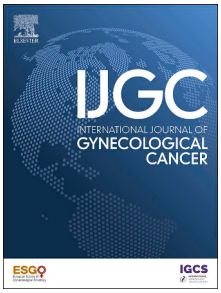
ORIGINAL RESEARCH

SUROVA study: global real-world treatment strategies and mortality risk prediction in advanced ovarian cancer



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ABSTRACT

Objective: This study aimed to compare 5-year overall survival between primary debulking surgery and neoadjuvant chemotherapy followed by interval surgery in patients with stage IIIB to IVB epithelial ovarian cancer, using global real-world data. Secondary objectives included evaluation of progression-free survival and the influence of race, post-operative complications, and residual disease.

Methods: SUROVA is a retrospective, international cohort study involving patients treated between 2018 and 2019 across 174 centers in 55 countries. Patients underwent primary surgery or received neoadjuvant chemotherapy followed by interval surgery, per institutional protocols. Propensity score matching was based on 7 baseline variables: age, race, Eastern Cooperative Oncology Group performance status at diagnosis, CA125 level at diagnosis, FIGO (International Federation of Gynecology and Obstetrics) stage IV disease, presence of ascites, and final tumor grade. Cox regression models with time-dependent effects and interaction terms were applied. A clinical risk calculator was developed and internally validated.

Results: A total of 3286 patients had a mean age of 60.0 years (SD 12); 2978 (90.6%) had high-grade serous carcinoma, and 795 (24.7%) presented with FIGO stage IV disease. A total of 1666 patients (50.7%) underwent primary cytoreductive surgery, and 1620 (49.3%) received neoadjuvant chemotherapy. The median follow-up duration was 43.8 months (interquartile range; 22.6-59.3). After propensity score matching ($n=1524$), overall survival was similar between groups (67.2 vs 65.0 months; HR 1.002, 95% CI 0.85 to 1.18, $p=.98$). Outcomes differed by ethnicity, residual disease, and post-operative complications. Post-operative complications (28%) significantly worsened survival (66 vs 46 months; HR 1.5, 95% CI 1.2 to 1.9, $p<.001$), especially among patients undergoing primary surgery (73 vs 46 months; HR 1.85, 95% CI 1.43 to 2.37, $p<.001$). The most favorable outcomes were observed among patients with primary surgery, complete resection, and no complications, with median overall survival not reached (HR 1.25, 95% CI 1.12 to 1.40, $p<.001$).

WHAT IS ALREADY KNOWN ON THIS TOPIC

Previous randomized controlled trials (EORTC, CHORUS) supported the non-inferiority of neoadjuvant chemotherapy compared with primary debulking surgery but suffered from limited generalizability due to low complete resection rates and selection bias. More recent trials (SCORPION, JCOG0602) offered mixed findings. The TRUST trial, conducted in expert centers, found longer progression-free survival with primary debulking surgery but no difference in overall survival.

WHAT THIS STUDY ADDS

SUROVA provides the largest real-world analysis comparing primary debulking surgery with neoadjuvant chemotherapy in advanced ovarian cancer. Using propensity score matching and time-dependent models, it shows that neoadjuvant chemotherapy is associated with slightly better outcomes in the first 24 months, but beyond this point, primary debulking surgery provides a clear long-term survival advantage. Importantly, the benefit of primary debulking surgery was restricted to patients achieving complete resection without major complications.

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Conclusions: Although overall survival was similar between groups, treatment effects differed by ethnicity, residual disease, and complications. Post-operative complications were associated with significantly worse survival, particularly among patients undergoing primary surgery, while the best outcomes were achieved in those who had primary surgery with complete resection and no complications.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

SUROVA supports personalized treatment based on predicted resectability, perioperative risk, and ethnicity. It highlights that primary complete cytoreduction without complications leads to the best survival outcomes. These findings may inform future guidelines and underscore the role of real-world data in complementing randomized trials such as TRUST.

Keywords:
Ovarian Cancer; Primary Debulking Surgery; Neoadjuvant Chemotherapy; Real-World Data; Survival Analysis

ORIGINAL RESEARCH

INTRODUCTION

Advanced epithelial ovarian cancer (FIGO [International Federation of Gynecology and Obstetrics] stage IIIB-IVB) remains one of the most lethal gynecologic malignancies, largely due to delayed diagnosis and the complexity of treatment. For over 3 decades, the standard approach has been primary debulking surgery followed by platinum-based chemotherapy, which improves survival when complete cytoreduction is achieved. However, in patients with high tumor burden or poor performance status, neoadjuvant chemotherapy followed by interval debulking has become a common alternative.[1,2]

Early randomized trials, including EORTC 55971[3] and CHORUS,[4] demonstrated the non-inferiority of neoadjuvant chemotherapy, with similar survival and lower perioperative morbidity. More recent studies (such as JCOG0602[5] and SCORPION[6]) have raised concerns about patient selection and long-term outcomes. Preliminary findings from the TRUST[7] trial also showed no difference in overall survival, but a divergence in progression-free survival between treatment arms.

To address these uncertainties, the SUROVA (SURgery in OVArian cancer) study was designed as a large, international, multi-center retrospective cohort based on real-world data. Its main goal was to compare overall survival between patients treated with primary surgery versus neoadjuvant chemotherapy. Using propensity score adjustment and a global data set, the study also aimed to develop a clinical risk calculator to support individualized decision-making based on key prognostic factors.

METHODS

Study Design and End Points

SUROVA is an international, retrospective, observational cohort study conducted in 174 centers across 55 countries. Eligible patients were diagnosed with stage IIIB to IVB epithelial ovarian, fallopian tube, or primary peritoneal carcinoma between January 2018 and December 2019. The primary objective was to compare 5-year overall survival between patients treated with primary debulking surgery and those receiving neoadjuvant chemotherapy followed by interval debulking surgery. Secondary end points included progression-free survival and exploratory analyses on the influence of residual disease, stage, post-operative complications, and the use of poly (ADP-ribose) polymerase (PARP) inhibitors. The study protocol was previously published,[8] approved by institutional review boards, and registered at ClinicalTrials.gov (NCT06223763).[9]

Outcome Definition

Overall survival was defined as the time from first treatment (surgery or chemotherapy) to death from any cause or last follow-up. Progression-free survival was defined as the time from first treatment to progression or death. Progression was determined by clinical or radiological evidence, or death without prior documentation of progression.

Participants and Eligibility Criteria

Patients were eligible if they were aged $\geq$18 years, had newly diagnosed stage IIIB to IVB disease, and were considered fully resectable on the basis of pre-operative imaging (computed tomography, whole-body magnetic resonance imaging, or positron emission tomography—computed tomography). Other inclusion criteria were a pre-operative Eastern Cooperative Oncology Group (ECOG) performance status of 0 to 1 and an American Society of Anesthesiologists score of $\leq$2. Patients were excluded if they had borderline or non-epithelial tumors, recurrent disease, a history of chemotherapy or pelvic radiotherapy, unresectable metastases as determined by clinical examination or pre-operative imaging, or if they were pregnant. The decision to pursue primary debulking surgery or neoadjuvant chemotherapy followed by interval debulking surgery was made according to institutional protocols and local tumor board consensus, on the basis of pre-operative imaging, performance status, comorbidity profile, and expected surgical complexity.

Data Collection and Interventions

Between January and July 2024, investigators completed a 157-item standardized case report form with demographic, clinical, imaging, surgical, therapeutic, and follow-up information. In the primary surgery group, patients underwent cytoreductive surgery followed by a median of 6 platinum-based chemotherapy cycles. The neoadjuvant group received 3 to 4 cycles of platinum—taxane chemotherapy before surgery, followed by additional cycles as needed. The total number of cycles per group is reported in the Results section. Importantly, neither the number of pre-operative

nor post-operative chemotherapy cycles was used as an exclusion criterion. Residual disease was documented using the European Society of Gynaecological Oncology operative report. Surgical complexity and complications were assessed using the Aletti score[10] and Clavien–Dindo classification[11], respectively. Complications were categorized as none (grade 0), low (grades 1-2), or high (grade ≥3) for analysis. Maintenance therapy, when delivered, was recorded. Given that BRCA and homologous recombination deficiency (HRD) testing were not routinely performed during the study period, PARP inhibitor use was applied as a surrogate marker of presumed molecular vulnerability.

Statistical Analysis

A total of 990 patients (495 per group) were required to detect a 10-month difference in overall survival with 90% power and 95% confidence. Propensity score matching was used to balance groups based on variables available before treatment allocation[12]: age, ECOG status, race, stage IV status, ascites, CA125 levels, and tumor grade (retrospectively derived when pre-treatment biopsy was unavailable). Race was recorded according to the investigator's assessment using a standardized case report form with pre-defined categories (White, Asian, Latin American, African, Other, or Not reported). Matching was performed using a 0.05 standard deviation caliper, yielding standardized mean differences <0.1. Analyses were performed on both unmatched ($n=3286$) and matched ($n=1524$) cohorts. Survival was assessed using Kaplan–Meier and Cox models. Proportional hazards assumptions were evaluated via log–log plots; time-by-covariate interactions were added when violations were detected.[13,14] Sub-group analyses were stratified by residual disease and post-operative complications; however, ethnicity was not pre-defined in the initial study design. Statistical analyses were conducted using IBM SPSS Statistics, Version 26.0 (IBM Corp). All *p*-values were nominal because of the observational design.

Risk Prediction Model (SUROVA Risk Calculator)

To estimate individual mortality risk based on pre- and post-operative clinical factors, a multi-variable logistic regression model, the SUROVA Risk Calculator, was developed in the unmatched cohort of 2342 non-Asian patients with high-grade serous ovarian cancer who underwent surgery between January 2018 and December 2019. Variables included age, ECOG status, stage IV, ascites, residual disease, post-operative complications, and PARP inhibitor use. The risk score is based on the beta coefficients of a logistic regression model using dichotomized predictors. Individualized survival curves were generated using Cox models. Discrimination was evaluated via the concordance index (0.71 for mortality, 0.69 for recurrence); calibration was assessed with decile-based plots. External validation is planned.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and was approved by a central institutional review board. Data were anonymized and centrally stored. A waiver of informed consent was granted for this retrospective study. Following the journal policy, data are available for independent analysis upon request.

In accordance with the journal's guidelines, we will provide our data for independent analysis by a team selected by the Editorial Team for the purposes of additional data analysis or for the reproducibility of this study in other centers if such is requested.

RESULTS

Data were collected from 3463 patients with stage IIIB to IVB (FIGO 2018) epithelial ovarian cancer who underwent either primary debulking surgery (1773, 51.2%) or neoadjuvant chemotherapy followed by interval cytoreductive surgery (1690, 48.8%) across 174 centers in 55 countries between January 1, 2018, and December 31, 2019. After excluding 177 patients because of duplications or missing or ineligible data, the final sample included 3286 patients for analysis. A total of 1666 patients (50.7%) underwent primary cytoreductive surgery, and 1620 (49.3%) received neoadjuvant chemotherapy followed by interval debulking surgery. On average, each center contributed 18.9 patients (range; 1-123), with a median of 14 patients per center. A total of 59 centers (33.9%) contributed ≥20 patients, accounting for 2285 patients, which represents approximately 69.5% of the entire cohort. Figure 1 shows the flowchart.

Of the 3286 patients, 67% (2201) were operated in Europe, and only 27% (888/3286) underwent surgery in centers certified by the European Society of Gynaecological Oncology. The average time required to complete each questionnaire per patient was 47.5 minutes. The accrual curve is shown in Figure S1.

Table 1 presents the baseline characteristics of the study population, stratified by treatment group (primary debulking surgery vs neoadjuvant chemotherapy). Variables include age, race, ECOG performance status, body mass index, CA125 levels at diagnosis, pre-operative ascites, FIGO stage IV disease, hyperthermic intra-peritoneal chemotherapy use, stoma formation, duration of surgery, post-operative complications, hospital stay, residual disease, tumor grade, adjuvant therapy, and maintenance therapy.

The average patient age was 59.9 years (median: 60.4; standard deviation: 11.9), and 73% were White. Asian patients represented 14.2% of the cohort; among non-Asians, 85.3% were White. Pre-operative ECOG performance status was 0 in 53% of cases. Most patients (91%) had high-grade tumors, and 24% were diagnosed with FIGO stage IV disease. The median CA125 level at diagnosis was 616.5 U/mL (mean 1617.3; standard deviation: 3810.6). The distribution between primary debulking surgery and interval debulking surgery was nearly even (51% vs 49%). Complete resection, defined as intra- and extra-abdominal resection (R0), was achieved in 74% of cases. Patients undergoing interval surgery received a median of 3 cycles of neoadjuvant chemotherapy (mean 3.92; standard deviation: 1.47) before surgery. The mean operative time was 266.8 minutes (median: 233.5; standard deviation: 145.5), and the average estimated blood loss was 576.9 mL (median: 400; standard deviation: 565.3).

Hyperthermic intra-peritoneal chemotherapy was administered in 6.5% of cases, more frequently in the neoadjuvant group (11.5%) than in the primary surgery group (1.6%). The average length of hospital stay was 10.2 days (median: 9; standard deviation: 7.1). Post-operative complications of any grade occurred in 28% of patients, with severe complications (grade ≥3) in 11%.

The 30-day post-operative mortality rate was 1.3%. The average time from surgery to initiation of adjuvant chemotherapy was 34.9 days (median: 31.0; standard deviation: 23.7). Bevacizumab was administered as part of first-line maintenance therapy in 25.8% of patients, and 39% received it at some point during the disease course. PARP inhibitors were used as maintenance therapy in 11.6% of patients in the primary setting, and 20.6% received PARP inhibitors at some point during their disease. Among 3286 patients, median overall survival was 65.1 months (95% CI 61.7 to 68.4), with 59.5% censored. In 3150 patients with evaluable data, median progression-free survival was 21.7 months (95% CI; 20.9-22.6), with 24.3% censored. At 1, 3, and 5 years, overall survival rates were 91.2%, 72.6%, and 52.4%, respectively; progression-free survival rates at 1 and 3 years were 53.8% and 24.9%.

Before propensity score adjustment, significant baseline differences were observed between the primary debulking surgery and neoadjuvant chemotherapy groups (Table 2). Median overall survival was 71 months in the primary debulking surgery group, as opposed to 55 months in the neoadjuvant chemotherapy group, corresponding to a 32% higher risk of death for patients who received neoadjuvant chemotherapy (HR 1.321, 95% CI 1.186 to 1.471, $p<.001$). Patients in the neoadjuvant chemotherapy group were older, had poorer performance status, more advanced disease, were more frequently diagnosed with FIGO stage IV, and had a higher incidence of ascites (Fig. S2). After propensity score matching (caliper <5%, mean difference −0.0012), 1524 patients (762 per group) were included in the matched cohort. Standardized mean differences were <0.1 for all baseline variables, confirming adequate covariate balance between groups (Table 2; Fig. S3).

In the overall matched population, median overall survival was 67.2 months in the primary debulking surgery group and 65.0 months in the neoadjuvant chemotherapy group, with no statistically significant difference (HR 1.002, 95% CI 0.854 to 1.176, $p=.98$) (Fig. 2A). In the matched cohort, the median progression-free survival was 21.1 months for patients treated with primary debulking surgery and 20.7 months for those who received neoadjuvant chemotherapy followed by interval debulking surgery. The difference between groups was not statistically significant (HR 0.96, 95% CI 0.91 to 1.02, $p=.38$) (Fig. 2B).

Although not pre-specified, sub-group analysis suggested that ethnicity may modify the treatment effect. Among Asian patients ($n=227$; 14% of the matched cohort), overall survival consistently favored neoadjuvant chemotherapy (HR 0.31, 95% CI 0.14 to 0.66, $p=.002$), with the proportional hazards assumption met ($p=.64$) (Fig. 2C). In non-Asian patients ($n=1297$), the proportional hazards assumption was violated, with survival curves crossing at 24 months: outcomes were similar in the first 2 years, but thereafter, primary surgery was associated with superior long-term survival (HR 2.02, 95% CI 1.37 to 3.00, $p<.001$) (Fig. 2D). Consistently, in the non-Asian sub-group, progression-free survival also favored primary surgery (HR 1.55, 95% CI 1.04 to 2.31, $p=.033$) (Fig. S3.1).

Post-operative complications of any grade significantly impacted overall survival. Grade ≥3 complications occurred more frequently in patients treated with primary debulking surgery (15.7%) than in those receiving neoadjuvant chemotherapy (9.5%; $p=.001$). Despite this, 30-day post-operative mortality remained low in both groups (1.5% vs 1.1%; $p=.40$). Among non-Asian patients, those who developed any post-operative complication (28%) had a median survival of 46.5 months, markedly shorter than the 66.0 months observed among patients without complications (HR 1.5, 95% CI 1.2 to 1.9, $p<.001$) (Fig. S4). For patients who did not experience complications, primary debulking surgery was associated with a superior median survival compared with neoadjuvant chemotherapy (73.0 vs 60.0 months, $p<.004$) (Fig. 3A). This survival advantage was not observed among patients who developed complications, as both treatment groups had a median survival of 46 months ($p=.48$) (Fig. 3B).

The combination of primary debulking surgery and complete resection yielded the most favorable outcomes in the entire cohort, but only in the absence of complications (HR 1.25, 95% CI 1.12 to 1.40, $p<.001$), compared with all other patients without complications, regardless of treatment strategy or residual disease (Fig. 3C). Among patients selected for primary surgery, more than half (53%) achieved complete resection without complications, with median overall survival not reached. This sub-group represented 27% of the entire study population.

Again, in patients with complications, even after complete resection, neoadjuvant chemotherapy was associated with similar survival (HR 1.06, 95% CI 0.92 to 1.23, $p=.43$) (Fig. 3D).

The detrimental effect of post-operative complications on survival correlated closely with severity. Median survival was longest among patients without complications (67 months), shorter

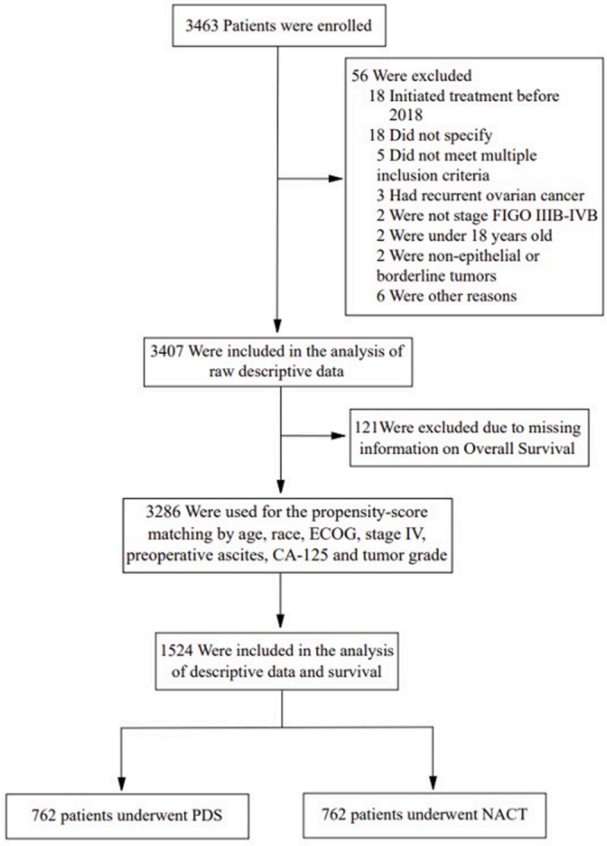

Figure 1 Flowchart of the study population. ECOG, Eastern Cooperative Oncology Group; FIGO, International Federation of Gynecology and Obstetrics; NACT, neoadjuvant chemotherapy; PDS, primary debulking surgery.

Table 1 Characteristics of Patients with Stage IIIB—IVB Ovarian Cancer Undergoing Cytoreductive Surgery by Surgical Approach

Characteristic	Whole group ($n=3286$)	Primary debulking ($n=1666$)	NACT ($n=1620$)
Age, y, mean (SD)	60.0 (12.0)	59.3 (12.3)	60.6 (11.5)
Race, *n* (%)			
African	68 (2.2)	38 (2.5)	30 (2.0)
Asian	431 (14.1)	174 (11.2)	257 (17.0)
White	2238 (73.1)	1204 (77.6)	1034 (68.5)
Latin American	196 (6.4)	83 (5.4)	113 (7.5)
Other	128 (4.2)	52 (3.4)	76 (5.0)
Not reported	225	115	110
ECOG performance status at diagnosis, *n* (%)			
PS 0	1695 (53.5)	990 (61.3)	705 (45.4)
PS >0	1473 (46.5)	624 (38.7)	849 (50.9)
Not reported	118	52	66
BMI, kg/m^2, mean (SD)	26.1 (5.2)	26.2 (5.2)	26.1 (5.2)
CA125 at diagnosis, U/mL, mean (SD)	1617.3 (3810.6)	1192.8 (3051.6)	2038.0 (4430.7)
Pre-operative ascites, *n* (%)			
No	800 (25.8)	553 (35.1)	247 (16.2)
Yes	2297 (74.2)	1023 (64.9)	1274 (83.8)
Not reported	189	90	99
Stage IV disease at diagnosis, *n* (%)			
No	2422 (75.3)	1444 (88.0)	978 (62.1)
Yes	795 (24.7)	197 (12.0)	598 (37.9)
Not reported	69	25	44
Histology, *n* (%)			
Serous	2978 (90.6)	1442 (86.6)	1536 (94.8)
Endometrioid	84 (2.6)	50 (3.0)	34 (2.1)
Clear cell	90 (2.7)	68 (4.1)	22 (1.4)
Mucinous	91 (2.8)	69 (4.1)	22 (1.4)
Other	43 (1.3)	37 (2.2)	6 (0.4)
Tumor grade, *n* (%)			
High grade	3086 (93.9)	1502 (90.2)	1584 (97.8)
Low grade	200 (6.1)	164 (9.8)	36 (2.2)
Stoma, *n* (%)			
No	2183 (88.6)	1124 (84.8)	1059 (93.1)
Yes	280 (11.4)	202 (15.2)	78 (6.9)
Not reported	823	340	483
HIPEC, *n* (%)			
No	2635 (93.7)	1408 (98.5)	1227 (88.8)
Yes	182 (6.5)	23 (1.6)	159 (11.5)
Not reported	469	235	234
Duration of surgery, min, mean (SD)	265.2 ± 144.6	260.2 ± 130.1	270.7 ± 159.0
Post-operative complications (any grade), *n* (%)			
No	2333 (71.9)	1150 (69.8)	1183 (74.0)
Yes	912 (28.1)	497 (30.2)	415 (26.0)
Not reported	41	19	22
Post-operative complications (grade ≥3), *n* (%)			
No	2787 (88.7)	1395 (86.4)	1392 (91.2)
Yes	354 (11.3)	219 (13.6)	135 (8.3)

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Table 1 (*continued*)

Characteristic	Whole group (*n* = 3286)	Primary debulking (*n* = 1666)	NACT (*n* = 1620)
Not reported	145	52	93
Post-operative death (30 d), *n* (%)	40 (1.3)	24 (1.5)	16 (1.1)
Hospital stay, d, mean (SD)	9.95 ± 7.2	10.8 ± 8.1	9.0 ± 5.8
Residual disease, *n* (%)			
R0 (complete resection)	2432 (74.1)	1188 (71.4)	1244 (76.9)
0.1-0.5 cm	378 (11.5)	195 (11.7)	183 (11.3)
0.6-1.0 cm	161 (4.9)	98 (5.9)	63 (3.9)
>1 cm	309 (9.4)	182 (11.0)	127 (7.8)
Not reported	6	3	3
Cycles of NACT, mean (SD)	-	-	3.9 (1.4)
Cycles of adjuvant chemotherapy, mean (SD)	4.74 (2.4)	5.96 (1.7)	3.4 (2.3)
Bevacizumab in maintenance at any time, *n* (%)			
Yes	1133 (39.1)	530 (35.9)	603 (42.4)
No	1764 (60.9)	945 (64.1)	819 (57.6)
Not reported	389	191	198
PARP-i in maintenance at any time, *n* (%)			
Yes	677 (20.6)	340 (20.4)	337 (20.8)
No	2609 (79.4)	1326 (79.6)	1283 (79.2)

*Analyses were performed excluding missing observations.
Abbreviations: BMI, body mass index; ECOG, Eastern Cooperative Oncology Group; HIPEC, hyperthermic intra-peritoneal chemotherapy; NACT, neoadjuvant chemotherapy; PARP-i, poly (ADP-ribose) polymerase inhibitor.

among those with grade 1 to 2 complications (47 months), and shortest among those with grade ≥3 complications (45 months) ($p<.001$). Time to chemotherapy initiation also increased with complication severity: 34 days (interquartile range [IQR]; 29-42) among patients without complications, 40 days (IQR; 32-50) among those with grade 1 to 2, and 43 days (IQR; 35-60) among those with grade ≥3 ($p<.01$). Figure S5 presents the survival curves according to the presence and grade of complications.

Finally, the SUROVA Risk Calculator was developed to calculate individual mortality risk based on pre- and post-operative clinical factors. The risk score is based on the beta coefficients of a logistic regression model using dichotomized predictors (Fig. S6). The median follow-up for this population was 43 months (range; 0-80 months), with 1100 patients followed for >55 months. The concordance index and calibration plots comparing predicted with observed risk across deciles suggested acceptable performance of the model in the development data set. External validation is pending, and it is planned in an international, independent cohort. The final model was embedded into an online clinical risk calculator, available at https://surovatrial.github.io/SUROVA-Risk-Calculator/.

DISCUSSION

Summary of Main Results

In our study, overall survival was similar between those treated with primary debulking surgery and those who received neoadjuvant chemotherapy followed by interval surgery, after propensity score adjustment. However, outcomes differed by ethnicity, presence of residual disease, and post-operative complications. The presence of post-operative complications significantly worsened survival, even in patients with complete resection. The most favorable outcomes were observed among patients with no residual disease and no complications.

Results in the Context of Published Literature

Previous trials such as EORTC 55971[3] and CHORUS[4] suggested that neoadjuvant chemotherapy was non-inferior to primary debulking surgery, but had low complete resection rates, particularly in the primary debulking surgery arms, often <20%. More recent trials such as JCOG0602[5] and SCORPION[6] failed to show superior survival with neoadjuvant chemotherapy, although both reported reduced surgical morbidity with interval surgery.

The recent TRUST trial (American Society of Clinical Oncology 2025),[7] conducted in expert centers, compared primary debulking surgery with neoadjuvant chemotherapy in patients with advanced ovarian cancer. The TRUST trial also found no significant difference in overall survival (54.3 vs 48.3 months; HR 0.89, $p=.24$) between primary and interval surgery. As a secondary outcome evaluation, the authors found longer progression-free survival with primary debulking surgery (Fig. S7).

The global composition of the SUROVA cohort enhances the generalizability of findings and allows for the identification of ethnic differences in treatment effect. Asian patients had markedly better outcomes with neoadjuvant chemotherapy (63.1 vs 52.6 months; HR 0.31, $p=.002$), a finding supported by prior studies suggesting that pharmacogenomic differences may confer greater platinum sensitivity.[15–17]

Table 2 Selected Characteristics of Patients Who Underwent Cytoreductive Surgery for Stage IIIB to IVB Ovarian Cancer, Before and After Propensity Score Matching.

Characteristics[a]	Before matching			After matching		SMD after[b]
	PDS (*n* = 1739)	NACT (*n* = 1668)	SMD before[b]	PDS (*n* = 762)	NACT (*n* = 762)	
Age, y, mean (SD)	59.3 (12.3)	60.6 (11.5)	**0.11**	59.3 (11.8)	59.9 (11.3)	**0.05**
Race (%)			**0.18**			**0.02**
Not Asian	1321 (88.7)	1216 (82.9)		646 (84.8)	651 (85.4)	
Asian	168 (11.3)	251 (17.1)		116 (15.2)	111 (14.6)	
Not reported	250	201		-	-	
ECOG performance status, *n* (%)			**0.34**			**0.02**
PS 0	956 (61.6)	689 (45.3)		410 (53.8)	402 (52.8)	
PS >0	597 (38.4)	831 (54.7)		352 (46.2)	360 (47.2)	
Not reported	186	148		-	-	
CA125, U/mL, mean (SD)	1192.8 (3015.6)	2038.0 (4430.7)	**0.24**	1445.6 (3607.2)	1492.6 (2132.8)	**0.01**
Ascites, *n* (%)			**0.42**			**0.05**
No ascites	533 (35.2)	240 (16.2)		151 (19.8)	168 (22.0)	
Ascites	980 (64.8)	1246 (83.8)		611 (80.2)	594 (78.0)	
Not reported	226	182		-	-	
FIGO stage IV, *n* (%)			**0.65**			**0.03**
No	1383 (87.9)	948 (61.9)		617 (81.0)	609 (79.9)	
Yes	190 (12.1)	583 (38.1)		145 (19.0)	153 (20.1)	
Not reported	166	137		-	-	
Tumor grade, *n* (%)			**0.28**			**0.01**
High grade	1467 (90.1)	1530 (97.8)		732 (96.1)	733 (96.2)	
Low grade	161 (9.9)	35 (2.2)		30 (3.9)	29 (3.8)	
Not reported	111	103		-	-	

Abbreviations: ECOG, Eastern Cooperative Oncology Group; FIGO, International Federation of Gynecology and Obstetrics; NACT, neoadjuvant chemotherapy; PDS, primary debulking surgery; PS, propensity score; SMD, standardized mean difference.

[a] All characteristics presented in this table refer to variables assessed at the time of initial diagnosis, except for histologic subtype, which corresponds to the final histologic diagnosis. Only 58.5% of patients had a pathological diagnosis prior to treatment decision-making.

[b] Standardized mean differences (SMDs) were calculated to assess the balance of covariates between treatment groups. An SMD <0.1 is generally considered to indicate adequate balance. The PSM resulted in substantially improved balance across all covariates included in the matching algorithm.

The early non-significant advantage of neoadjuvant chemotherapy and later significant benefit of primary debulking surgery may reflect post-operative morbidity, which affects long-term survival. This interpretation aligns with previous reports of higher complication rates in primary debulking surgery arms.[18,19] TRUST has not yet reported on complications, but SUROVA provides critical insight: it can be inferred that complications, particularly high-grade, neutralize the survival advantage of complete resection. Even low-grade complications were associated with progressively worse outcomes, likely reflecting underlying patient frailty rather than the direct effect of the adverse event itself. This pattern suggests, as other authors reported, that frailty may amplify the long-term impact of even minor perioperative morbidity.[20,21]

In our study, only patients with complete resection and no complications had the best long-term survival. In contrast, patients with complications, regardless of surgical completeness, had diminished outcomes. Delays in starting adjuvant chemotherapy further compounded this effect (Fig. S5).

Strengths and Weaknesses

The SUROVA study offers several key contributions. It represents one of the largest real-world analyses of advanced ovarian cancer treatment, drawing on data from a highly diverse group of centers across multiple countries. This broad scope reflects everyday clinical practice beyond randomized trials. Although retrospective, the study applied clear eligibility criteria, adjusted for baseline differences using propensity score matching, and used time-dependent survival analysis to address confounding.

This study has several limitations. First, the heterogeneity in patient recruitment. Fifty-seven centers contributed >20 patients each (2377 patients, 68.6% of the cohort), whereas 43 centers contributed <5 patients (93 patients, 2.7%). Second, treatment allocation was not randomized and followed local institutional protocols, potentially introducing selection bias. Resectability and surgical decisions were determined independently by each center, with variable case volumes, likely leading to heterogeneity in surgical expertise, perioperative care, and complication management. The high rates of complete

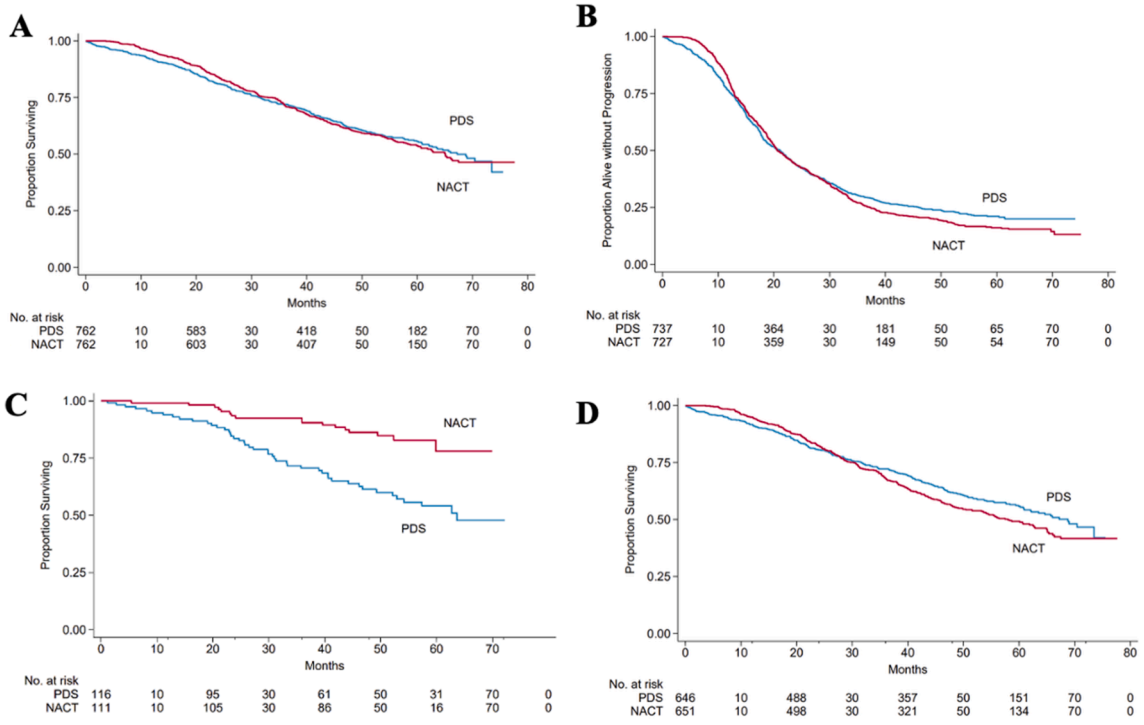

Figure 2 Kaplan-Meier estimates of overall and progression-free survival according to treatment group and ethnicity. Data on overall survival (**A**) and progression-free survival (**B**) are shown according to treatment group in the total study population. Data on overall survival are shown according to treatment group among the Asian patients (**C**) and non Asian patients (**D**). NACT, neoadjuvant chemotherapy; PDS, primary debulking surgery.

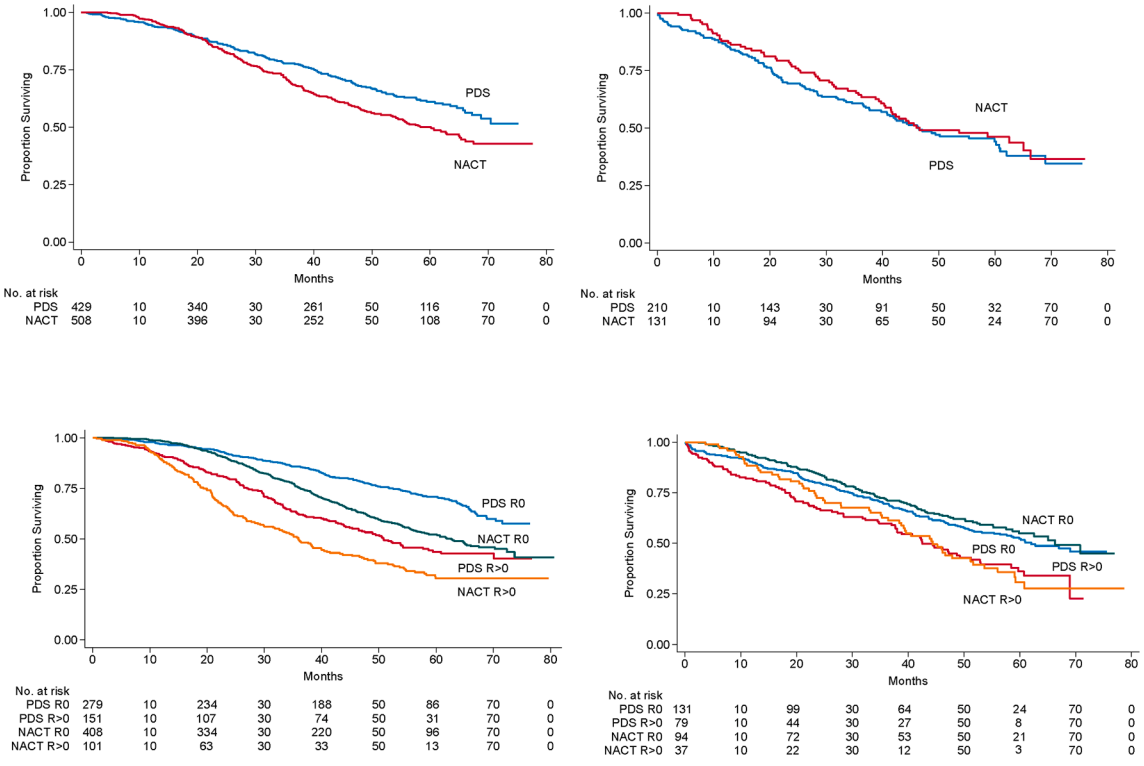

Figure 3 Data on overall survival are shown according to treatment group among the non-Asian population after propensity score who did not have any complications (**A**) and the non-Asian patients who had complications of any grade (**B**). Data on overall survival are shown according to treatment group and post-operative residual disease among the non-Asian population who did not have any complications (**C**) and the non-Asian patients who had complications of any grade (**D**). NACT, neoadjuvant chemotherapy; PDS, primary debulking surgery.

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cytoreduction reported, even higher than those observed in the TRUST trial, may reflect variability in how complete resection was defined across institutions. As in all large multi-institutional cohorts, there was no central pathology review, and data on chemotherapy completion rates, dose modifications, or treatment delays were not uniformly available, which could affect outcomes. Additionally, although propensity score matching was performed using baseline pre-treatment variables, post-operative complications (occurring later in the care pathway) were analyzed separately and not included in the matching process. We acknowledge that patients undergoing primary debulking surgery are inherently at higher risk for surgical complications, and this was explicitly analyzed to assess its impact on long-term survival. Furthermore, BRCA or HRD status were unavailable in many cases, consistent with the limited access to testing in 2018-2019. Given that BRCA and HRD testing were not routinely performed, PARP inhibitor use was applied in our study as a surrogate marker of presumed molecular vulnerability. The use of PARP inhibitors was reported in 21% of patients, with similar proportions across treatment groups.

Finally, the SUROVA risk calculator was developed using non-Asian patients with high-grade serous carcinoma, as this group represented the largest and most homogeneous sub-group within the data set. External validation in other populations, including Asian cohorts, is ongoing.

Despite its inherent limitations, the SUROVA study provides a comprehensive reflection of real-world clinical practice in advanced ovarian cancer. It underscores the critical importance of pre-operative patient selection and accurate assessment of resectability in improving long-term outcomes. While randomized prospective trials remain the cornerstone for establishing causal treatment effects, thoughtfully designed real-world studies offer essential complementary value. When rigorously conducted, such studies can generate clinically meaningful hypotheses, reveal actionable patterns of care, and ultimately help shape evolving therapeutic paradigms, particularly in complex and heterogeneous contexts such as advanced ovarian cancer.[22-25]

Implications for Practice and Future Research

The SUROVA study offers practical insight into the initial management of advanced ovarian cancer, highlighting the need for individualized treatment decisions. Rather than following a uniform approach, clinicians should consider resectability, surgical risk, and patient factors such as ethnicity. Neoadjuvant chemotherapy may be more appropriate for patients with poor performance status, significant comorbidities, or limited likelihood of achieving complete resection, while primary surgery appears beneficial only in selected cases.

Perhaps the most clinically relevant finding is that the group deriving the greatest survival benefit consisted of patients treated with primary surgery who achieved complete resection without post-operative complications. This ideal combination, however, was only achieved in 53% of those selected for primary surgery, representing only 27% of the entire cohort. These results highlight the importance of careful pre-operative selection and complication prevention to optimize long-term outcomes.

Conclusions

In this global real-world analysis, overall survival was similar between primary debulking surgery and neoadjuvant chemotherapy. However, treatment effects varied significantly by ethnicity, follow-up, post-operative complications, and residual disease. Asian patients benefited more from neoadjuvant chemotherapy, whereas non-Asian patients experienced a long-term survival advantage with primary surgery, particularly when complete resection was achieved. Importantly, complete resection conferred survival benefit in primary surgery only when achieved without complications, highlighting the importance of patient selection, surgical quality, and perioperative care. These findings support the need for individualized treatment strategies and risk-adapted decision-making in advanced ovarian cancer.

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REFERENCES

1. du Bois A, Reuss A, Pujade-Lauraine E, Harter P, Ray-Coquard I, Pfisterer J. Role of surgical outcome as prognostic factor in advanced epithelial ovarian cancer: a combined exploratory analysis of 3 prospectively randomized phase 3 multicenter trials: by the Arbeitsgemeinschaft Gynaekologische Onkologie Studiengruppe Ovarialkarzinom (AGO-OVAR) and the Groupe d'Investigateurs Nationaux pour les Etudes des Cancers de l'Ovaire (GINECO). *Cancer*. 2009;115(6):1234–1244. https://doi.org/10.1002/cncr.24149.
2. Coleridge SL, Bryant A, Kehoe S, Morrison J. Neoadjuvant chemotherapy before surgery versus surgery followed by chemotherapy for initial treatment in advanced ovarian epithelial cancer. *Cochrane Database Syst Rev*. 2021;7(7):CD005343. https://doi.org/10.1002/14651858.CD005343.pub6.
3. Vergote I, Tropé CG, Amant F, et al. Neoadjuvant chemotherapy or primary surgery in stage IIIC or IV ovarian cancer. *N Engl J Med*. 2010;363(10):943–953. https://doi.org/10.1056/NEJMoa0908806.
4. Kehoe S, Hook J, Nankivell M, et al. Primary chemotherapy versus primary surgery for newly diagnosed advanced ovarian cancer (CHORUS): an open-label, randomised, controlled, non-inferiority trial. *Lancet*. 2015;386(9990):249–257. https://doi.org/10.1016/S0140-6736(14)62223-6.
5. Onda T, Satoh T, Ogawa G, et al. Comparison of survival between primary debulking surgery and neoadjuvant chemotherapy for stage III/IV ovarian, tubal and peritoneal cancers in a phase III randomised trial. *Eur J Cancer*. 2020;130:114–125. https://doi.org/10.1016/j.ejca.2020.02.020.
6. Fagotti A, Ferrandina G, Vizzielli G, et al. Randomized trial of primary debulking surgery versus neoadjuvant chemotherapy for advanced epithelial ovarian cancer (SCORPION-NCT01461850). *Int J Gynecol Cancer*. 2018;30(11):1657–1664.
7. Mahner S, Heitz F, Salehi S, et al. TRUST: trial of radical upfront surgical therapy in advanced ovarian cancer (ENGOT-OV33/AGO-OVAR OP7). *J Clin Oncol*. 2025;43 (suppl 17):LBA5500. LBA5500.
8. Chiva L, Ordás P, Martin-Calvo N, et al. An international worldwide retrospective cohort observational study comparing primary cytoreductive surgery with neoadjuvant chemotherapy and interval cytoreductive surgery in patients with carcinoma of the ovary, fallopian tubes, and peritoneum (SUROVA Trial). *Int J Gynecol Cancer*. 2024;34 (6):942–945. https://doi.org/10.1136/ijgc-2024-005354.
9. ClinicalTrials.gov. Surgery in Ovarian Cancer (SUROVA). Identifier. https://www.clinicaltrials.gov/study/NCT06223763.
10. Aletti GD, Dowdy SC, Podratz KC, Cliby WA. Surgical treatment of diaphragm disease correlates with improved survival in optimally debulked advanced stage ovarian cancer. *Gynecol Oncol*. 2006;100(2):283–287. https://doi.org/10.1016/j.ygyno.2005.08.027.
11. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg*. 2004;240(2):205–213. https://doi.org/10.1097/01.sla.0000133083.54934.ae.
12. Rosenbaum PR, Rubin DB. The central role of the propensity score in observational studies for causal effects. *Biometrika*. 1983;70(1):41–55. https://doi.org/10.1093/biomet/70.1.41.
13. Kalbfleisch JD, Prentice RL. *The Statistical Analysis of Failure Time Data*. Wiley; 1980.
14. Collett D. *Modelling Survival Data in Medical Research*. Chapman & Hall; 1994. https://doi.org/10.1007/978-1-4899-3115-3.
15. O'Donnell PH, Dolan ME. Cancer pharmacoethnicity: ethnic differences in susceptibility to the effects of chemotherapy. *Clin Cancer Res*. 2009;15(15):4806–4814. https://doi.org/10.1158/1078-0432.CCR-09-0344.
16. Khrunin A, Ivanova F, Moisseev A, et al. Pharmacogenomics of cisplatin-based chemotherapy in ovarian cancer patients of different ethnic origins. *Pharmacogenomics*. 2012;13(2):171–178. https://doi.org/10.2217/pgs.11.140.
17. Lee AW, Poynor V, Siddiqui S. Disparities in ovarian cancer survival among ethnic Asian American populations, 2006–2020. *Gynecol Oncol*. 2024;191:292–298. https://doi.org/10.1016/j.ygyno.2024.10.017.
18. Xu Z, Becerra AZ, Justiniano CF, et al. Complications and survivorship trends after primary debulking surgery for ovarian cancer. *J Surg Res*. 2020;246:34–41. https://doi.org/10.1016/j.jss.2019.08.027.
19. Angeles MA, Hernández A, Pérez-Benavente A, et al. The effect of major postoperative complications on recurrence and long-term survival after cytoreductive surgery for ovarian cancer. *Gynecol Oncol*. 2022;166(1):8–17. https://doi.org/10.1016/j.ygyno.2022.05.002.
20. Kengsakul M, Nieuwenhuyzen-de Boer GM, Udomkarnjananun S, Kerr SJ, Niehot CD, Van Beekhuizen HJ. Factors predicting postoperative morbidity after cytoreductive surgery for ovarian cancer: a systematic review and meta-analysis. *J Gynecol Oncol*. 2022;33(4):e53. https://doi.org/10.3802/jgo.2022.33.e53.
21. Wajekar A, Solanki SL, Cata J, Gottumukkala V. Postoperative complications result in poor oncological outcomes: what is the evidence? *Curr Oncol*. 2024;31(8):4632–4655. https://doi.org/10.3390/curroncol31080346.
22. Lederer DJ, Bell SC, Branson RD, et al. Control of confounding and reporting of results in causal inference studies: guidance for authors from editors of respiratory, sleep, and critical care journals. *Am J Respir Crit Care Med*. 2019;200(2):239245. https://doi.org/10.1513/annalsats.201808-564ps.
23. Booth CM, Karim S, Mackillop WJ. Real-world data: towards achieving the achievable in cancer care. *Nat Rev Clin Oncol*. 2019;16(5):312–325. https://doi.org/10.1038/s41571-019-0167-7.
24. Eskola SM, Leufkens HGM, Bate A, De Bruin ML, Gardarsdottir H. The role of real-world data and evidence in oncology medicines approved in EU in 2018–2019. *J Cancer Policy*. 2023;36:100424. https://doi.org/10.1016/j.jcpo.2023.100424.
25. Castelo-Branco L, Pellat A, Martins-Branco D, et al. ESMO guidance for reporting oncology real-world evidence (GROW). *ESMO Real World Data Digit Oncol*. 2023;1:100001. https://doi.org/10.1016/j.esmorw.2023.10.001.