Original Research

Total parietal peritonectomy for 61 patients: a retrospective study

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Abstract

Objective: To evaluate the morbidity of total parietal peritonectomy (TPP) during cytoreduction surgery, and its impact on the site of recurrence of different peritoneal surface malignancies (PSM). **Methods**: We led a retrospective study in a French tertiary cancer institution (Centre Oscar Lambret - Lille) experienced in treating PSM over a 6-year period from 2012 to 2018. All patients underwent a total parietal peritonectomy during a debulking surgery for PSM including ovarian cancer, appendiceal pseudomyxoma peritonei or peritoneal mesothelioma. **Results**: Among the 61 patients included in this study, 49 patients(80.3%) had an ovarian cancer. The rate of complete tumor resection reached 86.9% with almost 69% of surgeries being highly complex. 73.8% were transfused during the surgical procedure. The median length of hospital stay was 10 days including 7 days in Intensive Care Unit. Overall, 19 patients (31.1%) had an early postoperative complication, including 3 with a grade IIIB complication of Clavien Dindo classification. With a median follow-up of 30 months, the estimated disease-free survival in the ovarian cancer subgroup who had an initial peritonectomy ($n = 42$) was 84.7% at 1 year and 12.0% at 3 year. The main site of first and second recurrence was peritoneal (42% and 14%). **Conclusion**: TPP is a safe surgical procedure to treat peritoneal surface malignancies and their recurrences with a low rate of grade IIIB morbidity and no treatment-related death and allow optimal surgery. In this study there is no atypical recurrence site, such as abdominal muscle involvement.

Keywords: Ovarian cancer; Peritonectomy; Primary surgery debulking; Interval debulking surgery; Neo-adjuvant chemotherapy

1. Introduction

Peritonectomy has been used for the treatment of peritoneal surface malignancies (PSM) including colorectal cancer [1,2], appendiceal pseudomyxoma peritonei [3], and peritoneal mesothelioma [4]. Baratti *et al*. [5] was the first to evaluate the concept of total parietal peritonectomy (TPP) in peritoneal mesothelioma. Pelvic peritonectomy has been applied in advanced ovarian cancer with peritoneal carcinomatosis and has increased the rate of complete cytoreduction up to 60% [6].

As a technique, peritonectomy has been described and standardized first by Sugarbaker in 1995 [7] for colon cancer then modified by other groups depending on histopathology [8]. According to Sugarbaker [9], only abnormal peritoneum should be excised. But the extensive resection of tumors showed contradictory outcomes. Kyriazanos *et al*. [10], described the "cocoon technique" a standardized approach to achieve total extraperitoneal peritonectomy. Usually coupled with Hyperthermic Intraperitoneal Chemoperfusion (HIPEC), extensive cytoreduction surgery (CRS) has been criticized for its morbidity and mortality rates along with its benefits for all patients [11]. On the other hand, other studies have shown significant improvements in rates of survival and acceptable rates of morbidity [12,13].

In order to obtain an optimal cytoreduction, surgeons perform a TTP to resect all visible disease, since any residual disease represents a potential risk for recurrence, especially in chemo-resistant tumors.

However, removing only visible residual disease following neoadjuvant chemotherapy (NACT) and not "normally appearing peritoneum" that was previously affected before chemotherapy, showed a high rate of recurrence of 70% with the commonest site being the peritoneum, at previous disease sites [14]. Therefore, it may be hypothesized that complete removal of the peritoneum affected prior to NACT may prevent or delay the recurrence in these patients.

Another hypothesis of the TPP benefits is the removal of a potential site of disease recurrence.

We performed this observational study to evaluate primarily the morbidity and mortality related to TPP performed during CRS. We also evaluated the impact of this surgery on the site of recurrence of different PSM, essentially the ovarian cancer.

2. Methods

2.1 Study design

We conducted a retrospective and descriptive cohort study in a French tertiary cancer institution (Centre Oscar

Table 1. Patient characteristics.

Total population, $n = 61$	n (%) or median (range)
Age at diagnosis:	61.9 (28.9–80.0)
Body Mass Index:	24.2 (17.4–44.5)
WHO performance status:	
0	50 (82)
1	10 (16.4)
2	1 (1.6)
Peritoneal histology:	
Ovarian cancer	49 (80.3)
High-Grade serous	40
Low-Grade serous	1
Clear cell carcinoma	1
Endometroid	3
Mucinous	2
Carcinosarcoma	2
Pseudomyxoma Peritonei	8 (13.1)
Mesothelioma	1(1.6)
Other	3 (4.9)
Lobular breast carcinoma	1
Sarcoma and High-Grade serous	2
Peritonectomy timing:	
At Primary or Interval Debulking Surgery	53 (86.9)
At recurrence	8 (13.1)
Residual disease after surgery:	
CC0	53 (86.9)
CC1	7 (11.5)
CC2	1 (1.6)
Time between diagnosis and peritonectomy, days:	161 (0–1714)
Surgeon visual diagnosis *versus* histology report:	
Macroscopic and microscopic lesions	51 (83.6)
No macroscopic or microscopic lesions ("preventive peritonectomy")	2 (3.2)
Macroscopic lesions and histology results without lesions	8 (13.1)

CC, Completeness of cytoreduction; WHO, World Health Organization.

Lambret - Lille) over a 6-year period from 2012 to 2018.

All patients included in the present study underwent a TTP during a debulking surgery for PSM and treatments were validated by the tumor-board committee. Data were collected from hospital patient files without direct interaction with the patients for the research purpose. The study protocol was approved by the institutional review board and conformed to the French ethical standards and 2008 Helsinki declaration.

2.2 Surgical procedures

The goal of CRS was to obtain a complete cytoreduction (no macroscopic residual disease). The disease extent was quantified using Sugarbaker's Peritoneal Cancer Index (PCI) [7]. Completeness of cytoreduction score (CC-score) was used to describe the residual disease status.

Completeness of cytoreduction (CCR) was classified as follows: macroscopically complete (CCR-0); nearly complete: residual disease $\leq$2.5 mm in any region (CCR-1); or suboptimal: residual disease >2.5 mm (CCR-2). All resected specimens were submitted to pathologic examination. Tumors were histologically categorized following the World Health Organization (WHO) classification [15].

TPP was defined as removal of the complete peritoneum (pelvic, bilateral anteroparietal peritoneum, bilateral upper quadrant peritoneum) using electric cautery or blunt dissection, as described in details by Yokosu *et al*. [16]. A TPP was performed in three different cases. First, to resect all sites of peritoneal disease in primary debulking surgery (PDS) prior to administration of a chemother-

apy. Second, to resect all sites of residual disease in interval debulking surgery (IDS). And finally, to remove potential sites of disease recurrence.

Small and scattered localizations on the visceral surface were resected by local excision and/or electrocoagulation. In case of massive and/or deeply infiltrating disease, visceral resections were performed, including cholecystectomy, splenectomy, sigmoid, right or total colectomy. Clinically suspicious lymph nodes (para-aortic and pelvic) were sampled and submitted to pathologic examination.

2.3 Systemic chemotherapy

All patients with ovarian cancer received at least 6 cycles of a platinum compound (Carboplatin or Cisplatin) and Taxane (Paclitaxel or Docetaxel) before and/or after surgery depending on the resectability of the tumor.

2.4 Follow up and definition of recurrence

The occurrence of a recurrence was assessed by a clinical examination completed by biological (increase in the tumor marker CA-125), radiological examinations (thoraco-abdominopelvic CT scan, PET-scan) and/or histological evidence if possible.

The date of diagnosis of the first recurrence was collected, as well as the site of recurrence (Liver, Pleural, peritoneal carcinomatosis…) and the date of the latest news or death if any.

2.5 Data collection

Consecutive patients with PSM including carcinomatosis of gastrointestinal (colon cancer) or gynecologic origin, mostly advanced ovarian cancer, fallopian tube and primary peritoneal tumors such as mesothelioma (DMPM) or pseudomyxoma peritonei, undergoing PDS or IDS with or without intraperitoneal chemotherapy (IPC) were included. In the ovarian subgroup, we included patients with FIGO stage I–IV-B. Patients with stage IV-A (pleural effusion and/or lung metastasis) were operated only if they showed complete response to systemic chemotherapy and the cytology became negative. Patients with stage IV-B who had resectable liver metastasis, inguinal lymph node metastasis and spleen metastasis lesions were also included. We only collected data for patients whose records included complete information.

The following clinical and paraclinical items were collected: age at diagnosis, body mass index (BMI), WHO performance status [17], preoperative CA 125 level. The tumor characteristics were also detailed: International Federation of Gynaecology and Obstetrics (FIGO) [18] stage for ovarian cancer, histological type [15] (serous, mucinous, endometrioid, clear-cell, papillary, mixed, non-epithelial adenocarcinoma, pseudomyxoma, mesothelioma and serous borderline tumors), peritoneal disease spread according to the PCI [7] at time of diagnosis, CRS results according to the CCR score [7], presence or absence of micro- or macro-

scopic peritoneal lesions as long as the presence or absence of identified genetic mutations.

Surgical characteristics at time of peritonectomy included the Aletti Score [19] to classify the difficulty of the procedure in High, Moderate and Low risk. The severity of postoperative complications were described using the Clavien-Dindo classification [20] based on the therapy used to correct them.

2.6 Statistical analysis

Analysis of all the included patients was performed. Results were presented using descriptive statistics: numbers and proportions for categorical variables, and median and ranges, for continuous variables.

Time-to-event analyses were calculated from the date of diagnostic in patients with peritonectomy performed as part of initial surgery and not for a recurrence. Overall survival (OS) was defined as the time interval from the date of initial diagnosis to the date of death from any case. Patient alive were censored at the date of last news. Disease-free survival (DFS) was defined as the time interval from the date of initial diagnosis to the date of the first tumor recurrence or death due to any cause. Patient alive without recurrence were censored at the date of the last news. Data for survival curves were calculated using the Kaplan Meier method. OS and DFS were assessed according to the histopathology but also to the context of the TPP (when undergoing a debulking surgery at initial diagnosis or to treat a recurrence). Data were analyzed using the STATA v15.0 software (Timberlake Consultants Limited, Richmond upon Thames, UK).

3. Results

From 2004 to 2018, 61 patients underwent a TPP at our center. Patient characteristics are summarized in Table 1. The median age was 62 years (29–80) and 82% had a good performance status. Eighty percent of the patients had ovarian cancer, mainly High Grade Serous Ovarian Cancer (HGSOC), 13% pseudomyxoma, and 2% mesothelioma. Fifty three patients (87%) had the peritonectomy at initial diagnosis and 8 patients (13%) had a recurrent disease with CCR-0 resection obtained in 87% of all patients.

Forty eight patients (84.2%) had a peritonectomy for macroscopic lesions and histology confirmed the disease. Only two patients had a preventive peritonectomy, where no macroscopic lesions were visualized and pathology report did not show any lesions. On the contrary, 8 patients had a complete peritonectomy for "supposedly" macroscopic lesions and histology report came back negative.

The characteristics of the surgery are available in Table 2. The complexity of the surgical procedures was assessed using the Aletti score: 42 patients (68.9%) were classified as "high" in terms of surgical difficulties, often associated with a more efficient debulking. The median operating time was 310 min with 82% percent having an ex-

traperitoneal peritonectomy and 66.7% lymphadenectomy. Eighteen patients (32.7%) had at least one complication during their surgery with the most common being bleeding (55.6%). Other complications were pleural (22.2%), ureter or bladder (16.7%) and digestive injuries (5.6%). The median blood loss was around 1200 mL with forty-five patients (73.8%) being transfused during the operating time.

Table 2. Surgical characteristics at time of peritonectomy (n = 61).

Surgery characteristics	n (%)
Extraperitoneal peritonectomy:	50 (82)
Lymphadenectomy:	38 (66.7)
Aletti Score:	
High	42 (68.9)
Intermediate	19 (31.1)
Low	0 (0)
Estimated Blood Loss (mL): median (range)	1200 (50–4000)
Transfusion:	
No	16 (26.2)
Yes	45 (73.8)
Packed red blood cells transfused	
0	16 (26.2)
≤3	32 (52.5)
≤6	12 (19.7)
8	1 (1.6)
Fresh Frozen Plasma transfused	
0	56 (91.8)
2–3	5 (8.2)
Per-operative complications:	
No	37 (67.3)
Yes	18 (32.7)
Vascular or spleen injury	10 (18.2)
Pleural injury	4 (7.3)
Bladder injury	3 (5.3)
Sigmoid injury	1 (1.8)
Operative time (min): median (range)	310 (120–570)

The median hospitalization stay after the surgery was 10 days (6–50), including 7 days (2–17) in Intensive Care Unit (ICU) with a median parenteral nutrition of 6 days (2–21). The early post-operative complications affected 19 patients (31.1%) and are detailed in Table 3. The main complications were medical complications like infections, renal failure, *etc* (11.5%), wound dehiscence and evisceration (6.6%) and lymphoceles (6.6%). Three patients were re-operated: one for a leakage from a bowel anastomosis complicated by peritonitis, one for a subphrenic abscess and one for internal bleeding. Other complications were in terms of frequency: parietal wall infection (3.3%), thromboem-

bolism (1.6%) and bleeding (1.6%).

In the ovarian cancer subgroup who had an initial peritonectomy (n = 42), Table 4, almost 73.8% of patients had a FIGO stage IIIC, 7.1% stage IVA and 16.7% stage IVB. At time of diagnosis, the median of CA125 was 1236 UI/L (8–30780) and 69% had ascites whereas only 16.7% had it at time of peritonectomy. With a median PCI of 20 (6–39) at the time of diagnosis, 54.8% of patients received a NACT before undergoing an IDS in order to optimize the cytoreduction of the cancer.

Among all patients, 32 (54.1%) had a recurrence (Table 5) of their cancer, 29 in the ovarian subgroup and 3 in the Pseudomyxoma Peritoneii subgroup. Out of 49 patients in the ovarian subgroup, 21 had a peritoneal recurrence (42%), 10 had distant metastasis (20%) and 3 lymph nodes recurrence (6%). Of them, 9 patients had a second recurrence after treating the first one. Again, the predilection of recurrence was peritoneal (14%), distant metastasis (6%) and lymph node (4%). Only 2 patients (4%) had a third recurrence with peritoneal lesions in all of them. The only patient who had a preventive peritonectomy during IDS did not have any per- or post-operative complications but had a liver recurrence without peritoneal lesions after almost 1 year.

In Table 6, HIPEC regimens and site of recurrences were detailed. Different HIPEC protocols were used depending on the histology studies: irinotecan and oxaliplatin heated to 42–43 °C for 30–40 min for pseudomyxoma, endometrioid carcinoma and mucinous carcinoma, cisplatin and doxorubicin heated to 41–43 °C for 60–90 min for mesothelioma and cisplatin heated to 40–42 °C for 90 min for high-grade serous adenocarcinoma. Two patients with pseudomyxoma were given mitomycin C because of a higher risk of bleeding and allergy. Patients who received the irinotecan and oxaliplatin protocol were also given an infusion of 5-fluouracil (5-FU) along with folinic acid 1 hour prior to HIPEC. Patients who received the Cisplatin protocol were given an IV perfusion of sodium thiosulfate for renal protection.

In the ovarian subgroup who had an initial peritonectomy, 8 patients had an IPC during surgery: 5 HGSOC, 2 mucinous and 1 endometrioid ovarian cancer. All patients had a FIGO stage IIIC. Only 2 patients had a Grade 3 complication in the postoperative period: one patient with an infected lymphocele drained under CT-Scan guidance and one patient re-operated for post-operative bleeding. Five patients had a recurrence out of 8:1 peritoneal and 3 at the level of lymph nodes and 1 patient died 2 months after surgery from general status alteration with liver and lung metastasis.

At a median follow-up of 30 months (95% Confidential Interval (CI): 23–38 months), 12 deaths occurred in the whole cohort (n = 61). In the ovarian subgroup, 23 recurrences occurred leading to death in 6 patients. In this group, the median DFS was 19.1 months (15.5–26.6 months) with

Table 3. Post-operative complications (*n* = 61).

Postoperative characteristics	*n* (%) or median (range)
Intensive Care Unit stay, days:	7 (2–17)
Parenteral feedings, days:	6 (2–21)
Hospital stay, days:	10 (6–50)
Postoperative complications (≤30 days):	
No	42 (68.9)
Yes	19 (31.1)
Type of complications	
Wound dehiscence and evisceration	4 (6.6)
Hemoperitoneum	1 (1.6)
Medical complications	7 (11.5)
Lymphocele	4 (6.6)
Thromboembolism	1 (1.6)
Parietal wall infection	2 (3.3)
Treatment of complications (Clavien-Dindo Classification)	
I	2 (10.5)
II	9 (47.3)
IIIA	5 (26.3)
IIIB	3 (15.8)
IV	0 (0)

Table 4. Clinical characteristics for "Initial peritonectomy" group for Ovarian cancer (*n* = 42).

Characteristics	N (%) or median (range)
FIGO stage	
IIB	1 (2.4)
IIIC	31 (73.8)
IVA	3 (7.1)
IVB	7 (16.7)
CA-125 at time of diagnosis (UI/mL)	1236 (8–30780)
Ascites at diagnosis:	29 (69)
Ascites at time of peritonectomy:	7 (16.7)
Number of NACT cycles before peritonectomy:	6 (0–12)
PCI at diagnosis:	20 (6–39)
PCI at time of peritonectomy:	15 (0–26)
Timing for surgery:	
Primary debulking surgery	14 (33.3)
Interval debulking surgery	28 (66.7)
Number of adjuvant chemotherapy cycles after peritonectomy	2 (0–8)
Type of chemotherapy	
Carboplatin + Paclitaxel	32
Carboplatin + Paclitaxel then Avastin	3
Carboplatin + Docetaxel	1
Carboplatin + Caelyx then Carboplatin + Docetaxel	1
Cisplatin + Paclitaxel then Carboplatin + Paclitaxel	1
Carboplatin + Paclitaxel + Folfox then Folfiri	1

NACT, Neoadjuvant chemotherapy; PCI, Peritoneal Cancer Index.

Table 5. Localization of recurrences in the ovarian cancer and pseudomyxoma peritonei subgroups (N = 57).

Characteristics of recurrences in the Ovarian subgroup	N (%)
Localization of 1st recurrence (N = 28)	
Abdominal	21 (42)
Retroperitoneal (Lymph nodes)	3 (6)
Distant Metastasis (Bones, Lungs, Pleura, Liver)	10 (20)
Other (CA125 elevation)	1 (2)
Localization of 2nd recurrence (N = 9)	
Abdominal	7 (14)
Retroperitoneal (Lymph nodes)	2 (4)
Distant Metastasis (Lungs, Pleura, Liver)	3 (6)
Digestive	1 (2)
Localization of 3rd recurrence (N = 2)	
Abdominal	2 (4)
Characteristics of recurrences in the Pseudomyxoma Peritoneii subgroup	
Localization of 1st recurrence (N = 3)	
Abdominal	2 (25)
Distant Metastasis (Bones, Lungs, Pleura, Liver)	1 (12.5)
Localization of 2nd recurrence (N = 2)	
Abdominal	2 (25)
Distant Metastasis (Lungs, Pleura, Liver)	1 (12.5)
Localization of 3rd recurrence (N = 1)	
Abdominal	1 (12.5)

a 3-year overall survival of 77% (54%–90%).

4. Discussion

Over the last decades, concepts about the treatment of PSM and specifically advanced-stage ovarian cancer have evolved. The optimal surgical treatment has changed over time from residual tumour of less than 1 cm [21] to the complete removal of all macroscopic disease with no residual tumour [22,23], even in selected recurrence cases [24,25]. This change was independently associated with better overall survival and disease-free survival. Even though systematic complete peritonectomy is not usually recommended unless there is a widespread peritoneal involvement, it can be a necessary step for optimal surgery except in colorectal and gastric cancer carcinomatosis, where high-volume disease is a common contraindication for treatment.

Since a visual examination concurred in only 8% with the final pathologic findings, a macroscopically normal peritoneum (no obvious residual tumor) may hide a tumor beneath it with up to 50% in the region surrounding the tumor nodule and 35% in uninvolved regions [26]. According to Baratti et al. [5], selective peritonectomy of macroscopically involved peritoneum resulted in 50% of patients with residual tumour remaining on parietal surfaces. Sinukumar et al. [27] in the INDESPO study found residual disease in 23.3% of the patients with normal-looking areas of the peritoneum in the IDS. In our study, we could not study this no-

tion, since we did a complete peritonectomy regardless of visual assessment. But on the contrary, 12% of supposedly affected lesions, were histologically normal.

Complete peritonectomy was associated with high morbidity (about 40%) and significant mortality (around 4%), especially when combined with visceral resection, and even in experienced hands. In a German study, the rate of postoperative complications for the same surgical technique was 54.5%, higher than the rate in our study [28]. In our study, around 28% of patients had per-operative complications like haemorrhage, bladder injury, diaphragmatic resection and bowel injury and 74% of patients being blood transfused. After 30 days, 30% had postoperative complications with grade 3–4 morbidity observed in 11%. Our rate of complication is slightly higher than other studies like the INDEPSO study [27]. This can be explained partly by the complexity of the surgery represented by the high Aletti Score in 69% of patients. The same reason can also explain the long median ICU stay (7 days) and median parenteral feeding duration (8 days).

In the ovarian cancer group, the overall survival was 77% at 3 years and the median disease-free survival was 19.1 months (15.5–26.6). Compared to other studies, like Vergote et al. [29] and Bakrin et al. [30], our patients did not have a worse overall survival. Bakrin et al. had a median OS of 35.4 months and Vergote et al. of 29–30 months in PDS and IDS groups respectively. In the LION trial [31]

Table 6. Detailed HIPEC regimens and associated complications and recurrences.

	Histology	IPC	T °C	Duration	FIGO	Per-operative complications	Post-operative complications	Clavien-Dindo Classification	Recurrence
1	Pseudomyxoma peritonei	Irinotecan/Oxaliplatin	42–43 °C	35 min	IIIC	Non	Renal	2	Non
2	Pseudomyxoma peritonei	Irinotecan/Oxaliplatin	43 °C	30 min	IIIC	Non	Non		Abdominal + Pleural
3	Pseudomyxoma peritonei	Irinotecan/Oxaliplatin	42 °C	30 min	IIIC	Non	Non		Non
4	Pseudomyxoma peritonei	Irinotecan/Oxaliplatin	42–43 °C	30 min	IIIC	Bleeding	Non		Non
5	Pseudomyxoma peritonei	Irinotecan/Oxaliplatin	42–43 °C	40 min	IIIC	Non	Infection	3A	Non
6	Pseudomyxoma peritonei	Irinotecan/Oxaliplatin	43 °C	30 min	IIIC	Non	Non		Non
7	Pseudomyxoma peritonei	Mitomycine1	41 °C	90 min	IIIC	Non	Digestive	2	Non
8	Pseudomyxoma peritonei	Mitomycin2	42 °C	90 min	IVA	Non	Non		Non
9	Mesothelioma	Cisplatin-Doxorubicin	41–42 °C	90 min	IIIC	Non	Pulmonary	2	Non
10	Mucinous ovarian cancer	Irinotecan/Oxaliplatin	42–43 °C	30 min	IIIC	Bleeding	Non		Lymph nodes
11	Mucinous ovarian cancer	Irinotecan/Oxaliplatin	43 °C	30 min	IIIC	Non	Non		Non
12	HGSOC	Cisplatin 80 mg/m^2	42 °C	60 min	IIIC	Non	Non		Abdominal
13	HGSOC	Cisplatin 100 mg/m^2	40 °C	90 min	IIIC	Urinary	Non		Lymph nodes
14	HGSOC	Cisplatin 100 mg/m^2	40 °C	90 min	IIIC	Non	Infection	3A	Non
15	HGSOC	Cisplatin 100 mg/m^2	40 °C	90 min	IIIC	Bleeding	Non		Lymph nodes
16	HGSOC	Cisplatin 100 mg/m^2	40 °C	90 min	IIIC	Non	Non		Non
17	Endometrioid ovarian cáncer	Irinotecan/Oxaliplatin	43 °C	45 min	IIIC	Bleeding	Bleeding	3B	Liver + Lung

IPC, Intraperitoneal chemotherapy; T °C, Temperature; FIGO, International Federation of Gynaecology and Obstetrics stage; HGSOC, High-grade Serous Ovarian Cancer.

1, Hemorrhagic risk; 2, Allergy.

and Yokosu *et al.* [16] who had the same conditions as our study, the 3-year OS was 62% and 87.5% respectively.

But when comparing the DFS in our study to other studies, we notice conflicting conclusions. For example, in the INDEPSO study [27] the median DFS was 37 months, almost 18 months longer than the one we got with a CC0 rate lower than ours (60% versus 86.9%). On the contrary, Vergote *et al.* [29,32] showed shorter DFS in both studies (11.1–12 months).

We also noticed that even with a complete peritonectomy there is a predilection for abdominal recurrence as we can see in Table 5. In both ovarian and pseudomyxoma subgroups, abdominal localization was present in 42% and 25% of first recurrences respectively, 14% and 25% of second recurrences and 100% of third recurrence. Those findings are in accordance with other studies like Sinuku-

mar *et al.* (Peritoneal recurrences = 100%) [24] and Akaishi *et al.* [33] (62.5%). On the contrary, lymph node localization only formed 6% of first recurrences and 4% of second recurrences in the ovarian subgroup.

An innovative treatment for PSM - HIPEC - was developed in 1980 by Spratt [34], who reported the first case successfully treated with HIPEC. Later on, different conflicting results came from retrospective studies until a randomized controlled trial was published recently by Van Driel *et al.* [35]. This study was important because it is the best evidence to date that HIPEC can achieve significant benefits in terms of survival without excess of morbidity or loss of quality of life in advanced ovarian cancer. On the other hand, HIPEC is the recommended treatment of pseudomyxoma peritonei along with optimal surgery. Several studies confirmed the benefice of such a combination on

the survival rates [36,37]. In our study, HIPEC was used in nineteen patients, with eight of them having an advanced ovarian cancer and eight having pseudomyxoma peritonei. As expected, the rate of grade 3–4 postoperative morbidity in the HIPEC group (16.6%) was slightly higher than the rest of the patients (11%). Another significant thing is the high rate of recurrence in the ovarian subgroup which reached 50% with a preferential site of recurrence being the lymph nodes.

The limitations of our study are firstly linked to its retrospective character. There is a potential selection-bias of diseases associated with confounding risk factors. Another limitation is the heterogeneity of the studied group: it included patients with different peritoneal histology and different timing of surgery (initial or recurrence).

However, the strength of this study consists in the limited number of studies discussing this topic. Another strong point is the detailed description of the morbidity and sites of recurrence after TTP.

5. Conclusions

Complete peritonectomy is a feasible surgical procedure to treat PSM and their recurrences with a low rate of grade 3–4 morbidity and an acceptable operating time. Even though it does not prevent peritoneal recurrence, this technique did not show to be a risk factor for distant recurrences, especially parietal wall metastasis. It should be known and mastered by surgeons to increase the rate of optimal surgery which can affect the survival rates.

Author contributions

RS , AB, SM , FN, EL, DH designed the research study. RS, AB, FK and DH performed the Data Collection. SM and OA analyzed the data. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Centre Oscar Lambret (approval code: CEC-2022-001).

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Conflict of interest

The authors declare no conflict of interest.

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