

Surgical Anatomy of the Upper Abdomen

Subjects: **Oncology**

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Cytoreductive surgery (CRS) is the cornerstone of treating advanced ovarian cancer. Approximately 60–70% of patients with advanced ovarian cancer will have involvement in the upper abdomen or the supracolic compartment of the abdominal cavity. Though the involvement of this region results in poorer survival compared, complete cytoreduction benefits overall survival, making upper-abdominal cytoreduction an essential component of CRS for advanced ovarian cancer. The upper abdomen constitutes several vital organs and large blood vessels draped with the parietal or visceral peritoneum, common sites of disease in ovarian cancer. A surgeon treating advanced ovarian cancer should be well versed in upper-abdominal cytoreduction techniques, including diaphragmatic peritonectomy and diaphragm resection, lesser omentectomy, splenectomy with or without distal pancreatectomy, liver resection, cholecystectomy, and suprarenal retroperitoneal lymphadenectomy. Other procedures such as clearance of the periportal region, Glisson's capsulectomy, clearance of the superior recess of the lesser sac, and Morrison's pouch are essential as these regions are often involved in ovarian cancer.

advanced ovarian cancer

cytoreductive surgery

upper-abdominal surgery

1. Introduction

This excerpt describes the surgical anatomy of the upper abdomen in the context of performing cytoreductive surgery for peritoneal cancer spread from ovarian cancer. Epithelial ovarian cancer (EOC) continues to be diagnosed in an advanced stage in over 70% of patients, and approximately 60–70% of these patients will have involvement in the upper abdomen or the supracolic compartment of the abdominal cavity ^{[1][2][3]}. Over time, upper-abdominal cytoreductive surgery (CRS) has become an essential component of the skill set of surgical and gynecological oncologists treating advanced EOC ^{[4][5]}. The most common surgical procedures to clear the tumor from the upper abdomen include diaphragmatic peritonectomy and diaphragm resection, lesser omentectomy, splenectomy with or without distal pancreatectomy, liver resection, cholecystectomy, and suprarenal retroperitoneal lymphadenectomy. Other procedures such as clearance of the periportal region, Glisson's capsulectomy, clearance of the superior recess of the lesser sac, and Morrison's pouch are essential as these regions are often involved in ovarian cancer ^[6].

Advanced EOC is a peritoneal disease that often has a miliary or plaque-like morphology and is not detected on preoperative imaging ^[7]. A thorough exploration of the abdominal cavity to identify all disease sites is essential to avoid missing disease in some areas and thus perform what could be termed a 'pseudo-complete' cytoreduction ^[8] ^[9]. There is limited information about the patterns of peritoneal dissemination or disease distribution in the scientific

literature, which increases the dependence on surgical exploration and visual inspection performed during surgery [10]. The upper abdomen, in particular, could be challenging to explore for surgeons unfamiliar with the anatomy.

2. Surgical Anatomy of the Upper Abdomen

The upper abdomen could be defined in two ways. Considering the anatomy of the peritoneal cavity and its spaces, the supracolic compartment could be regarded as the ‘upper abdomen’ [11]. The peritoneal cancer index devised by Paul Sugarbaker divides the abdominal cavity into 13 anatomical regions, of which regions 1, 2, and 3 could jointly be considered the upper-abdominal regions [12].

2.1. Peritoneal Ligaments and Spaces

The upper-abdominal cavity or supracolic compartment comprises several ligaments and spaces [13]. The falciform and triangular ligaments are the suspensory ligaments of the liver that bind the bare area. The hepatoduodenal ligament (containing the common bile duct, hepatic artery, and portal vein) and the gastrohepatic ligament (which includes the left gastric artery and the coronary vein) form the lesser omentum [13]. The gastrosplenic ligament connects the greater curve of the stomach to the spleen and contains the short gastric vessels. The splenorenal ligament has the pancreatic tail. Ovarian cancer could involve any of these structures and the surgeon should be familiar with their anatomy.

The supramesocolic compartment is divided into the left and right subphrenic spaces by the falciform ligament on the anterior aspect of the liver. The sub-hepatic space, including the lesser sac, is located under the liver. The right subphrenic space is located under the right diaphragm; it communicates inferiorly with the right paracolic space and is separated from the left subphrenic space by the falciform ligament [14]. The right sub-hepatic space continues medially through the foramen of Winslow (Epiploic foramen) to the lesser sac (Bursa Omentalis) [14].

The lesser sac is a potentially large cavity with various recesses communicating with the left subphrenic space cranially and into the greater omentum caudally. The lesser sac contains a superior recess (located above the peritoneal reflection of the left gastric artery) close to the caudate lobe and a larger inferior recess between the stomach and the pancreatic body. The superior and inferior recesses are separated by a peritoneal fold that accompanies the left gastric artery. Sometimes, the inferior recess communicates with a potential space between the leaves of the greater omentum [14].

2.2. Anatomical Boundaries from the Surgical Viewpoint

The peritoneal regions lying in each region and their boundaries are described in **Table 1**. More details can be found online in the PROMISE internet application (www.e-promise.org). [15]

Table 1. Boundaries of peritoneal regions lying in the upper abdomen from the surgical viewpoint.

RegionPeritoneal Region Boundaries

1	Right subphrenic peritoneum	From the right of the falciform ligament medially, it includes all the peritoneum the under the surface of the right dome, extending inferiorly to the lower pole of the right kidney [16]. Postero-superiorly, it merges with Glisson's capsule at the superior boundary of the right lobe. The coronary or right triangular ligament has to be divided completely to excise this part of the peritoneum. Postero-medially it is attached to the posteromedial edge of segments 6 and 7. Division of this attachment exposes the retrohepatic inferior vena cava (IVC) [17]. Medially, it follows the inferior edge of segments 5 and 6 to the lateral edge of the porta hepatis and includes the peritoneum on the second and third parts of the duodenum. The sub-hepatic region is Morrison's pouch, as described below.
	Morrison's pouch	This is the right sub-hepatic space that extends laterally from the medial boundary of the right kidney [16]. It is bounded superiorly by the inferior surface of segments 5 and 6, medially by the lateral edge of the hepatoduodenal ligament, inferiorly, the superior and lateral edge of the duodenum, and inferolaterally, the hepatic flexure. It merges laterally with the right subphrenic peritoneum [17].
	Right Glisson's capsule	Capsule of the right lobe of the liver (superior and lateral surfaces). Extends from the right side of the falciform's attachment onto the right lobe's superior surface and the lateral surface, merging with the attachment of the right subphrenic peritoneum to the liver in that region.
	Right inferior Glisson's capsule	The part of the capsule on the inferior surface of the right lobe and the right caudate lobe.
	Foramen of Winslow	The foramen of Winslow, also known as the omental foramen, epiploic foramen and foramen epiploicum (Latin), is a foramen connecting the greater sac or the general cavity (of the abdomen), and the lesser sac, the omental bursa. It is bounded by the free edge of the lesser omentum anteriorly that contains the common bile duct, the hepatic artery and the portal vein; the peritoneum covering the anterior surface of the inferior vena cava posteriorly; the peritoneum covering the caudate lobe superiorly; and the peritoneum covering the first part of the duodenum inferiorly.
2	Falciform ligament	It is a fold of fibrofatty tissue extending from the umbilicus along the inferior surface of the anterior abdominal wall to the diaphragm. Inferiorly, it forms the umbilical round ligament in the umbilical fissure containing the obliterated umbilical vein.
	Tissue in the umbilical fissure	This is a band of tissue containing the obliterated umbilical vein that merges superiorly with the falciform ligament and inferiorly with the hepatoduodenal ligament.
	Left central diaphragmatic peritoneum-	From the left edge of the falciform ligament till the left lateral boundary of the esophageal hiatus and inferiorly, it merges with the peritoneal reflection on the superior edge of the left lobe of the liver.
	Left Glisson's	Capsule on the superior and inferolateral surface of the left lobe that lies to the

RegionPeritoneal Region Boundaries

	capsule-	left of the falciform ligament	
	Hepatoduodenal ligament	This is the peritoneum overlying the porta hepatis extending from the lateral border of the common bile duct to the medial border of the portal vein and the lower end of the umbilical ligament to the superior border of the first part of the duodenum. The common bile duct, the hepatic artery, and the portal vein are encased in this peritoneal fold.	
	Lesser omentum	The lesser omentum extends from the medial boundary of the hepatoduodenal ligament inferiorly to the left coronary ligament superiorly. It is attached inferomedially to the lesser curve and superiorly to the inferior surface of the left lobe overhanging the caudate. The left coronary ligament must be divided completely to excise the lesser omentum. The gastric arcade is preserved without gross tumor deposits in this region.	
	Lesser sac superior recess	This is part of the lesser sac lying superior to the left coronary ligament. The caudate lobe is reflected laterally to expose this region. This region is bounded by the IVC laterally, and the lesser curve medially, and its floor is formed by the IVC and the right crus of the diaphragm. Superiorly it merges with the central diaphragmatic peritoneum.	
	Lesser sac inferior recess	This includes the anterior leaf of the transverse mesocolon, the pancreatic capsule, and the gastro-pancreatic fold of the peritoneum. The capsule is removed over the entire pancreas, head, body, and tail.	
3	Left subphrenic peritoneum	Extends from the midline anteriorly to the left lateral side to include all the peritoneum on the undersurface of the left dome of the diaphragm, merging postero-inferiorly with the upper end of the left antero-parietal peritoneum, superomedially the lateral edge of the abdominal esophagus and fundus, and along the lateral edge of the spleen inferomedially. Removal of the peritoneum from the spleen should extend right up to the hilum posteriorly and expose the splenic hilar vessels.	se nodes clude the The other odes, and on include

the sub-xiphoid or cardiophrenic angle nodes, costophrenic lymph nodes, and paracaval nodes [18]. It is unclear whether these nodal stations are regional nodes or distant metastases, as their involvement has not been classified in the TNM and FIGO classifications [19][20]. **Figure 1** shows the anatomical location of the supradiaphragmatic nodes.

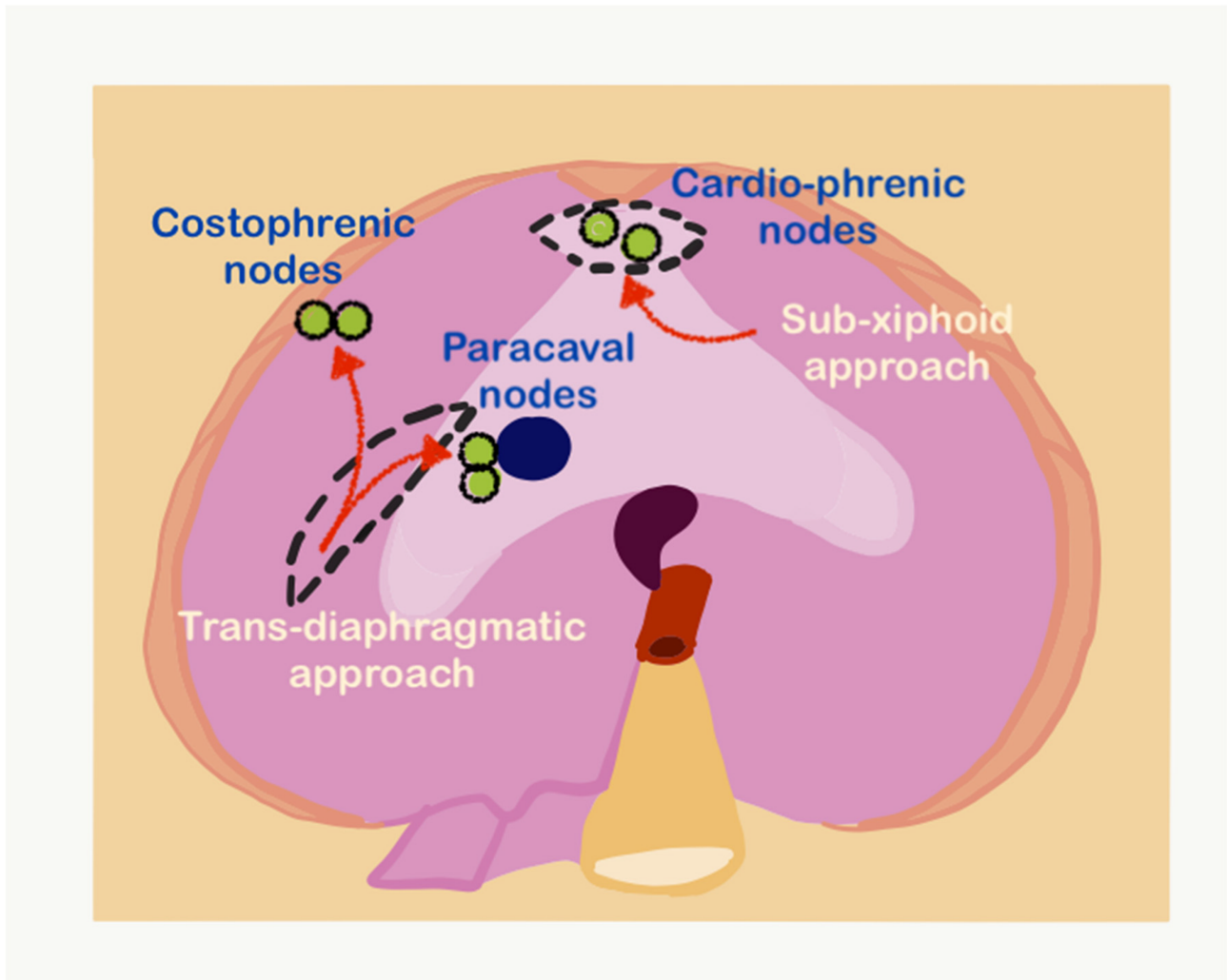


Figure 1. The sub-xiphoid and transdiaphragmatic approaches for resecting supradiaphragmatic lymph nodes (adapted from [21] with permission).

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