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Article

Factors influencing success: Secondary cytoreductive surgery in the management of recurrent ovarian cancer

Huixing Yi[1], Rongdong Zeng[2], Xiaogang Lv[3,*]

[1] Department of Obstetrics and Gynecology, Panyu Sixth People's Hospital of Guangzhou, Guangzhou 511400, China
[2] College of Pharmaceutical Information Engineering, Guangdong Pharmaceutical University, Guangzhou 510006, China
[3] Guangzhou Institute of Cancer Research, the Affiliated Cancer Hospital, Guangzhou Medical University, Guangzhou 511495, China
*** Corresponding author:** Xiaogang Lv, Lvxiaogang1985@163.com

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Abstract: Objective: Secondary cytoreductive surgery (SCRS) plays a key role in the treatment of ROC. The aim of this study was to provide an in-depth analysis of the practical application of SCRS in the management of recurrent ovarian cancer (ROC) and to assess the specific impact of its therapeutic effect on the long-term prognosis of patients. Methods: We collected clinicopathologic data on 83 ROC patients who received SCRS from January 2010 to January 2020, including patient age, histological type, and SCRS results. Kaplan-Meier survival curve, Logistic regression test and Cox proportional risk model were used for univariate regression analysis. Results: We ended up with a detailed analysis of 80 patients. During the observation period, up to the prescribed end of follow-up, 26 patients were observed to be alive, while 57 patients had died. The mean survival of all patients was 56 months. The clinical factors affecting progression-free survival were neoadjuvant chemotherapy [HR (95% CI) = 1.40 (1.13–1.74)], The recurrence interval [HR (95% CI) = 0.51 (0.36–0.70)], previously used chemotherapy line number [HR (95% CI) = 1.46 (1.17–1.82)], recurrence period to the total number of cycles of chemotherapy [HR (95% CI) = 3.48 (2.65–4.57)]. Factors affecting the degree of SCRS completion include tumor stage [HR (95% CI) = 2.723(1.281–5.786)], tumor size [HR (95% CI) = 0.386 (0.153–0.896)], The number of tumors [HR (95% CI) = 2.893 (1.056–7.925)]. Conclusion: Tumor stage, time interval of recurrence, size and number of lesions are closely related to the success rate of SCRS. Recurrent ovarian cancer patients achieve complete elimination of tumor cells through SCRS to optimize treatment outcomes and prognosis.

Keywords: secondary cytoreductive surgery; recurrent ovarian cancer; overall survival; influencing factor

1. Introduction

Recurrent ovarian cancer (ROC) are thoroughly tumor cells to destroy the loss and fully after chemotherapy, patients achieved clinical complete remission, but again in six months after discontinuation is showing signs of tumor activity [1]. Signs of recurrence may include continued elevation of serum CA125 levels or other tumor markers, the presence of ascites and pleural fluid, mass found on physical examination or imaging, and unexplained intestinal obstruction [2]. When a patient shows two or more of these signs during follow-up, tumor recurrence is usually confirmed and the patient should immediately undergo secondary cytoreductive surgery (SCRS).

The role of SCRS in ROC therapy is debated in academic circles. Historically, SCRS emerged as a therapeutic option based on the principle that reducing tumor burden could improve survival and enhance the efficacy of subsequent chemotherapy.

Some studies have shown that SCRS combined with chemotherapy can prolong the survival time of relapsed patients compared with salvage chemotherapy alone, and it is believed that successful SCRS has a positive impact on treatment, although the improvement of quality of life is limited [3]. However, opponents pointed out that due to pelvic and abdominal adhesion in ROC patients, greater surgical difficulty and trauma, and more postoperative complications, the quality of life of patients may be seriously affected. Moreover, they believed that SCRS could not extend the survival period of patients, so it was of limited clinical value [4]. Despite these controversies, as research progresses, most investigators now agree that thoroughness of tumor cell reduction is an important independent predictor of patient outcome [5]. The implementation of SCRS should be individualized and patients' conditions should be fully assessed before surgery. Only when SCRS is completely reduced can patients obtain significant survival benefits [6]. Therefore, the pursuit of complete tumor cell reduction should be the ultimate goal of SCRS.

However, not all ROC patients are suitable for SCRS. To ensure that these patients can benefit from surgery and achieve complete tumor reduction, surgical indications must be strictly controlled [7]. Therefore, it is critical to identify which patients may benefit from SCRS and identify the key factors that influence surgery to achieve complete cell reduction. This study explores the correlation between age, cell grade, histological type and SCRS in ROC patients, with the aim of providing guidance for screening patients suitable for SCRS and determining the optimal timing of surgery. To enhance the effectiveness of SCRS and develop more precise guidelines for its application, this study focuses on several key clinical factors: (i) neoadjuvant chemotherapy: previous studies have shown conflicting results regarding its impact on SCRS outcomes. Some suggest it can reduce tumor size and facilitate easier surgical resection, while others argue it may be associated with chemotherapy resistance and poorer survival outcomes; (ii) recurrence interval: the time interval between the end of initial treatment and recurrence is a crucial factor. Longer recurrence intervals are generally associated with better prognosis and higher likelihood of achieving complete cytoreduction; (iii) number of prior lines of chemotherapy: the number of chemotherapy regimens a patient has undergone prior to SCRS can impact the tumor's chemosensitivity and the patient's overall health status; (iv) number of chemotherapy cycles during relapse; the extent of chemotherapy received during relapse may reflect the aggressiveness of the disease and the patient's tolerance to treatment; and (v) tumor stage, size, and number of lesions: these anatomical and pathological characteristics are fundamental determinants of the feasibility and success of SCRS. Tumor stage at recurrence, the size of recurrent tumors, and the number of metastatic lesions is directly related to the complexity of the surgical procedure and the likelihood of achieving complete cytoreduction.

Given the high recurrence rate and significant impact of SCRS on survival outcomes, it is essential to refine the criteria for patient selection and surgical planning. By exploring the correlation between these clinical factors and SCRS outcomes, this study aims to provide a comprehensive analysis that can help optimize treatment protocols and improve prognoses for patients with recurrent ovarian cancer.

2. Information and methods

2.1. Study population

We conducted a retrospective cohort study that strictly adheres to the STROBE statement, ensuring transparency and integrity in reporting. This study is based on real data extracted from the electronic medical record system of our hospital. We accessed the database from March 2024 to June 2024 and included 83 ROC patients from January 2010 to January 2020 in the study. No characteristic information about the patients was extracted or accessed during the study period, so no ethical clearance or waiver of authorization or exemption from informed consent was required.

2.2. Criteria for inclusion of medical records

Patients needed to meet the following inclusion criteria: (i) Age 18 years or older; (ii) expected survival time of at least 12 weeks; (iii) limited to 2 or fewer prior lines of chemotherapy; (iv) underwent initial tumor cytoreduction and received a chemotherapy regimen containing platinum-based agents; (v) diagnosis of ovarian epithelial carcinoma confirmed by postoperative pathology, with a course of chemotherapy exceeding 6 courses; (vi) elevated tumor marker levels and/or imaging studies indicating signs of tumor recurrence; (vii) detection of a mass on physical examination or imaging, or unexplained bowel obstruction; (viii) disease-free survival (DFI) greater than 6 months; and (ix) little or no ascites.

2.3. Medical history exclusion criteria

Exclusion criteria were: (i) history of malignant tumors elsewhere; (ii) severe cardiovascular and cerebrovascular diseases, severe hepatic and renal dysfunction, or any other diseases that preclude radiotherapy and chemotherapy; (iii) history of severe mental illness, alcoholism or drug addiction; (iv) contraindications to chemotherapy and surgery; (v) pathologic diagnosis of malignant teratoma, endodermal sinus tumor, carcinosarcoma, granular cell tumor and other types of ROC; (vi) incomplete clinical data affecting study analysis.

2.4. Data collection

In this study, the necessary data will be collected by compiling patients' medical records, including age, International Federation of Gynecology and Obstetrics (FIGO) stage, pathological differentiation, histological type, results of initial tumor cytoreduction, and DFI. At the same time, the research team will carefully review the records of the secondary surgery to determine the size, location, and number of recurrent tumors, as well as the thoroughness of the secondary surgery. The results of SCRS will be classified into three categories based on the size of the residual tumor after surgery: complete cytoreduction (R0, no residual foci visible to the naked eye), optimal cytoreduction (R1, residual foci less than 1 cm), and non-optimal cytoreduction (R2, residual foci greater than or equal to 1 cm). To ensure data integrity and accuracy, we employed a double-check system where two independent researchers verified the collected data. In case of discrepancies, a third senior researcher resolved

conflicts. Missing data were handled using multiple imputation techniques to ensure the robustness of our findings.

In addition, the study will collect information on the survival status of patients by telephone or outpatient follow-up and analyze it retrospectively. After completion of initial treatment or re-treatment, patients will be required to undergo regular outpatient reviews, which will include clinical symptoms, signs, and ultrasound examinations of the pelvis and abdomen. If any abnormality occurs, further CT or PET/CT will be performed. In addition, tumor markers such as serum CA125 and HE4 will be tested regularly. The frequency of review will be every 3 months in the 1st to 2nd year after treatment, every 3 to 6 months in the 3rd to 5th year, and annually after 5 years. By means of telephone questioning, the researchers will find out the survival status of the patients. Survival is defined as the time from the start of the second tumor cytoreduction until the patient's death or the last contact with the patient. Patient follow-up will continue until 20 June 2024.

2.5. Statistical processing

Data processing and analysis for this study were performed using the SPSS 26.0 statistical software package. Survival analysis was conducted with survival defined from SCRS to death or last contact. Kaplan-Meier survival curves were used to estimate the survival function of ROC patients undergoing SCRS, and the log-rank test was employed to compare survival curves between different patient groups. For univariate and multivariate analyses, Cox proportional hazards models were utilized to explore the impact of various factors on the survival of ROC patients. The variables included in the model were age, FIGO stage, pathological differentiation, histological type, neoadjuvant chemotherapy, and initial tumor cytoreduction results, with hazard ratios (HR) and 95% confidence intervals (CI) calculated for each variable. Logistic regression analysis was performed to identify factors affecting the completeness of SCRS, incorporating variables such as tumor stage, size, number, and patient characteristics, and reporting odds ratios (OR) and 95% CI. Categorical variables were coded as binary or dummy variables as appropriate. Continuous variables were standardized if necessary. All statistical tests were two-sided with a significance level set at $\alpha = 0.05$.

3. Results

3.1. Comparison of clinical data

Patients aged ≤ 54 years accounted for 26.51%, while those aged >54 years accounted for 73.49%, indicating that most patients relapsed at an older age. The FIGO stages of the patients were widely distributed, ranging from stage I to IV. Stage III patients were the most prevalent (36.14%), followed by stage I (24.10%) and stage II (22.89%), and relatively few stage IV patients (16.87%) (**Table 1**). The majority of patients (96.38%) had moderately or poorly differentiated tumors, indicating a high degree of tumor cell heterogeneity (**Table 1**). Highly differentiated patients accounted for only 3.61% (**Table 1**), suggesting that tumor cell heterogeneity was low in this group of patients. Plasmacytoid adenocarcinoma was the most common pathologic

type (48.19%), followed by mucinous adenocarcinoma (24.10%) and endometrioid carcinoma (12.04%) (**Table 1**). The majority of patients had a complete (no residual) or optimal (≤ 1 cm) initial surgical outcome, 44.58% and 48.19%, respectively (**Table 1**). Non-optimal (> 1 cm) initial surgical outcomes were only found in 2.41% of cases (**Table 1**), indicating that surgical outcomes were generally good. After SCRS (which may refer to a treatment of some kind but is not clearly labeled in the **Table 1**), complete remission was achieved in 44.58% of patients, optimal remission in 36.14%, and non-optimal remission in 19.28% (**Table 1**). The majority of patients (48.19%) received SCRS within 1 month of relapse, and a minority (2.41%) received treatment more than 2 months after relapse (**Table 1**). About half of the patients (54.22%) had not received chemotherapy before receiving SCRS, while the other half (45.78%) had received chemotherapy (**Table 1**). Most of the recurrent tumors were less than 6 cm in diameter (84.34%), with 21.69% ≤ 3 cm and 62.65% ≤ 6 cm. More than half of the patients (72.29%) had ≥5 tumors, while relatively few patients had isolated tumors and 2–4 tumors (**Table 1**).

Table 1. Comparison of clinical data between the two groups [*n* (%)].

Age of recurrence		**>February**	**42 (50.60)**
≤54 years old	22 (26.51)	Tumor location in SCRS	
>54 years old	51 (73.49)	Epigastrium	20 (24.10)
FIGO staging		Midabdomen	13 (15.67)
Phase I	20 (24.10)	Pelvic cavity	50 (60.24)
Phase I	19 (22.89)	Largest recurrent tumor (cm)	
Phase III	30 (36.14)	3 or less	18 (21.69)
Stage IV	14 (16.87)	6 or less	52 (62.65)
Degree of cell differentiation		>6	13 (15.67)
Highly differentiated	3 (3.61)	Tumor number	
Moderately differentiated	40 (48.19)	Isolate	14 (16.87)
Poorly differentiated	40 (48.19)	Two to four	9 (10.84)
Pathological type		≥5	60 (72.29)
Serous adenocarcinoma	40 (48.19)	DFI (Month)	
Mucinous adenocarcinoma	20 (24.10)	The < 12	20 (24.10)
Endometrioid cancer	10 (12.04)	12–30	33 (39.76)
other	13 (15.67)	30 higher	30 (36.14)
Primary surgical outcome		There is no chemotherapy before SCRS	
Complete (no residue)	37 (44.58)	None	45 (54.22)
Optimum (≤1cm)	40 (48.19)	Yes	38 (45.78)
Non-optimal (>1cm)	6 (26.51)	SCRS results	
Time to recurrence to SCRS (months)		Complete	37 (44.58)
≤1 month	40 (48.19)	Best	30 (36.14)
≤2 months	2 (2.41)	Not best	16 (19.28)

3.2. Clinical univariate and multifactorial analyses affecting progression-free survival

Patients with an astern Cooperative Oncology Group(ECOG） score of 0–1 had longer progression-free survival than those with an ECOG score of 2 (P = 0.012) (**Table 2**). A lower ECOG score means a better ability to perform daily activities. Patients who did not receive neoadjuvant chemotherapy had a longer progression-free survival than those who received neoadjuvant chemotherapy (P = 0.023) (**Table 2**). This is related to the side effects of chemotherapy or the sensitivity of chemotherapy to tumor cells. Patients with a recurrence interval of 6–12 months had a shorter progression-free survival than those with a recurrence interval of more than 12 months (P = 0.009) (**Table 2**). It is suggested that tumor growth rate or recurrence frequency is an important prognostic factor. Patients previously treated with 1-line chemotherapy had a longer progression-free survival compared with patients treated with 2–3 lines of chemotherapy (P = 0.003) (**Table 2**). This is associated with the development of chemotherapy resistance. Patients who received ≤3 cycles of chemotherapy during the relapse cycle had a longer progression-free survival than those who received 4–8 cycles of chemotherapy (P = 0.031) (**Table 2**). This is also related to chemotherapy resistance or the side effects of chemotherapy. In a multifactor analysis, patients with an ECOG score of 0–1 still showed longer progression-free survival than patients with a score of 2 (P = 0.011) (**Table 2**). In contrast to univariate analysis, multivariate analysis showed that patients receiving neoadjuvant chemotherapy had shorter progression-free survival (P = 0.028) (**Table 2**). This may be due to other unaccounted variables having an effect in the model. Consistent with univariate analysis, patients with a recurrence interval of 6–12 months had shorter progression-free survival (P = 0.026) (**Table 2**). Consistent with univariate analysis, patients previously treated with 1-line chemotherapy had a longer progression-free survival (P = 0.0012) (**Table 2**). Consistent with univariate analysis, patients receiving ≤3 cycles of chemotherapy had longer progression-free survival (P = 0.006) (**Table 2**). The effect of this factor was reinforced in the multifactor analysis, showing a much larger effect.

Table 2. Clinical univariate and multifactorial analyses affecting progression-free survival.

	P	**Single factor analysis HR (95% CI)**	***P***	**Multifactor analysis HR (95% CI)**
Age (≤55v>55)	0.415	0.93 (0.75–1.15)		
ECOG(0-1v2)	0.012	0.53 (0.42–0.66)	0.011	0.62 (0.50–0.78)
Differentiation (low differentiation v high differentiation)	0.613	1.00 (0.81–1.25)		
Neoadjuvant chemotherapy (no v yes)	0.023	0.78 (0.63–0.97)	0.028	1.40 (1.13–1.74)
Satisfaction with initial tumor reduction (satisfied v dissatisfied)	0.312	1.12 (0.86–1.61)		
FIGO Classification (III-IV vI-II)	0.285	1.15 (0.93–1.43)		
Recurrent cycle surgery (yes v no)	0.312	1.17 (0.80–1.72)		
The recurrence interval (6-12v>12)	0.009	0.43 (0.31–0.60)	0.026	0.51 (0.36–0.70)
Number of chemotherapy lines previously used (1v2-3)	0.003	1.52 (1.23–1.89)	0.0012	1.46 (1.17–1.82)
Recurrence cycles Total chemotherapy cycles (≤3v4-8)	0.031	1.88 (0.70–2.11)	0.006	3.48 (2.65–4.57)

3.3. Clinical univariate and multivariate analyses affecting overall survival

Age, HR (95% CI) = 1.03 (0.81–1.32), *P* = 0.688 (**Table 3**). There was no significant difference in the risk of recurrence between those younger than 55 years and those older than 55 years (**Table 3**). ECOG score, HR (95% CI) = 0.55 (0.43–0.71), *P* = 0.072 (**Table 3**). Patients with a score of 0–1 had a lower risk of recurrence compared to patients with a score of 2. Degree of differentiation, HR (95% CI) = 0.91 (0.71–1.18) *P* = 0.377 (**Table 3**). Degree of differentiation is an indicator of how similar a cancer cell is to a normal cell. There was no significant difference in recurrence risk between patients with low differentiation and those with high differentiation. Neoadjuvant chemotherapy, HR (95% CI) = 0.51 (0.39–0.66), *P* = 0.026 (**Table 3**). Patients receiving neoadjuvant chemotherapy have a lower risk of recurrence. Satisfaction with initial tumor reduction, HR (95% CI) = 1.04 (0.81–1.34) *P* = 0.636 (**Table 3**). Satisfaction with primary tumor reduction surgery was not significantly associated with recurrence risk. FIGO scale (III-IV vs I-II), HR (95% CI) = 0.96 (0.62–1.47) *P* = 0.712 (**Table 3**). FIGO scale is an indicator describing the severity of gynecological tumors. There was no significant difference in the risk of recurrence between patients with grades III-IV and I-II. HR (95% CI) for recurrence cycle was 0.39 (0.26–0.58), *P* = 0.019 (**Table 3**). Patients who have surgery after a recurrence have a lower risk of recurrence. The recurrence interval (6–12 months vs >12 months), HR (95% CI) = 2.28 (1.77–2.93) *P* = 0.020 (**Table 3**). Patients with a recurrence interval of 6 to 12 months had a higher risk of recurrence than those with a recurrence interval of more than 12 months. Number of chemotherapy lines previously used HR (95% CI) = 1.66(0.50–6.87) (**Table 3**). Patients who received 1 line of chemotherapy had a different risk of recurrence than those who received 2 or 3 lines of chemotherapy. The number of relapse cycles HR (95% CI) = 2.59 (1.74–3.86), *P* = 0.279 (**Table 3**). Patients who received ≤3 cycles of chemotherapy in a recurrence cycle had a higher risk of recurrence than those who received 4–8 cycles.

Table 3. Clinical univariate and multivariate analysis of overall survival.

	P	**Single factor analysis HR (95% CI)**	**P**	**Multifactor analysis HR (95% CI)**
Age (<55v>55)	0.688	1.03 (0.81–1.32)		
ECOG(0-1v2)	0.072	0.55 (0.43–0.71)		
Differentiation (Low differentiation v High differentiation)	0.377	0.91 (0.71–1.18)		
Neoadjuvant chemotherapy (No v Yes)	0.026	0.51 (0.39–0.66)	0.013	0.53 (0.38–0.73)
Satisfaction with initial tumor reduction (satisfied v dissatisfied)	0.636	1.04 (0.81–1.34)		
FIGO Classification (III-IV vI-II)	0.712	0.96 (0.62–1.47)		
Recurrent cycle surgery (yes v no)	0.019	0.39 (0.26–0.58)	0.021	0.55 (0.42–0.72)
The recurrence interval (6-12v>12)	0.020	2.28 (1.77–2.93)	0.013	1.98 (1.52–2.59)
Number of chemotherapy lines previously used (1v2-3)	0.030	1.66 (0.50–6.87)	0.017	0.48 (0.36–0.65)
Recurrence cycles Total chemotherapy cycles (≤3v4-8)	0.279	2.59 (1.74–3.86)		

3.4. Analysis of factors affecting the completeness of SCRS

Tumor stage had significant influence on the degree of SCRS completion (P = 0.024) (**Table 4**). Tumor size had a significant effect on SCRS complete degree (P = 0.016) (**Table 4**), indicating that patients with larger tumors had a higher risk of SCRS complete degree, and tumor size may be negatively correlated with SCRS complete degree. The number of tumors had a significant effect on the degree of SCRS completion (P = 0.015) (**Table 4**), indicating that patients with multiple tumors had a higher risk of SCRS completion.

Table 4. Analysis of factors affecting the degree of SCRS completeness.

	P	Single factor analysis HR (95% CI)	P	Multifactor analysis HR (95% CI)
Age (>55/≤54)	0.592	0.60 (0.09–3.88)		
Tumor stage (III-IV/I-II)	0.024	7.58 (1.39–43.92)	0.009	2.723 (1.281, 5.786)
Classification (low differentiation/Medium differentiation)	0.778	1.27 (0.23–6.81)		
Histological type (serous/other)	0.156	3.33 (0.63–17.66)		
Recurrence to the second operation time	0.095	2.46 (0.88–6.92)		
Recurrent location (upper abdomen/midabdomen, pelvis)	0.189	1.87 (0.72–4.82)		
Tumor size	0.016	6.45 (1.41–29.51)	0.040	0.386 (0.153, 0.896)
Tumor number	0.015	4.19 (1.32–13.29)	0.039	2.893 (1.056, 7.925)
DFI	0.344	0.60 (0.21–1.70)		
There is no chemotherapy before SCRS	0.952	0.95 (0.14–4.67)		

3.5. Survival analysis of prognostic factors

In this study, COX proportional hazards model was used to analyze the factors affecting the survival of ROC patients after receiving SCRS. The results showed that the outcome of SCRS surgery, the outcome of primary surgery, and DFI were significantly associated with the survival of patients with recurrence. Specifically, the median survival of patients receiving complete SCRS was 49 months, compared with 26 months for those receiving optimal SCRS and 18 months for those receiving non-optimal SCRS (**Figures 1–3**).

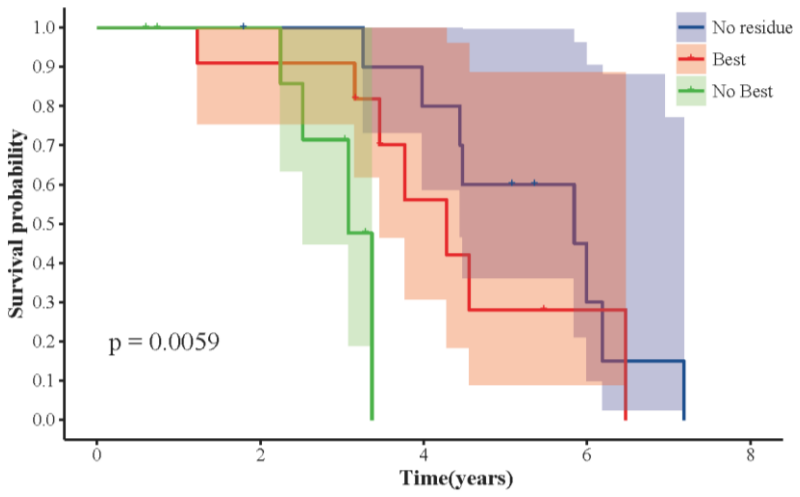

Figure 1. Comparison of survival curves of patients grouped by SCRS satisfaction.

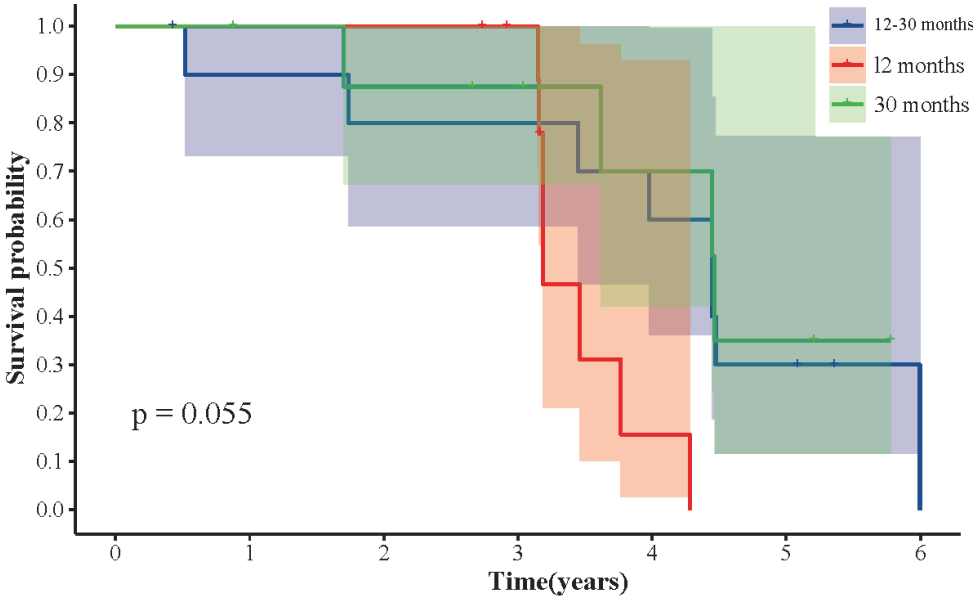

Figure 2. Comparison of DFI survival curves of patients.

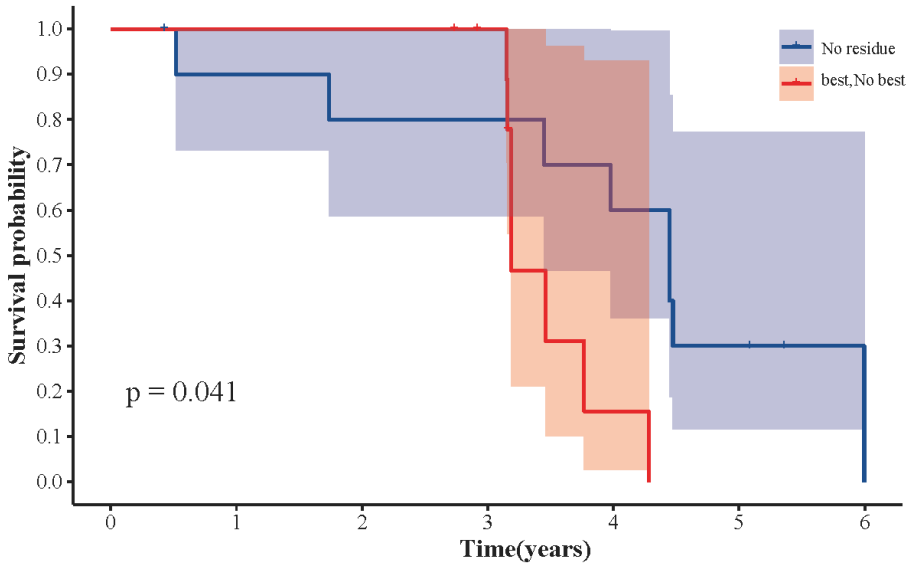

Figure 3. Survival comparison of patients with initial surgical outcomes.

3.6. Survival period analysis

In this study, we continuously monitored 83 patients. but three were excluded due to incomplete follow-up date, leaving 80 for detailed analysis. At the end of follow-up, 26 patients were alive, while 57 had died. The mean survival was 56 months (**Figure 4**).

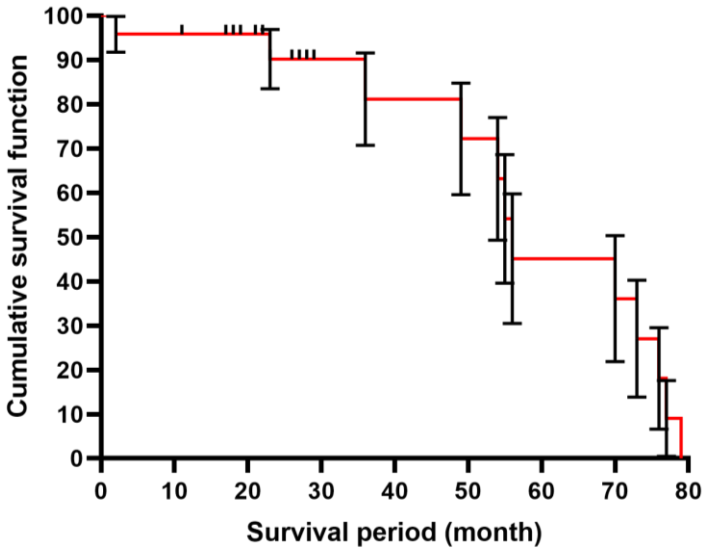

Figure 4. Survival of ROC patients with SCRS.

4. Discussion

ROC, as a malignant tumor of the female reproductive system, is known for its high morbidity, mortality and recurrence rates, posing a serious threat to women's health [8]. After initial standardized systemic treatment, the recurrence rate in early-stage patients ranges between 20% and 25%, whereas the recurrence rate in advanced-stage patients can be as high as 70% [9]. Although there is no global standardization of treatment after recurrence, and chemotherapy remains the mainstay of treatment for ROC, its effectiveness in improving patient prognosis and quality of life is limited [10]. Chemotherapy resistance is one of the major obstacles to improving the cure rate of ROC [11]. According to pharmacokinetic principles, the effect of a drug is related to its exposure in the body [12]. Drug resistance and chemotherapeutic response of tumor cells are closely related to the number of tumor cells, i.e., the effect of chemotherapy is directly related to the size of the tumor [13]. For large tumors visible to the naked eye, the chemotherapy response rate is only 25% [14]. In addition, large tumor masses have a poor blood supply, resulting in either an inability to achieve effective drug concentrations within the tumor cells or a reduced accumulation of intracellular platinum compounds, which results in a reduced sensitivity to chemotherapy.

Our findings corroborate the results of previous studies, which indicate that the thoroughness of tumor reduction is a critical predictor of survival outcomes in ROC patients. Specifically, the median survival times (**Figures 1–3**) in undergoing complete SCRS (49 months), optimal SCRS (26 months), and non-optimal SCRS (18 months) align closely with the ranges reported in the literature. Previous studies showing a significant positive impact of complete SCRS on patient survival, with patients with residual lesions less than 1 cm in size having a better prognosis than those with unsatisfactory reduction. Patients with unsatisfactory SCRS have a shorter survival and may not be as well off as recurrent patients who receive only chemotherapy. These consistent findings reinforce the importance of achieving complete cytoreduction maximize patient survival. Numerous studies have also pointed out that not all recurrent patients are suitable for reoperation or can benefit from SCRS, which may involve risks of surgical trauma and complications [15]. Numerous scholars have

explored the indications for SCRS with the aim of screening recurrent patients suitable for secondary surgery [16]. The role of SCRS in the treatment of ROC remains a controversial topic. In recent years, the significance of this procedure has been studied extensively both nationally and internationally [17]. However, due to the limitations of medical ethics and the difficulty of collecting ROC cases, many studies have been limited to retrospective analyses and are mostly non-randomized controlled trials. The results of these studies are influenced by a variety of factors, including the time of study implementation, number of patients, missing data, and follow-up time [18]. Clinicians tend to select patients with favorable survival factors (e.g., sensitivity to platinum agents, isolated lesions, and good overall patient status) for SCRS, which may also bias the study results. A number of randomized controlled trials underway in some countries have not yet completed enrollment or reached the expected follow-up time [19]. Despite these challenges, a large number of studies have shown that thorough SCRS does significantly prolong patient survival, and the size of postoperative residual lesions is an important indicator for assessing the effectiveness of SCRS and a key factor influencing survival prognosis [20]. According to the size of postoperative residual lesions, the results of SCRS can be categorized into three types: complete cytoreduction, optimal cytoreduction, and non-optimal cytoreduction. In this study, the median survival of complete and optimal SCRS was significantly longer than that of non-optimal secondary cytoreduction. Satisfactory tumor cytoreduction minimizes tumor load, which leads to increased sensitivity to radiotherapy, enhanced immune response, symptomatic relief, and ultimately clinical benefits [21]. Preoperative evaluation and selection of surgical indications are directly related to the degree of thoroughness of SCRS, so it is crucial to study the impact of preoperative evaluation and risk prediction on the degree of satisfaction of SCRS, which is of great significance for prolonging the survival of patients with ROC [22].

However, our study also highlights some differences. For example, we observed that neoadjuvant chemotherapy was associated with shorter progression-free survival (**Table 2**), which contrasts with some studies that suggest neoadjuvant chemotherapy can be beneficial. This discrepancy may be attributed to differences in patient populations, the extend oden, or the timing of chemotherapy administration. Additionally, our study found that patients who did not receive neoadjuvant chemotherapy had better progression-free survival, which may suggest a need for re-evaluation of patient selection criteria for neoadjuvant chemotherapy in ROC treatment protocols.

Furthermore, our analysis identified that recurrence interval, the number of prior lines of chemotherapy, and the number of chemotherapy cycles during the relapse cycle were significant factors affecting progression-free survival and overall survival (**Table 2**). These findings are consistent with the literature indicating that shorter recurrence intervals and higher numbers of chemotherapy lines are associated with poorer outcomes. However, the specific impact of chemotherapy cycles during relapse is less frequently reported, aspect of our study that warrants further investigation.

The findings of this study have significant implications for current treatment guidelines and clinical practice. The strong association between the thoroughness of SCRS and improved survival outcomes underscores the necessity for meticulous surgical planning and execution. It highlights the need for surgeons to aim for

complete cytoreduction whenever feasible, given its substantial impact on patient prognosis. Our results suggest that current guidelines should emphasize the importance of careful preoperative assessment to identify patients most likely to benefit from SCRS. Factors such as tumor stage, size, and number of lesions should be thoroughly evaluated to optimize surgical outcomes. This study also supports the selective use of neoadjuvant chemotherapy, considering its potential impact on progression-free survival, and suggests that treatment guidelines may need to be adjusted to reflect these findings. Furthermore, the results of our study advocate for the integration of multidisciplinary teams in the management of ROC. Collaboration between gynecologic oncologists, medical oncologists, radiologists, and pathologists is crucial to ensure comprehensive preoperative evaluations and postoperative care. The goal should be to tailor treatment plans to individual patient profiles, thereby maximizing the chances of complete cytoreduction and improving overall survival rates.

For platinum-sensitive ROC patients or FIGO stage I patients who have not received chemotherapy after initial surgery, the following conditions should be met when considering SCRS: no or only a small amount of ascites, good overall patient status (ECOG grade 0), isolated or limited tumor (no distant metastasis), and no residual tumor after initial surgery, as well as the patient's personal wishes and economic status [23]. In preoperative evaluation, in addition to imaging, laparoscopic exploration and Fagotti laparoscopic scoring are recommended due to the limitations of imaging to improve the accuracy of assessing whether satisfactory tumor cytoreduction can be achieved [24]. Timely and accurate diagnosis of recurrence and a thorough and comprehensive assessment of the patient's condition should be performed before selecting a treatment plan for ROC patients [25]. The indications for SCRS should be strictly grasped, and the tumor should be completely resected as much as possible while improving the quality of patient survival to avoid worse prognosis that may result from blind surgery [26]. For recurrent patients found to have isolated lesions, reoperation should be performed as early as possible to avoid tumor spread with the prolongation of recurrence, which increases the difficulty of surgery. This is important for improving the quality of patient's survival and prolonging the survival period [27].

5. Conclusion

This study provides novel insights into the factors influencing the success of SCRS in the management of ROC. We identified key clinical factors affecting progression-free survival and overall survival, including neoadjuvant chemotherapy, and the number of chemotherapy cycles during the relapse cycle. Our findings underscore the significant impact of tumor stage, size, and number of lesions on the completeness of SCRS.

The novelty of this study lies in its comprehensive analysis of a decade-long dataset, providing robust evidence for the critical role of SCRS in improving patient outcomes. Specifically, the study highlights the importance of achieving complete cytoreduction to optimize treatment efficacy and patient prognosis. These findings have important implications for clinical practice. They suggest that thorough

preoperative assessments and careful patient selection are essential to maximize the benefits of SCRS. Additionally, the results advocate for a re-evaluation of the use of neoadjuvant chemotherapy, given its potential impact on progression-free survival.

In conclusion, by aligning clinical practices with these findings, healthcare providers can enhance the management of ROC, leading to better treatment outcomes and improved survival rates for patients. This study contributes valuable knowledge to the field of gynecologic oncology and supports the ongoing refinement of treatment protocols for recurrent ovarian cancer.

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