications classified through Clavien-Dindo.

MATERIAL AND METHODS

We obtained Institutional Review Board approval (number: 04/03/15:55) and then identified all patients with International Federation of Gynecology and Obstetrics (FIGO) stage IIIC and IV epithelial ovarian cancer or recurrent epithelial ovarian cancer who underwent extensive upper abdominal surgery at the Suleyman Demirel University Hospital from January 1, 2009 thru April 30, 2016. The medical records of all patients were retrospectively reviewed for the following data: age, body mass index (BMI) American Society of Anesthesiologist (ASA) score, Eastern Cooperative Oncology Group (ECOG) performance status, FIGO stage, pre-operative albumin, serum cancer antigen (CA125), hemoglobin levels, ascites, upper abdominal surgery procedures, estimated blood loss, intraoperative blood transfusion, duration of surgery, residual disease after surgery, length of hospital stay, and finally post-operative complications within 30 days and pathologic data.

We included patients who had undergone at least one upper abdominal surgery procedure with or without optimal cytoreduction for epithelial ovarian cancer (FIGO stages IIIC–IV or recurrent). We excluded patients who had received neoadjuvant chemotherapy or histologically confirmed non-epithelial ovarian cancers, low malignant potential tumors from the study.

These patients were classified according to residual disease (RD); RD 0: no residual disease, RD 1–10: residual disease 1–10 mm, and RD > 10: gross residual disease is more than 10 mm. Extensive surgical procedures were performed on the upper abdomen included diaphragm peritonectomy, full-thickness diaphragm resection, liver surgery (partial liver resection or segmental hepatectomy or liver capsule metastasectomy), cholecystectomy, splenic surgery (splenectomy or resection of tumor on the surface of spleen without splenectomy), pancreatic surgery (distal pancreatectomy or resection of tumor on the pancreatic capsule), partial gastric resection, celiac lymph node excision, and resection of tumor from porta hepatis.

We recorded post-operative complications with the Clavien-Dindo Classification. We accepted post-operative complications or death associated with surgery if occuring within 30 days after surgery. Complications were evaluated in five categories depending on their severity in the CDC (1: no treatment or simple medical treatment, and 5: death) (Tab. 1). We subdivided patients into two groups; grade 1–2 complications as mild and grade 3–5 as a severe group. We focused on those grades with serious clinical outcomes. If patients had more than one complication, we noted the highest grade complication in the analysis. Adjuvant chemotherapy was routinely administered within 6 weeks of the operation.

Mean, standard deviation, median lowest, highest, frequency and ratio values were used in the descriptive statistics of the data. The distribution of the variables was measured by the Kolmogorov Simirnov Test. Mann-Whitney U Test and Independent Sample T Test were used in the analysis of quantitative data. The Chi-square test was used to analyze qualitative data, and the Fisher test was used when the chi-square test conditions were not met. SPSS 22.0 program was used in the analyzes.

Table 1. Clavien-Dindo Classification of surgical complications

Grade	Definition
Grade I	Any deviation from the normal course without the need for pharmacological treatment or surgical, endoscopic and radiologic interventions. Allowed therapeutic regimens are: drugs as antiemetics, antipyretics, analgetics, diuretics, electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside
Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included
Grade III	Requiring surgical, endoscopic or radiological intervention
IIIA	Intervention not under general anesthesia
IIIB	Intervention under general anesthesia
Grade IV	Life-threatening complication (including CNS complications)* requiring IC/ICU management
IVA	Single organ dysfunction (including dialysis)
IVB	Multiorgan dysfunction
Grade V	Death of a patient

*Brain hemorrhage, ischemic stroke, subarachnoid bleeding, but excluding transient ischemic attacks; CNS — central nervous system; IC — intermediate care; ICU — intensive care unit

RESULTS

Fifty-eight patients with EOC who underwent upper abdominal surgery at our institution were included in this study between January 1, 2009 and April 30, 2016. All patients underwent cytoreductive surgery by exploratory laparotomy. The demographic characteristics and surgical outcomes were abstracted in Table 2.

The mean age was 62.2, mean BMI was 27.6 kg/m^2, mean ascites volume was 919.3 ml, mean preoperative serum hemoglobin level was 12.4 g/dL, mean preoperative serum albumin level was 3.6 g/dL, mean preoperative serum CA125 was 799 u/mL, mean estimated blood loss was 387.1 mL, mean operative time was 319.1 minutes and mean post-operative hospital stay was 13.4 days. An intra-operative blood transfusion was required in 33 patients (56.8%).

The most common ECOG performance status score was 0 (36.2%) and 65.5% of patients had an ASA class of 2. The majority of patients had serous histology (87.9%) and grade 3 tumors (67.3%).

Thirty-two out of 58 patients (55.2%) had primary disease and 26 patients (44.8%) had recurrent disease. According to the results of cytoreductive surgery, no gross residual disease after surgery was in 58.6% (n: 34/58, RD 0), gross residual disease ≤ 10 mm in 12.1% (n: 7/58, RD 1–10mm), and gross residual disease > 10 mm in 29.3% (n: 17/58, RD > 10 mm). In patients who underwent debulking surgery was primary cytoreduction in 55.2% (32/58), secondary cytoreduction in 31.1% (18/58), tertiary cytoreduction in 13.7% (8/58) of cases respectively. Twenty-seven out of 32 patients (84.3%) who had primary disease was stage IIIC and 5 patients (15.7%) were stage VI according to FIGO classification.

There were 120 UAS procedures performed on the 58 patients, and multiple procedures were performed in many of patients. Diaphragm peritonectomy was the most

Table 2. Patient and clinical characteristics

	Min–max	Mean + SD/N–%
Age [years]	42.0–92.0	62.2 + 10.6
BMI [kg/m^2]	18.0–34.4	27.6 + 4.1
Preoperative serum hemoglobin [g/dL]	9.2–15.4	12.4 + 1.4
Preoperative serum albumin [g/dL]	1.6–4.8	3.6 + 0.6
Preoperative serum CA125 [u/mL]	11.0–5005.0	799.0 + 1140.1
Ascites volume [mL]	0–7000.0	919.3 + 1490.1
Operative time [min]	140.0–570.0	319.1 + 116.9
Length of hospitalization [days]	5.0–42.0	13.4 + 8.2
Estimated blood loss [mL]	100–1700.0	387.1 + 332.7
Intra-operative units of blood transfused		33 56.8
ECOG performance status		
0		21 36.2
1		16 27.6
2		12 20.7
3		9 15.5
ASA score		
1		3 5.2
2		38 65.5
3		17 29.3
Cytoreduction		
Primary		32 55.2
Secondary		18 31.1
Tertiary		8 13.7
FIGO stage		
IIIC		27 46.6
IV		5 8.6
Recurrent disease		26 44.8
Residual disease		
RD 0		34 58.6
RD 1–10 mm		7 12.1
RD > 10 mm		17 29.3
Histology		
Serous		51 87.9
Endometrioid		3 5.2
Mucinous		1.7
Carcinosarcoma		3.5
Transitional		1 1.7
Tumor grade		
1		7 12.1
2		12 20.6
3		39 67.3

PO — postoperative; BMI — body mass index; ASA — American Society of Anesthesiologist; ECOG — Eastern Cooperative Oncology Group; FIGO — International Federation of Gynecology and Obstetrics; CA125 — cancer antigen; RD — residual disease; SD — standard deviation

performed surgery (50%, 29/58), and then the other UAS procedures were liver surgery (39.7%, 23/58), (right posterior bisegmentectomy (segment 6–7); 1/58, intraparenchymal tumor resections; 10/58, liver capsule metastasectomy; 12/58), cholecystectomy (24.1%, 14/58), splenic surgery (24.1%, 14/58) (splenectomy; 12/58, resection of the tumor on the surface of spleen; 2/58), full-thickness diaphragm resection (22.4%, 13/58), pancreatic surgery (19%, 11/58) (distal pancreatectomy; 4/58, resection of tumor on the pancreatic capsule; 7/58), resection of tumor from porta hepatis (17.2%, 10/58), celiac lymph node excision (8.6%, 5/58), partial gastrectomy (1.7%, 1/58), respectively. Other surgical procedures implemented to patients were hysterectomy, unilateral/bilateral salpingo-oophorectomy, pelvic lymph node dissection, para-aortic lymph node dissection, omentectomy, peritonectomy, small bowel resection, large bowel resection, ileostomy, appendectomy, cardiophrenic lymph node dissection, VATS (video assisted thoracoscopic surgery), IP (intraperitoneal) catheter, and HIPEC (hyperthermic intraperitoneal chemotherapy) (Tab. 3).

Thirteen patients (22.4%) had post-operative grade 3–5 complications according to Clavien-Dindo Classification within 30 days after surgery (Tab. 4). Ten patients (17.2%) were reported as grade 3 complication, 1 patient (1.7%) was reported as grade 4 complication, and 2 patients (3.5%) were reported as grade 5 complication. Grade 3 complications were treated surgical, endoscopic or radiological intervention. Grade 4 complication was a life-threatening complication and treated at intensive care unit.

Two patients had grade 5 complications (mortalities) within 30 days of surgery (3,5%). The first patient died due to short bowel syndrome in the 28th post-operative day; she was a 49-year-old patient with an ECOG performance status of 2 who underwent multiple surgical procedures (right diaphragm peritonectomy, splenectomy, distal pancreatectomy, total colon resection, resection of the small intestine segment after the 70th cm of the treitz ligament, jejunostomy, HIPEC and RD 0 tertiary cytoreduction) for recurrent serous ovarian carcinoma. The second patient died due to acute cardiopulmonary failure in the 5th post-operative day; she was an 87-year-old patient with an ECOG performance status of 3 and cardiac failure who underwent multiple surgical procedures (total abdominal hysterectomy with bilateral salpingo-oophorectomy, splenectomy, cholecystectomy, distal pancreatectomy, porta hepatis disease resection, total colectomy, ileostomy and optimal cytoreduction) for a stage 4 serous ovarian carcinoma. The patient's status was stable until the third postoperative day. On the third postoperative day, respiratory arrest occurred suddenly. She was taken to the intensive care unit and was connected to a ventilator

Table 3. Data of surgical procedures implemented to patients

	Patients (N: 58) n %
Upper abdominal surgery procedures (n: 120)	
Diaphragm peritonectomy	29/58 50
Full-thickness diaphragm resection	13/58 22.4
Splenic surgery	14/58 24.1
Pancreatic surgery	11/58 19.0
Cholecystectomy	14/58 24.1
Partial gastrectomy	1/58 1.7
Liver Surgery	23/58 39.7
Celiac lymph node resection	5/58 8.6
Porta Hepatis disease resection	10/58 17.2
Other procedures	
Hysterectomy	34/58 58.6
Unilateral/bilateral salpingo-oophorectomy	34/58 58.6
Pelvic lymph node dissection	25/58 43.1
Para-aortic lymph node dissection	24/58 41.3
Omentectomy	39/58 67.2
Peritonectomy	29/58 50
Small bowel resection	13/58 22.4
Large bowel resection	21/58 36.2
Ileostomy	2/58 3.4
Colostomy	4/58 6.9
Anastomosis	19/58 32.7
Appendectomy	14/58 24.1
Cardiophrenic lymph node dissection	1/58 1.7
VATS	7/58 12.1
IP catheter	5/58 8.6
HIPEC	5 /58 8.6

VATS — video assisted thoracoscopic surgery; IP — intraperitoneal; HIPEC — hyperthermic intraperitoneal chemotherapy

Table 4. Post-operative grade 3–5 complications according to Clavien-Dindo Classification

Type of complication	UAS Patients (N: 58%)
Anastomotic insufficiency	2/58 3.5
Short bowel syndrome*	1/58 1.7
Pleural effusion	1/58 1.7
Pneumothorax	1/58 1.7
Pulmonary embolism	1/58 1.7
Postop bleeding	1/58 1.7
Acute cardiopulmonary failure*	1/58 1.7
Intra-abdominal abscess	1/58 1.7
Wound infection	2/58 3.5
Evisceration	2/58 3.5
Total complication	**13/58 22.4**

*Postoperative 30-day mortality (3.5%); UAS — Upper Abdominal Surgery

device and monitored. Her status worsened and she died on postoperative day 5.

We analyzed the parameters for prediction of the major postoperative complication and mortality after extensive upper abdominal surgery. There was no statistical difference in age, BMI, ascites, preoperative serum hemoglobin level, preoperative serum albumin level, preoperative serum CA125 level, estimated blood loss, operative time, ECOG performance status score, ASA score, FIGO stage and residual disease between complicated and uncomplicated patients ($p > 0.05$). Only the length of the post-operative hospital stay was statistically significant between complicated and uncomplicated patients ($p < 0.05$) (Tab. 5).

No statistical difference was found between the length of the post-operative hospital stay and the types of upper abdominal surgical procedures ($p > 0.05$) (Tab. 6).

There was also no statistical difference in upper abdominal surgery procedures between complicated and uncomplicated patients ($p > 0.05$). Only diaphragm peritonectomy was statistically significant ($p < 0.05$) (Tab. 7).

DISCUSSION

The amount of residual tumors after surgery in patients with advanced stage cancer is closely related to disease free and overall survival [11]. Ovarian cancer tends to spread to the upper abdominal anatomic sites and organs and therefore upper abdominal surgery has a key role to achieve the optimally cytoreduction rate [15]. There are very few studies to indicate the complication rate in patients with extensive upper abdominal surgeries. Kuhn et al. [12] reported that the rate of perioperative serious complication increased in patients with advanced ovarian cancer who underwent UAS compared to standard surgery for tumor debulking. Chi et al. demonstrated that the rate of postoperative major complications in patients underwent extensive UAS was 22% and the rate of postoperative mortality was 1.4%. This postoperative mortality and morbidity rate was acceptable [16]. In a population-based systematic review an average postoperative mortality after primary cytoreductive surgery for advanced stage epithelial ovarian cancer was reported as 2.5–3.7% [17]. In our study, the mortality rate was 3.4% and was similar to the literature.

Table 5. Comparison of parameters between patients with or without severe complications

		PO severe complication no		PO severe complication yes		p
		Mean + SD/n–%	Min–Max	Mean + SD/n–%	Min–Max	
Age [years]		61.5 ± 10.2	42–92	64.5 ± 12.1	45–87	0.355
BMI [kg/m^2]		27.7 ± 3.8	18–34	27.2 ± 5.0	21–34	0.532
Preoperative serum hemoglobin [g/dL]		12.4 ± 1.3	10–15	12.4 ± 1.8	9–15	0.881
Preoperative serum albumin [g/dL]		3.7 ± 0.7	1.6–4.8	3.5 ± 0.5	2.6–4.2	0.170
Preoperative serum CA125 [u/mL]		827.8 ± 1190.5	11–5005	699.2 ± 981.4	22–3372	0.758
Ascites volume [mL]		815 ± 1454	0–7000	1281 ± 1617	0–4000	0.665
Operative time [min.]		313.8 ± 118.4	140–570	337.7 ± 114.4	180–560	0.520
Length of hospitalization [days]		11.0 ± 4.4	5–24	21.9 ± 12.0	5–42	0.001
Estimated blood loss [mL]		353.3 ± 282.7	100–1300	503.8 ± 462.1	100–1700	0.285
ECOG performance status	0	16 35.6%		5 38.5%		0.393
	1	14 31.1%		2 15.4%		
	2	9 20.0%		3 23.1%		
	3	6 13.3%		3 23.1%		
ASA score	1	3 6.7%		0 0.0%		0.896
	2	29 64.4%		9 69.2%		
	3	13 28.9%		4 30.8%		
FIGO Stage	3C	22 48.9%		5 38.5%		0.600
	4	2 4.4%		3 23.1%		
	Recurrent	21 46.7%		5 38.5%		
Residual Disease	No Visible	27 60.0%		7 53.8%		0.210
	1–10 mm	3 6.7%		4 30.8%		
	> 10 mm	15 33.3%		2 15.4%		

T-test, Mann-Whitney U test, Chi-square test; PO — postoperative; BMI — body mass index; ASA — American Society of Anesthesiologist; ECOG — Eastern Cooperative Oncology Group; FIGO — International Federation of Gynecology and Obstetrics; CA125 — cancer antigen; SD — standard deviation

Table 6. Comparison of length of hospital stay and types of surgical procedures

	Length of Hospital Stay			
	Min–Max	Median	Mean + SD	p
Diaphragm Resection No Yes	5.0–42.0 8.0–33.0	11 12	13.2 + 8.4 14.2 + 7.5	0.437
Diaphragm Peritonectomy No Yes	5.0–24.0 5.0–42.0	10 12	10.8 + 4.2 16.1 + 10.2	0.057
Splenic Surgery No Yes	5.0–42.0 5.0–33.0	11 11	13.4 + 8.2 13.7 + 8.2	0.827
Cholecystectomy No Yes	5.0–42.0 5.0–24.0	11 11	13.8 + 8.9 12.2 + 5.1	0.956
Gastric Surgery No Yes	5.0–42.0 28.0–28.0	11 28	13.2 + 8.0 28.0 + –	0.142
Pancreatic Surgery No Yes	5.0–42.0 5.0–33.0	10 13	12.8 + 8.0 16.1 + 8.9	0.164
Liver Surgery No Yes	5.0–38.0 5.0–42.0	11 12	12.7 + 7.0 14.7 + 9.8	0.566
Porta Hepatis Disease Resection No Yes	5.0–42.0 5.0–24.0	11 12	13.6 + 8.6 12.8 + 5.6	0.965
Celiac Lymph Node Resection No Yes	5.0–42.0 8.0–18.0	11 11	13.5 + 8.5 12.4 + 4.4	0.813

Mann-Whitney U test

Table 7. Comparison of postoperative severe complications and types of surgical procedures

	PO severe complication no	PO severe complication yes	p
	n %	n %	
Diaphragm Resection	11 24.4	2 15.4	0.490
Diaphragm Peritonectomy	19 42.2	10 76.9	**0.028**
Splenic Surgery	9 20.0	5 38.5	0.171
Cholecystectomy	12 26.7	2 15.4	0.402
Gastric Surgery	0 0.0	1 7.7	0.224
Pancreatic Surgery	7 15.6	4 30.8	0.118
Liver Surgery	16 35.6	7 53.8	0.235
Porta Hepatis Disease Resection	6 13.3	4 30.8	0.143
Celiac Lymph Node Resection	4 8.9	1 7.7	1.000

PO — postoperative, x^2 chi-square test (Fisher exact test)

In a previous study, the rate of postoperative major complications (grade 3–5) was reported as 19.8% in patients underwent UAS [18]. In our study, the rate of severe postoperative complications (grade 3–5) was 22.4% and was compatible with this study.

In recent studies, liver surgery, splenectomy, pancreatic surgery, cholecystectomy, celiac lymphadenectomy and resection tumor from porta hepatis were reported as strong predictive factors for postoperative severe complications during cytoreductive surgery for advanced ovarian cancer [19–22]. We did not find any correlation between these procedures and postoperative severe complications. In our study, only diaphragm peritonectomy was associated with postoperative severe complications.

In the literature, the incidence of postoperative pleural effusion after diaphragmatic surgery as part of ovarian cancer debulking surgery ranged from 10% to 59% [23–26]. There is no consensus about use of a chest tube when the pleural space is opened during diaphragm surgery. Some authors do not recommend prophylactic use of a chest tube during diaphragm resection [18, 24–28], on the contrary, some authors routinely recommend chest tube placement [29–32]. Eisenhauer et al. [24] reported that the postoperative pleural effusion developed in 60% of the patients who underwent diaphragm surgery for advanced mullerian cancer and 15% of these patients required a postoperative chest tube placement or thoracentesis. In another study, the rate of postoperative pleural effusion following diaphragmatic peritonectomy with ovarian carcinoma was 30%, and 12.5% of these patients were treated with thoracentesis or chest tube placement to manage symptomatic pleural effusions [25]. In these two studies, routine use of chest tubes were not recommended when the pleural space is opened. In contrast, Chereau and colleagues did not place a chest tube in patients whose pleural cavity was opened during diaphragm surgery with stage III/IV ovarian cancer (38%) and the rate of postoperative chest tube placement was 27%. Therefore, at the end of this study period, they decided to consist-

ently place a chest tube [31]. Einenkel et al. [32] reported a high rate of postoperative chest tube placement (18%) and recommended use of chest tubes during diaphragm resection. In our study, we routinely placed a chest tube during diaphragm resection (22.4%) and necessity postoperative chest tube was 0% after diaphragm resection. We placed postoperative chest tubes because of symptomatic pleural effusion and pneumothorax in only 2 patients (3.4%) whose were not performed diaphragm surgery.

Langstraat et al. [33] showed that low albumin level, emergent surgery, advanced age and stage IV disease were associated with poor surgical outcomes in multivariate analysis. Besides, they observed that increased surgical complexity did not increase the risk of postoperative major complications. In light of this information, extensive surgery should not be avoided in patients who require complex surgeries.

There are some scoring systems to predict postoperative complications. However, these scoring systems are neglected if you can completely remove the tumor in patients with advanced stage cancer [34]. Because, the maximal cytoreductive surgery is the most important prognostic factor for overall survival in patients with advanced ovarian cancer.

Ataseven et al. [35] reported that preoperative serum albumin level was a predictive factor for severe postoperative complications (grade 3–5). However, in another study preoperative serum, albumin levels were not associated with severe postoperative complications [16]. We didn't observed any significant relationship between serum albumin levels in patients with and without postoperative severe complications.

Chi et al. analyzed predictive factors for the risk of severe postoperative complications in patients underwent UAS. Parameters such as BMI, age, ASA score, FIGO stage, and preoperative CA-125 levels were found unrelated. However, ascites volume, estimated blood loss and operative time were reported as predictive factors [16]. In a recent study, BMI was reported as an independent risk factor for severe postoperative complications and mortality in patients underwent primary surgical debulking for ovarian cancer [35]. However, we did not find a correlation between these predictive factors and severe postoperative complications in our study.

Benedetti Panici et al. [18] showed that the types of surgical procedures (diaphragmatic, pancreatic, gastric resection and splenectomy) were significantly related to a longer postoperative stay. In our study, there was no correlation between the types of upper abdominal surgery procedures and the length of hospital stay. However, it was longer in patients with severe complication, this result may be due to longer treatment process.

In conclusion, this current study demonstrated that the addition of extensive upper abdominal surgery procedures were not associated with increased postoperative severe complications in patients with recurrent or advanced ovarian cancer. These procedures are safe and feasible for patients in need and also can be performed with acceptable mortality and morbidity.

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