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Concordance of a laparoscopic scoring algorithm with primary surgery findings in advanced stage ovarian cancer

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Abstract

Objectives: To determine the concordance between the laparoscopic scoring assessment and extent of disease identified at primary tumor reductive surgery (TRS) in patients with advanced ovarian cancer.

Methods: From April 2013 to June 2017, we prospectively triaged patients with stage IIA to IVB ovarian cancer to laparoscopic scoring assessment. A validated predictive index value (PIV) score (range: 0–14) was assigned. Patients with PIV scores <8 were offered primary surgery and those with score ≥8 received NACT. Patients who underwent primary TRS had a second PIV score based on laparotomy findings. Concordance percentages were calculated between the two scores. Positive predictive value (PPV) was calculated to reflect the performance of the laparoscopic PIV score to predict R0 (complete gross resection) at TRS.

Results: 226 patients underwent laparoscopic scoring assessment, of which 139 (61.5%) had a PIV score <8 and 81 (35.8%) had a PIV score ≥8. 6 patients (2.7%) were unscorable. There was 96% overall concordance between PIV scores at laparoscopy and primary TRS. Concordance scores by location were: bowel infiltration 74.7%, mesenteric disease 84.6%, liver surface involvement 86.5%, omental disease 89.7%, diaphragm disease 92.9%, stomach infiltration 94.7%, peritoneal carcinomatosis 94.8%. A laparoscopic PIV score of <8 had a PPV of 85.4% at predicting R0 at primary TRS.

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Conclusions: Laparoscopic assessment of tumor burden is a feasible tool to predict R0 cytoreduction in patients with advanced ovarian cancer. Concordance between PIV scores at laparoscopy and primary TRS varied by anatomic location, with the lowest concordance seen in predicting bowel infiltration.

Introduction

Ovarian cancer is most commonly diagnosed at advanced stage, with extensive intraperitoneal spread and carries a high risk of relapse despite aggressive surgery and chemotherapy. [1, 2] The mainstay of ovarian cancer therapy is tumor reductive surgery and platinum-based chemotherapy [3], as acknowledged by the National Comprehensive Cancer Network (NCCN) and other groups. [4] Prior studies have shown a survival benefit to maximal surgical cytoreduction. [5] While optimal cytoreduction has been traditionally defined as residual disease of less than 1 centimeter, more recently, the survival benefit of a subgroup undergoing cytoreduction to no gross residual disease (R0) has been demonstrated. [6–11] In patients who are medically inoperable or have distant metastatic disease leading to a low likelihood of achieving optimal cytoreduction, neoadjuvant chemotherapy (NACT) is recommended. [12–14]

It is important to determine at the time of diagnosis which patients should undergo primary tumor reductive surgery (TRS), and which should receive NACT in order to minimize surgical morbidity and maximize the extent of cytoreduction. As such, several algorithms to predict the extent of disease encountered at cytoreductive surgery have been developed and evaluated. [15, 16] Fagotti *et al.*, developed a laparoscopic scoring algorithm comprised of seven parameters: omental caking, peritoneal carcinomatosis, diaphragmatic carcinomatosis, mesenteric retraction, bowel infiltration, stomach infiltration, and liver metastases. [17, 18] Each of the seven parameters is scored either 0 (absence of disease) or 2 (presence of disease); the sum is referred to as the predictive index value (PIV). Patients in the initial pilot study underwent laparoscopy, in which the parameters listed above were evaluated, followed immediately by laparotomy and attempt at primary cytoreduction. Laparoscopy was found to have an accuracy of 75% at predicting surgical outcome and a laparoscopic PIV of 8 or greater was 100% specific among those having suboptimal (> 1cm tumor residual) TRS. [17] Follow-up studies have demonstrated that laparoscopic scoring carries a low risk of complications, helps avoid unnecessary laparotomies in patients in whom cytoreduction to no gross residual disease would not be possible [19], and is accurate and reliable when performed in high volume gynecologic oncology centers. [20] In a prospective study designed to evaluate the accuracy and reliability of the PIV to predict intraperitoneal spread, mesenteric retraction and bowel infiltration were the two parameters found most often to be non-evaluable and had the highest false negative rates at laparoscopy. [20]

We and others have used this individualized approach to the treatment of ovarian cancer, in which patients with suspected advanced stage ovarian cancer undergo laparoscopic scoring using the previously validated scale developed by Fagotti *et al.* [21–22]. In light of our own observations, and previous published data that mesenteric retraction and bowel infiltration may be less accurately evaluated by laparoscopy than the other parameters in the scoring algorithm, we sought to determine the concordance of laparoscopic scoring assessment in

predicting intraoperative tumor dissemination and residual disease at open primary TRS in advanced ovarian cancer.

Methods

All patients presenting to our institution between April 1, 2013 and June 30, 2017 with suspected advanced stage ovarian cancer were entered into a prospective quality improvement project, approved by the University of Texas MD Anderson Cancer Center Quality Improvement Board (QI-0139). The retrospective review of prospectively collected data was approved by our Institutional Review Board (PA16–1010). A consensus was reached among the 20 gynecologic oncologists at our institution and all patients with suspected advanced stage ovarian cancer were managed according to the same algorithm. Patients who were considered medically inoperable, including Eastern Cooperative Oncology Group (ECOG) performance status of 3 or 4, diagnosis of venous thromboembolism within six weeks of presentation, or distant metastatic or surgically unresectable disease were dispositioned to receive NACT. These patients were excluded from the analysis for the current study. Distant metastatic and/or unresectable disease was defined as intraparenchymal liver or lung metastases, mediastinal adenopathy, tumor burden and/or adenopathy in porta hepatis region, and bulky >2cm adenopathy in the aortic and retrocaecal region. Patients with suspected advanced stage ovarian cancer who were considered medically operable underwent diagnostic laparoscopy to determine resectability using a scoring algorithm previously described by Fagotti *et al.* [17, 18] Laparoscopic port placement was determined and performed at the discretion of the faculty surgeon. Patients with a score of less than 8 were offered primary TRS, and those who scored ≥ 8 were dispositioned to NACT. Patients who underwent primary tumor reductive surgery received a second PIV score at the time of their open primary TRS, representing actual intra-operative surgical findings in each of the anatomic locations described in the laparoscopic algorithm. Resection status and amount of residual disease following primary TRS was noted for each patient. R0 was defined as tumor cytoreduction to no gross residual disease, and R1 was used if any gross residual disease was present at the completion of tumor cytoreduction.

Standard summary statistics were used to describe the demographic and clinical characteristics of the study population. Sensitivity, specificity, accuracy, positive predictive value (PPV), and negative predictive value (NPV) were calculated for the ability of the PIV at time of primary surgery to discriminate resection status (R0 vs. R1). Concordance percentages were calculated for PIV scoring at laparoscopy and primary TRS. PPV was used to determine the ability of the PIV score at laparoscopy to predict R0 at primary TRS. Stata v15.0 (College Station, TX) was used to perform all statistical analysis. Study data were collected and managed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted at MD Anderson. [24]

Results

226 patients with presumed advanced stage ovarian cancer underwent laparoscopic scoring assessment (Figure 1). Among these 226 patients, resection at either primary or interval TRS to no gross residual disease (R0) was achieved in 167 patients (80.3%), <1cm residual

disease in 20 patients (9.6%), and 1cm residual disease in 21 patients (10.1%). The R0 resection rate in the group of patients who underwent primary TRS was 86.2%. 139 patients (61.5%) had a PIV score < 8, and 81 patients (35.8%) had a PIV score of ≥ 8. In 6 patients (2.7%), a score could not be assigned due to presence of extensive adhesions (n=1) or intraoperative trocar injury (n=5). Of the patients with PIV score < 8, 122 (87.7%) underwent primary TRS. 17 patients (12.3%) did not undergo primary surgery and received NACT due to patient or surgeon preference; these patients were excluded from the concordance analysis as they did not have a PIV score determined at primary TRS available for comparison. Of those that received NACT, six patients declined primary surgery based on laparoscopy findings and in 11 patients the faculty surgeon recommended NACT rather than primary surgery. All patients with PIV score ≥ 8 received NACT. PIV scores for both laparoscopy and primary TRS were available for 99 of the 122 patients who underwent primary TRS (81%). Table 1 lists the baseline clinical and demographic characteristics of these patients. The median age was 62 years (range 23–88 years). The majority of patients had stage IIIC disease (76.1%) and serous histology (85.8%). Ovary was the primary disease site in 194 patients (85.8%). The median serum CA125 at presentation was 502.6 u/mL (range 10.9–12,472 u/mL). *BRCA* mutation status information was available for 156 patients. Of these, 120 (76.9%) had no mutation detected. 22 patients (14%) had a *BRCA1* mutation, and 6 patients (5%) had a *BRCA2* mutation. Of the 226 patients who underwent laparoscopic scoring assessment, 209 patients went on to receive either primary (59.3%) or interval TRS (40.7%).

Figure 2 shows the overall concordance between the PIV scores at laparoscopy and at intraoperative assessment for the 99 patients who had scores available at both timepoints. Each point on the graph contains a number that represents the number of patients whose scores correspond to the x- and y-axes of the graph. The diagonal line on the graph represents the 45 patients in which the laparoscopic PIV score perfectly matched the score at laparotomy. There was a 96% concordance rate between the PIV score at laparoscopy and at laparotomy when a score of 8 was used as a cutoff point. Thus, in patients who underwent laparoscopy and achieved a PIV score of <8, the PIV score at TRS was also <8 in 96% of cases. The remaining 4% of cases had a PIV score of <8 at laparoscopy, but a PIV score ≥ 8 at TRS. These scores were as follows: 1. Scored 6 at laparoscopy and 8 at TRS, 2. Scored 4 at laparoscopy and 10 at TRS, 3. Scored 2 at laparoscopy and 10 at TRS, and 4. Scored 2 at laparoscopy and 12 at TRS.

Figure 3 shows the concordance between PIV scores at laparoscopy and at primary TRS for each component of the score. Concordance between PIV scores at laparoscopic assessment and primary TRS were as follows: peritoneal carcinomatosis 94.8%; stomach infiltration 94.7%; diaphragm disease 92.9%; omental disease 89.7%; liver surface involvement 86.5%; mesenteric disease 84.6%; bowel infiltration 74.7%. Tables 2a and 2b demonstrate the sensitivity and specificity of the PIV score on categorized resection status. The laparoscopic PIV score had a sensitivity of 71.3% and a specificity of 48.7% among those achieving R0 resection status at primary TRS. The laparoscopic PIV score had a sensitivity of 48.7% and a specificity of 71.3% among those with any gross residual disease present at the conclusion of primary TRS (R1). The laparoscopic PIV score of <8 had a positive predictive

value of 85.4% at predicting R0 resection at primary TRS, and had an accuracy of 67.0% at predicting resection status.

Discussion

Altogether, our study demonstrates that the concordance rates between the validated laparoscopic PIV score and actual intraoperative tumor dissemination at primary TRS varies by location, with the lowest concordance noted for predicting bowel infiltration. However, the overall PIV score found at the time of laparoscopy had excellent concordance with the PIV score found at the time of primary TRS. This suggests the usefulness of the laparoscopic scoring algorithm in decision making for primary tumor resectability. We also demonstrated that a laparoscopic PIV score of <8 had a PPV of 85.4% at predicting R0 resection at the time of primary TRS in our cohort. This coincides with our actual overall R0 resection rate at primary TRS of 86%.

Although diagnostic laparoscopy is a less invasive surgical method for intra-abdominal assessment compared to laparotomy, it does have inherent limitations. The small bowel and its mesentery and large bowel may be difficult areas to visualize on laparoscopy in patients with advanced ovarian cancer due to tumor burden or presence of intra-abdominal adhesions, which may introduce bias in scoring. Evaluation of these areas may be improved by placing additional ports for easier instrumentation, however, the extent of carcinomatosis may limit this as an option. Trocar placement can be limited in the setting of bulky advanced disease. In our cohort, we did have 5 trocar bowel injuries upon trocar insertion all performed by direct optical entry. Following these injuries as a part of our quality improvement process, all laparoscopy cases for scoring assessment have been presented in a multidisciplinary conference with radiology review to determine best location and method for trocar entry into the abdomen.

Our study adds to existing literature that demonstrates the difficulty of evaluating bowel and mesenteric involvement by laparoscopy. [17–20] In the prospective validation study published by Fagotti *et al.* of the laparoscopic predictive model, mesenteric retraction and bowel infiltration were assessable in 75.2% and 85.5% of cases, respectively, however, the accuracy of assessing bowel infiltration by laparoscopy was only 77.3%. [18] Similarly, in a prospective, multi-center trial designed to determine the accuracy of the laparoscopic predictive model, bowel infiltration and mesenteric retraction were non-evaluable in 10.0% and 25.8% of cases, respectively. These parameters also had the highest false negative and lowest accuracy rates of the seven parameters, when scores were compared between their coordinating center and satellite centers. [20] These rates are consistent with our data that showed concordance rates of 75% for bowel infiltration and 85% for mesenteric retraction. Computed tomography (CT) has also been examined as a potential triage mechanism for patients presenting with advanced ovarian cancer, however, the data are inconsistent with regard to whether this is a reliable and sensitive method, especially with respect to disease in the small and large bowel mesentery. [16, 25, 26]

Our study demonstrates that a PIV score <8 has a PPV of 85.4% at predicting R0 resection in patients with advanced ovarian cancer undergoing primary TRS. Among patients who had

any gross residual disease at primary TRS, the PIV score performed with 71.3% specificity. This contrasts with the initial study by Fagotti *et al.* [17] demonstrating that 100% of the patients who had suboptimal TRS had a PIV score of ≥ 8 . This difference can be accounted for, in part, by differences in study design. In the initial trial by Fagotti *et al.*, all patients underwent laparoscopic scoring assessment followed by immediate primary TRS in order to obtain their sensitivity analysis. At our institution, by following the validated Fagotti scoring algorithm, only patients that scored PIV <8 underwent a primary TRS, and those patients with a PIV score ≥ 8 underwent NACT followed by a possible interval TRS pending response to chemotherapy. Thus, our sensitivity analysis and PPV of the PIV score to predict resection status is based on those patients that scored <8 and went to primary TRS. Conclusions cannot be drawn on the sensitivity and PPV of the PIV score ≥ 8 to predict resection status at the time of interval TRS.

Altogether the validated scoring model performed well in our patient cohort leading to R0 resection rates of 86% in patients undergoing primary TRS. Only 10% of patients undergoing primary TRS were suboptimally resected to ≥ 1 cm disease. This is similar to data recently published by Rutten *et al.* which showed that implementing laparoscopic triage assessment in advanced ovarian cancer patients resulted in a significant decrease in futile laparotomy (10% vs. 39%, $p < 0.001$) in patients undergoing primary cytoreduction. However, R0 resection was only achieved in 57% of patients at primary surgery. [27]

The strengths of our study are the prospective data collection, large cohort size, and standardized approach to the triage and management of patients with advanced stage ovarian cancer. In addition, we utilized the laparoscopic scoring algorithm as developed by Fagotti *et al.*, which has been previously validated. The primary limitation of our study is the non-randomized approach, as all patients were subjected to the same triage mechanism. Our group adopted the initial scoring algorithm described by Fagotti and colleagues, which weighted each anatomic component equally, and our findings are based on the use of this algorithm. [17–20] However, since the initial publications, the algorithm has been updated such that laparoscopic findings of mesenteric retraction preclude patient from proceeding with further scoring or an attempt at cytoreduction, even if there is minimal disease present in other areas. Our group has adopted this strategy. [23] In addition, Petrillo *et al.* have established that the rate of suboptimal cytoreduction and inappropriate laparotomy increases significantly at a PIV score of 10 or greater, as opposed to 8 as demonstrated in the initial studies. Our group now triages patients who have a laparoscopic PIV of 8 to primary surgery rather than NACT.

In conclusion, our data demonstrate an overall high positive predictive value of the laparoscopic PIV score on R0 resection rate at primary TRS, suggesting that laparoscopic scoring is an appropriate triage mechanism to determine resectability for patients with suspected advanced ovarian cancer who are medically operable. We also demonstrate that the absence of bowel involvement by tumor on laparoscopic scoring assessment should be interpreted with some caution.

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References

- [1]. Morgan RJ, Jr., et al., Epithelial ovarian cancer. J Natl Compr Canc Netw, 2011 9(1): p. 82–113. [PubMed: 21233246]
- [2]. Siegel RL, Miller KD, and Jemal A, Cancer Statistics, 2017. CA Cancer J Clin, 2017 67(1): p. 7–30. [PubMed: 28055103]
- [3]. Ozols RF, et al., Phase III trial of carboplatin and paclitaxel compared with cisplatin and paclitaxel in patients with optimally resected stage III ovarian cancer: a Gynecologic Oncology Group study. J Clin Oncol, 2003 21(17): p. 3194–200. [PubMed: 12860964]
- [4]. Network, N.C.C. Ovarian Cancer, version 4.2017—November 9, 2017. Available from: https://www.nccn.org/professionals/physician_gls/pdf/ovarian.pdf Accessed December 30, 2017.
- [5]. Bristow RE, et al., Survival effect of maximal cytoreductive surgery for advanced ovarian carcinoma during the platinum era: a meta-analysis. J Clin Oncol, 2002 20(5): p. 1248–59. [PubMed: 11870167]
- [6]. Horowitz NS, et al., Does aggressive surgery improve outcomes? Interaction between preoperative disease burden and complex surgery in patients with advanced-stage ovarian cancer: an analysis of GOG 182. J Clin Oncol, 2015 33(8): p. 937–43. [PubMed: 25667285]
- [7]. Chi DS, et al., What is the optimal goal of primary cytoreductive surgery for bulky stage IIIC epithelial ovarian carcinoma (EOC)? Gynecol Oncol, 2006 103(2): p. 559–64. [PubMed: 16714056]
- [8]. Hoskins WJ, et al., The influence of cytoreductive surgery on recurrence-free interval and survival in small-volume stage III epithelial ovarian cancer: a Gynecologic Oncology Group study. Gynecol Oncol, 1992 47(2): p. 159–66. [PubMed: 1468693]
- [9]. Hoskins WJ, et al., The effect of diameter of largest residual disease on survival after primary cytoreductive surgery in patients with suboptimal residual epithelial ovarian carcinoma. Am J Obstet Gynecol, 1994 170(4): p. 974–9; discussion 979–80. [PubMed: 8166218]
- [10]. Eisenkop SM, et al., Relative influences of tumor volume before surgery and the cytoreductive outcome on survival for patients with advanced ovarian cancer: a prospective study. Gynecol Oncol, 2003 90(2): p. 390–6. [PubMed: 12893206]
- [11]. Chang SJ, et al., Survival impact of complete cytoreduction to no gross residual disease for advanced-stage ovarian cancer: a meta-analysis. Gynecol Oncol, 2013 130(3): p. 493–8. [PubMed: 23747291]
- [12]. Vergote I, et al., Neoadjuvant chemotherapy or primary surgery in stage IIIC or IV ovarian cancer. N Engl J Med, 2010 363(10): p. 943–53. [PubMed: 20818904]
- [13]. Meyer LA, et al., Use and Effectiveness of Neoadjuvant Chemotherapy for Treatment of Ovarian Cancer. J Clin Oncol, 2016.

- [14]. Wright AA, et al., Neoadjuvant Chemotherapy for Newly Diagnosed, Advanced Ovarian Cancer: Society of Gynecologic Oncology and American Society of Clinical Oncology Clinical Practice Guideline. *J Clin Oncol*, 2016 34(28): p. 3460–73. [PubMed: 27502591]
- [15]. Ferrandina G, et al., Role of CT scan-based and clinical evaluation in the preoperative prediction of optimal cytoreduction in advanced ovarian cancer: a prospective trial. *Br J Cancer*, 2009 101(7): p. 1066–73. [PubMed: 19738608]
- [16]. Axtell AE, et al., Multi-institutional reciprocal validation study of computed tomography predictors of suboptimal primary cytoreduction in patients with advanced ovarian cancer. *J Clin Oncol*, 2007 25(4): p. 384–9. [PubMed: 17264334]
- [17]. Fagotti A, et al., A laparoscopy-based score to predict surgical outcome in patients with advanced ovarian carcinoma: a pilot study. *Ann Surg Oncol*, 2006 13(8): p. 1156–61. [PubMed: 16791447]
- [18]. Fagotti A, et al., Prospective validation of a laparoscopic predictive model for optimal cytoreduction in advanced ovarian carcinoma. *Am J Obstet Gynecol*, 2008 199(6): p. 642 e1–6. [PubMed: 18801470]
- [19]. Fagotti A, et al., Introduction of staging laparoscopy in the management of advanced epithelial ovarian, tubal and peritoneal cancer: impact on prognosis in a single institution experience. *Gynecol Oncol*, 2013 131(2): p. 341–6. [PubMed: 23938372]
- [20]. Fagotti A, et al., A multicentric trial (Olympia-MITO 13) on the accuracy of laparoscopy to assess peritoneal spread in ovarian cancer. *Am J Obstet Gynecol*, 2013 209(5): p. 462 e1–462 e11. [PubMed: 23891632]
- [21]. Nick AM, et al., A framework for a personalized surgical approach to ovarian cancer. *Nat Rev Clin Oncol*, 2015 12(4): p. 239–45. [PubMed: 25707631]
- [22]. Fleming ND, et al., Laparoscopic surgical algorithm to triage the timing of tumor reductive surgery in advanced ovarian cancer. *Obstet Gynecol*, 2018 8 6 [Epub ahead of print]
- [23]. Petrillo M, et al., Definition of a dynamic laparoscopic model for the prediction of incomplete cytoreduction in advanced epithelial ovarian cancer: proof of a concept. *Gynecol Oncol*, 2015 139(1): p. 5–9. [PubMed: 26196319]
- [24]. Harris PA, et al., Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*, 2009 42(2): p. 377–81. [PubMed: 18929686]
- [25]. Hynninen J, et al., A prospective comparison of integrated FDG-PET/contrast-enhanced CT and contrast-enhanced CT for pretreatment imaging of advanced epithelial ovarian cancer. *Gynecol Oncol*, 2013 131(2): p. 389–94. [PubMed: 23994535]
- [26]. Bristow RE, et al., A model for predicting surgical outcome in patients with advanced ovarian carcinoma using computed tomography. *Cancer*, 2000 89(7): p. 1532–40. [PubMed: 11013368]
- [27]. Rutten MJ, et al., Laparoscopy to predict the result of primary cytoreductive surgery in patients with advanced ovarian cancer: a randomized controlled trial. *J Clin Oncol*, 2017 35(6): p. 613–621. [PubMed: 28029317]

Highlights

- Laparoscopic scoring in advanced ovarian cancer can be used to predict complete gross resection at tumor reductive surgery
- Laparoscopy is limited at predicting tumor involvement of the large bowel and mesentery
- Laparoscopy can accurately predict tumor involvement of the omentum, diaphragm, stomach, liver surface, and peritoneum

Figure 1:
CONSORT diagram. PIV=Predictive index value, TRS=Tumor reductive surgery,
NACT=Neoadjuvant chemotherapy.

Figure 2:

Overall concordance between PIV scores at laparoscopy and primary TRS. 96% concordance rate was observed between the overall PIV score at laparoscopy and primary TRS. PIV=Predictive index value, TRS=Tumor reductive surgery.

Figure 3:

Concordance between PIV scores at laparoscopy and primary TRS at individual anatomic sites. Concordance between PIV scores at laparoscopy and primary TRS were as follows: peritoneal carcinomatosis 94.8%, stomach infiltration 94.7%; diaphragm disease 92.9%, omental disease 89.7%, liver surface involvement 86.5%, mesenteric disease 84.6%, and bowel infiltration 74.7%. PIV=Predictive index value, TRS=Tumor reductive surgery.

Table 1:

Demographic and clinical characteristics. BMI=Body mass index, VUS=Variant of unknown significance, R0=no gross residual disease, NOS=not otherwise specified.

	N (%)
	N=226
Age, median, years (range)	62 (23–88)
BMI, median, kg/m² (range)	27.1 (17.1–66.8)
Race/Ethnicity	
Hispanic or Latino	22 (9.8)
Not Hispanic or Latino	201 (88.9)
Unknown/not reported	3 (1.3)
Known	
American Indian/Alaska native	2 (0.9)
African American/Black	14 (6.3)
Asian	8 (3.6)
Caucasian/White	199 (89.2)
Unknown/not reported	3 (1.3)
CA125, median, U/mL (range)	502.6 (10.9–12,472)
Primary disease site	
Fallopian tube	9 (4.0)
Ovary	194 (85.8)
Peritoneum	23 (10.2)
Stage	
IIA	1 (0.5)
IIB	14 (6.2)
IIIA1	2 (0.9)
IIIA2	3 (1.3)
IIIB	4 (1.8)
IIIC	172 (76.1)
IVA	12 (5.3)
IVB	18 (7.9)
Histology	
Serous	194 (85.8)
Endometrioid	4 (1.8)
Clear cell	8 (3.6)
Adenocarcinoma NOS	1 (0.4)
Mixed	12 (5.3)
Carcinosarcoma	7 (3.1)

	N (%)
	N=226
Residual disease	
R0	167 (80.3)
<1cm	20 (9.6)
1cm	21 (10.1)

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Table 2a:

Sensitivity and specificity of PIV score and ability to predict R0 resection status. PIV=Predictive index value, R0=no gross residual disease, R1=any gross residual disease, PPV=positive predictive value, NPV=negative predictive value.

Laparoscopic PIV score	R1	R0	Sensitivity (%)	Specificity (%)	Accuracy (%)	PPV	NPV
8	19	47	71.3	48.7	67.0	85.4	28.8
< 8	20	117					

Table 2b:

Sensitivity and specificity of PIV score and ability to predict R1 resection status. PIV=Predictive index value, R0=no gross residual disease, R1=any gross residual disease, PPV=positive predictive value, NPV=negative predictive value.

Laparoscopic PIV score	R0	R1	Sensitivity (%)	Specificity (%)	Accuracy (%)	PPV	NPV
< 8	117	20	48.7	71.3	67.0	28.8	85.4
8	47	19					