

## Right Upper Abdominal Resections in Advanced Stage Ovarian Cancer

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**Abstract.** *Background/Aim:* The right upper abdominal involvement is frequently encountered in patients with advanced stage ovarian cancer. The aim of this paper is to study the safety and efficacy of extended resections at this level as well as to determine the sites of residual disease. *Patients and Methods:* Between January 2016 and December 2019, 26 patients submitted to right upper abdominal resections were identified. *Results:* Peritoneal stripping and full thickness resections were the most commonly performed resections (in 57% and 19% of cases, respectively), followed by capsular liver resection and atypical liver resection (in 30% and 23% of cases, respectively) while the most common sites where resection was incomplete were the liver pedicle and porta hepatis. Exceptionally, one case necessitated performing a pancreatoduodenectomy as part of debulking surgery. *Postoperatively*, two cases developed serious complications and required reintervention; however, the overall mortality was null. *Conclusion:* Right upper abdominal resections seem to be

feasible and effective in order to maximize the debulking effort with acceptable risks arising from perioperative complications.

In patients with advanced stage ovarian cancer, the presence of free tumoral cells in the peritoneal fluid leads to the apparition of disseminated peritoneal lesions in both upper and the low abdominal regions; however, the physiological anti-clockwise peritoneal fluid movement leads especially to the development of upper right abdominal implants (1). Moreover, the areas of peritoneal fluid reabsorption, such as the large and small omenta and the diaphragmatic dome, represent areas of high tumoral cell concentration (2, 3). Besides the diaphragmatic involvement, other frequently affected areas are the liver and right colon, which necessitate, in certain cases, en bloc resections (4, 5). Therefore, extending the field of resection and including right colectomy alone or in association with atypical hepatic resections might be mandatory in a significant number of cases in order to achieve maximal debulking of the tumor (6-10).

### Patients and Methods

A retrospective analysis of patients submitted to upfront debulking surgery for advanced stage ovarian cancer between January 2016 and December 2019 was conducted, following the approval of the ethical committee (no 17/2020). All consecutive patients who went under right upper abdominal resections were included in this study. As for the types of procedures included in the right upper abdominal resections, they were represented by: i) right peritoneal stripping, ii) right diaphragmatic muscle resection, iii) liver resection iv) right colon resection, v) liver pedicle lymph node

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Table I. Intraoperative details at the time of primary cytoreduction.

Intraoperative details	Number of cases
Associated visceral resections	
Segmental enterectomy	8 (30%)
Left diaphragmatic peritonectomy/full thickness diaphragmatic resection	6 (24%)
Rectosigmoid resection	6 (24%)
Splenectomy	3 (12%)
Total/partial cystectomy	2 (8%)
Completeness of debulking	
R0	23 (88.4%)
R1	3 (11.6%)

dissection, vi) cholecystectomy and vii) pancreatoduodenectomy. All surgical procedures were performed by the same surgical team and aimed to obtain an R0 resection (defined as the absence of any visible residual disease) (11). The standard procedure consisted of: i) total hysterectomy en bloc with bilateral adnexectomy, ii) pelvic and para-aortic lymph node dissection and iii) total omentectomy; however, a significant number of cases necessitated other visceral resections in the lower, central or left upper abdomen, in order to maximize the debulking effort. Preoperatively, all patients were classified according to FIGO 2014 staging (12), while postoperative complications were classified according to the Dindo-Clavien scale (13).

## Results

Among the 114 cases submitted to upfront surgery for advanced stage ovarian cancer, a total number of 26 patients necessitating right upper abdominal resections were identified. The mean age of patients submitted to upper abdominal quadrant resection as part of primary cytoreduction was 51.4 years (range=36-77 years). Preoperatively, 19 cases were staged as FIGO stage IIIC ovarian cancer, while the remaining 6 cases were considered as FIGO stage IV patients, due to the presence of parenchymatous liver metastases. In 10 of the 26 cases ascites was identified with a mean volume of 1150 ml (range=200-3000 ml). The histopathological studies confirmed the presence of: i) serous ovarian cancer in 18 cases, ii) mucinous ovarian cancer in three cases, iii) clear cell ovarian cancer in other three cases and iv) endometrioid ovarian cancer in the remaining two cases. Although debulking surgery to no residual disease (R0) was attempted in all cases, this was achieved in 23 of the 26 cases (88.4%). In the remaining three cases, the presence of unresectable lesions at the level of the hepatic pedicle being responsible for an R1 resection (defined as a residual volume smaller than 1 cm) (11).

In all cases total hysterectomy en bloc with bilateral adnexectomy, total omentectomy, pelvic and para-aortic lymph node dissection was performed. Intraoperative details

of other associated resections in the lower, central or left abdominal quadrant are presented in Table I.

The median length of the surgical procedure was 280 min (range=120-400 min), the median estimated blood loss was 550 ml (range=200-1200 ml), with six out of the 26 cases necessitating blood transfusion. Details of the performed right upper quadrant resections are shown in Table II.

Moreover, among the seven cases in which the right colon was invaded, in two cases the local degree of invasion imposed the performance of subtotal colectomy, including right colectomy, in order to achieve complete debulking surgery. Interestingly, five cases in which the right colon was invaded by the presence of peritoneal nodules also associated with gross adenopathic masses at the level of the liver pedicle, which imposed the performance of extended lymph node dissection at this level.

In the meantime, one case, in which right colectomy was needed, presented a large tumoral mass involving both the hepatic angle of the colon as well as the duodenum and the pancreatic head. In this case, right colectomy extended to the transverse colon and pancreatoduodenectomy was performed. Another case, in which right colectomy was needed, also associated the presence of a large nodule of peritoneal carcinomatosis invading both the right colon and the abdominal wall. This necessitated an extended resection of the right abdominis muscle in order to achieve a good local control of the tumoral process.

As expected, the most commonly performed procedure was peritoneal stripping (15 cases). Among these patients, there were five cases in which the presence of deep infiltration of the tumoral nodules imposed full-thickness diaphragmatic resection, with a mean diameter of the resected diaphragmatic muscle at 3.5 cm (range=2-6 cm). Thoracic tube placement was routinely performed in cases where the diaphragmatic defect was larger than 4 cm; moreover, two of the five cases also presented contiguous lesions infiltrating the diaphragmatic muscle and the liver capsule and necessitated en block resections of the two

Table II. Types of right upper abdominal resections as part of debulking surgery for locally advanced ovarian cancer.

Surgical procedure	Number of cases
Diaphragmatic stripping	15
Full thickness diaphragmatic resection	5
Liver capsule or subcapsular tumor resection	8
Atypical hepatectomy	6
Porta hepatis lymph node dissection	7
Right colon resection	7
Cholecystectomy	4
Pancreatico-duodenectomy	1
Abdominal wall resection	1

organs. This was feasible after a proper ventral mobilisation of the liver; however, in both cases thoracic drainage tubes were placed in order to diminish the risks of postoperative complications.

Regarding cases where complete cytoreduction was not feasible, three of them were considered as unresectable lesions due to the presence of locally invasive hepatic pedicle adenopathies; however, one was associated with a common biliary duct stenosis and necessitated a hepatico-jejunal anastomosis in order to diminish the jaundice. Postoperatively, three cases developed Clavien-Dindo grade 3 complications represented by pleural effusion. These necessitated a thoracic tube placement while two other cases developed Clavien-Dindo grade 4 complications that required re-operation. From the latter, the first one developed an intraperitoneal bleeding from the area of the liver capsule resection on the second postoperative day and necessitated re-laparotomy for haemostasis, with suture of the ulceration and omentoplasty. The second case developed a postoperative acute peritonitis due to a gastric perforation secondary to a prepyloric ulceration. Despite these events, both patients had a favourable postoperative outcome, with null overall mortality. The histopathological studies confirmed the presence of ovarian cancer metastases in all cases submitted to extended peritoneal and parenchymatous resections. The same was revealed in four of the seven cases submitted to extended porta hepatis lymph node dissection, while in the remaining three cases inflammation with no signs of malignant invasion was revealed.

## Discussion

At the time of diagnosis up to 70% of patients with ovarian cancer will present widespread disease and necessitate high complexity surgical procedures involving both the lower and the upper abdomen (14). In general, onco-gynaecologists are considered appropriate to perform these procedures, since

they are more familiar with the biological features of ovarian cancer. However, in cases presenting significant extension in the upper abdomen a doctor would need particular training in the field of hepato-bilio-pancreatic surgery, and thus, multidisciplinary teams are mandatory in order to achieve a no residual disease outcome (15, 16). An interesting study by Nishikimi *et al.* that investigated the feasibility of complex surgical procedures in patients with advanced stage ovarian cancer demonstrated that the most commonly performed upper abdominal surgical procedure was represented by right diaphragmatic resection followed by splenectomy alone or in association with distal pancreatectomy and by liver resection (15). The authors underlined the fact that these procedures were performed almost exclusively in the high score complexity group patients and were associated with slightly increased but acceptable rates of postoperative complications. Similarly, in our study, the most commonly reported right upper abdominal procedures involved the right diaphragm and liver capsule or liver parenchymal resections. We observed 14 out of the 26 patients that went under atypical hepatectomies or liver capsule resection, seven cases that needed porta hepatis lymph node dissection and one case that needed pancreatoduodenectomy. Taken together, all these data underline the importance of performing extended resections in the field of the right upper abdomen to achieve the optimal result.

When it comes to lymph node involvement at the level of the liver pedicle, this has been widely encountered in patients with advanced stage ovarian cancer, which collectively give a sign of poor prognosis (17-19). In the meantime, it seems that the real incidence of lymph node metastases at the level of the liver pedicle is underestimated due to the fact that lymph node dissection at this level is rarely performed (19, 20). In a recent study on the involvement of porta hepatis in patients with advanced stage ovarian cancer, the authors reported that the aforementioned procedure was performed in 28.7% of cases, 39.5% of whom presented metastatic deposits (19). This needs to be taken into consideration, particularly since the hepatic pedicle lymph node metastases represent a common location of unresectable disease and are responsible for incomplete cytoreduction (17, 18). In a study by Angeles *et al.*, the presence of positive lymph nodes at the level of the liver pedicle and porta hepatis was significantly associated with a shorter disease-free survival and relapse as well as with a significantly shorter overall survival (19). Once again, this study came to demonstrate that the presence of enlarged or suspect lymph nodes at the level of the hepatic pedicle calls for the combined effort of a multidisciplinary surgical team, including a hepato-bilio-pancreatic surgeon. Dissecting adequate lymph nodes at this level plays a crucial role in maximizing the debulking effort as well as describing the

extent of the disease correctly in order to provide adequate tailoring of the adjuvant oncological treatment. When it comes to risk factors for tumoral involvement at the level of porta hepatis and liver pedicle, it seems that the presence of other upper abdominal sites of involvement, a higher peritoneal carcinomatosis index and peritoneal infiltration of the small or large bowel serosa represent the strongest such factors (19, 21). In our study, the association between right colectomy and porta hepatis lymph node dissection for large adenopathic masses at the level of the hepatic pedicle was encountered in five of the seven cases necessitating a right colectomy; however, due to the relatively low number of cases introduced in the presence study, a strong correlation ship cannot be established.

One of the most commonly encountered sites of disease in cases presenting upper abdominal involvement are the diaphragm. Tumor spread at this level has been described in half of patients with advanced stage ovarian cancer, with particular sensitivity in the right diaphragm compared to the left diaphragm (11, 22, 23). The real extent of the disease at the level of the diaphragm is frequently underestimated during the preoperative studies (24-26). For this reason, oncogynecologists dealing with advanced stage ovarian cancer patients should be prepared to complete the debulking process at this level as well, with the extent of the resection being proportional to the amount of tumoral nodules identified (27). Concerning the postoperative complications related to diaphragmatic surgery, it seems that the most commonly encountered ones are pleural effusions. These are strongly correlated with the manoeuvre of liver mobilisation and the dimension of the diaphragmatic disease (27). Complications related to diaphragmatic surgery are usually facile to be treated and should, thus, not preclude the completeness of cytoreduction (27). Special attention should be focused on cases presenting bulky tumors that involve both the right diaphragm and the capsule of the right liver, which need combined resections. In such cases, surgical techniques, such as ventral mobilization of the liver have been proposed in order to achieve a good control of the bulky disease (28). This situation was also encountered in two of our cases and was treated by an en block resection of the hepatic lesions involving the liver capsule and a full thickness diaphragmatic resection. In both cases thoracic tubes were placed due to the relatively large dimensions of the resulting diaphragmatic defects (of 4 and 4.5 cm respectively) associated with the extensive manoeuvre of liver mobilization.

Exceptionally, one of the 26 cases included in our study necessitated the association of pancreatoduodenectomy as part of the cytoreductive process. Pancreatic head resection was performed in combination with right colectomy for a large nodule invading both the right colonic angle and the pancreatic head. When it comes to the association of

pancreatic resections as part of the debulking surgery, this procedure is not commonly performed and is most often represented by distal pancreatectomy (17, 21). Pancreatic head resection has been rarely reported so far; the first such case was presented by Beissel *et al.* in 2014 as part of primary cytoreduction in a woman with stage IIIC ovarian cancer and a previous history of breast cancer (29). In this case, the necessity of associating a pancreatic head resection was indicated by the presence of enlarged adenopathic masses developed in the para-aortic area, intimately attached to the duodenal serosa. In order to maximize the debulking effort, total abdominal hysterectomy, bilateral adnexectomy, omentectomy, appendectomy, pelvic and para-aortic lymph node dissection were also performed (29).

In conclusion, right upper abdominal surgery is frequently needed in patients presenting advanced stage ovarian cancer, with the most commonly encountered lesions located at the level of the right diaphragm, followed by the liver and right colon. As for sites responsible for the presence of residual disease, it seems that the most frequently seen are deep infiltrating lesions at the level of the liver pedicle. In the meantime, although extending the field of resection at the level of the right upper abdomen usually involves performing demanding surgical procedures, the rate of postoperative complications is rather acceptable. This fact transforms this type of resection into a common procedure in the debulking process.

## Conflicts of Interest

The Authors have no conflicts of interest to declare regarding this study.

## Authors' Contributions

NB, MV, SD, CP, and IB performed the surgical procedure, MV and SD reviewed literature data, IB, CD, and LI prepared the draft of the manuscript, IB was the advisor of the surgical oncology procedures. IB reviewed the final version of the manuscript. All authors read and approved the final version of the manuscript.

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