



Original Article

Surgical outcome prediction in patients with advanced ovarian cancer using computed tomography scans and intraoperative findings



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ABSTRACT

Objective: This study aimed to identify features on preoperative computed tomography (CT) scans that are predictive of suboptimal primary cytoreduction and to evaluate the correlation between CT findings and intraoperative findings in advanced ovarian cancer.

Materials and methods: We retrospectively reviewed preoperative CT scans and operative findings from patients with stage III/IV epithelial ovarian cancer who underwent primary cytoreduction between 2003 and 2006. Fourteen criteria were assessed. Clinical data were extracted from medical records. Residual tumors measuring ≥ 1 cm were considered suboptimal.

Results: We retrospectively identified 118 patients who met the study inclusion criteria. The rate of optimal cytoreduction (≤ 1 cm residual disease) was 40%. On preoperative CT scans, omental extension to the stomach or spleen and inguinal or pelvic lymph nodes >2 cm were predictors of suboptimal cytoreduction on univariate ($p = 0.016$ and $p = 0.028$, respectively) and multivariate analysis ($p = 0.042$ and $p = 0.029$, respectively). Involvement of both omental extension and inguinal or pelvic lymph nodes had a positive predictive value (PPV) of 100%, a specificity of 100%, and an accuracy of 45.8% in predicting suboptimal cytoreduction. We correlated the preoperative CT findings with the intraoperative findings. There were significant correlations between CT and intraoperative findings of omental extension ($p = 0.007$), inguinal or pelvic lymph nodes >2 cm ($p < 0.001$), and large bowel mesentery implants >2 cm ($p = 0.001$).

Conclusion: The combination of omental extension to the stomach or spleen and involvement of inguinal or pelvic lymph nodes in preoperative CT scans is considered predictive of suboptimal cytoreduction. These patients may be more appropriately treated with neoadjuvant chemotherapy followed by surgical cytoreduction.

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Introduction

Epithelial ovarian cancer (EOC) has the worst prognosis among gynecological malignancies because it is usually diagnosed in the advanced stage of the disease [1]. The incidence increases with age and is most prevalent in the 8th decade of life, with an incidence rate of 57/100,000 women. The median age at the time of diagnosis is 63 years, and 70% of patients present with advanced disease (stage III/IV) at the time of diagnosis [2]. Treatment in advanced-

stage EOC is based on primary cytoreductive surgery followed by platinum-based chemotherapy. The extent of residual disease after primary cytoreductive surgery is an important predictor of prognosis [3]. Although optimal cytoreduction is a highly significant predictor of outcome, the benefit of suboptimal cytoreduction is less evident [4]. Patients who undergo suboptimal primary cytoreduction may incur significant surgical morbidity without an associated gain in survival.

A very recent prospective, randomized study comparing upfront debulking surgery versus neoadjuvant chemotherapy was published. This study (EORTC 55971) demonstrated that neoadjuvant chemotherapy followed by interval debulking surgery was not inferior to primary debulking surgery followed by chemotherapy as a treatment option for patients with bulky stage IIIC or IV ovarian cancer [5].

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An accurate preoperative assessment of patients with advanced-stage EOC who cannot be cytoreduced optimally by primary surgery may facilitate the identification of more tailored treatment strategies [6]. In order to increase the accuracy of preoperative prediction, many authors have attempted to identify specific predictors of suboptimal cytoreduction. Currently available prediction models use clinical and radiographic characteristics. A number of studies have demonstrated an association between the preoperative CA-125 level and the inability to achieve optimal cytoreduction; yet the overall accuracy for predicting surgical outcome was only 50–78%, with most studies using a CA-125 cut-off value of 500 U/mL [7–13]. The limited usefulness of using preoperative CA-125 for triage has been documented by other studies [12,14]. Predictors of suboptimal cytoreductive surgery that can be identified on computed tomographic (CT) scans include diaphragm disease, diffuse peritoneal thickening, and large bowel mesentery implants [6,10,15,16]. Interpretation of the results of studies published to date is limited due to their retrospective nature, the highly variable rates of optimal cytoreduction (33–80%), the fact that most studies included patients with both early- and advanced-stage disease [3,15,17,18], and the different combinations of CT predictors that correlated with suboptimal cytoreduction in each of the study cohorts; the latter calls into question the applicability of identified CT predictors to other patient populations.

In this study, we evaluated the correlation between CT findings and intraoperative findings prior to cytoreductive surgery, and identified features on CT scans to predict suboptimal primary cytoreduction in advanced ovarian cancer.

Materials and methods

Patient selection

We retrospectively reviewed electronic medical records to identify patients with EOC who were treated at Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea, between January 2003 and December 2006.

A total of 239 patients with EOC were treated during this time period. We excluded patients who were diagnosed with stage I/II ovarian cancer ($n = 78$), received neoadjuvant chemotherapy ($n = 20$), or did not have preoperative CT scans within 4 weeks prior to primary cytoreductive surgery ($n = 23$). Finally, 118 patients were selected for the analysis.

All patients underwent standard abdominal midline laparotomy, and intensive surgical staging was attempted according to the standard guidelines. Maximal surgical effort (achievement of no macroscopic residual tumor or <1 cm residual disease) was attempted in all patients, and when possible, included surgical removal of all tumor masses, along with total abdominal hysterectomy, bilateral salpingo-oophorectomy, total omentectomy, appendectomy, multiple biopsies, or additional surgery if required [large bowel resections (5.1%), small bowel resection (1.7%), diaphragm stripping (2.5%), splenectomy (2.5%), and abdominopelvic peritoneal resection (39.0%)]. Systematic pelvic and para-aortic lymphadenectomy was performed in all patients who underwent primary cytoreduction leaving a residual tumor of ≤ 1 cm.

Patient evaluation

Only patients who had preoperative CT scans within 4 weeks prior to primary cytoreductive surgery and whose CT films were available for review were included in the study. Fourteen radiologic and surgical criteria were chosen from pertinent positive predictors gathered from previous studies [6,10,16] and supplemented with potential predictors from clinical experience. Radiologic criteria

Table 1

Clinical data and tumor characteristics of study patients ($N = 118$).

	Patients	
	No.	%
Age (y)		
<50	36	30
50–59	46	39
60–69	28	24
70–79	7	6
≥ 80	1	1
ASA status		
1	64	55.7
2	47	40.9
3	4	3.4
FIGO stage		
III A/B	10	8
III C	100	85
IV	8	7
Histologic subtype		
Serous	96	82
Transitional	11	9
Endometrioid	6	5
Mixed	5	4
Optimal cytoreduction	47	40
Suboptimal cytoreduction	71	60
CA-125 levels (U/mL)		
≤ 500	33	28.7
> 500	82	71.3

ASA = American Society of Anesthesiologists; FIGO = International Federation of Gynecology and Obstetrics.

included presence of large-volume ascites, pleural effusion, diffuse peritoneal thickening, omental cake, omental extension to the spleen or stomach, suprarenal lymph nodes larger than 1 cm, infrarenal or inguinal lymph nodes larger than 1 cm, and tumor implants larger than 2 cm on small and large bowel mesentery, peritoneum, diaphragm, liver, or porta hepatis. Large-volume ascites were noted when the presence of ascites was visible on two-thirds or more of the abdominopelvic CT scan or when more than 1 L of ascites was observed on surgical findings.

Diffuse peritoneal thickening was defined as peritoneal thickening to ≥ 4 mm involving at least two of the five following areas: lateral colic gutters, lateral conal fascia, anterior abdominal wall, diaphragm, and pelvic peritoneal reflections [10].

Demographic data, surgical findings, and pathologic data were retrospectively obtained from medical records. Optimal cytoreduction was defined as ≤ 1 cm residual disease. The clinical data used in the analysis included age, CA-125 serum levels, and the American Society of Anesthesiologists physical status classification, which were obtained from the anesthesia record. Collected laboratory values included preoperative CA-125 levels obtained within 4 weeks prior to surgery.

Postoperatively, all patients received taxane/platinum combination chemotherapy for six to eight cycles. Follow-up information was recorded until the date of last contact or death. Survival time was calculated from the date of last chemotherapy to the date of last contact or death. Survival outcomes were analyzed based on the pattern of disease spread at various anatomic sites.

Data analysis

Univariate comparisons between patients with optimal versus suboptimal cytoreduction were carried out using Chi-square and Fisher's exact tests for each of the 14 potential radiologic and operative predictors and clinical parameters. Simultaneous multivariate analysis of all 14 radiologic and surgical variables was carried out using backward stepwise logistic regression. After the normality of

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