Surgical Anatomy of the Omental Bursa

13

Hylke J.F. Brenkman, Nicole I. van der Wielen, Ronald L.A. Bleys, Maarten S. van Leeuwen, Joris J. Scheepers, Donald L. van der Peet, Jelle P. Ruurda, Richard van Hillegersberg, and Miguel A. Cuesta

13.1 Introduction

During Minimally Invasive Surgery (MIS) of the Upper Gastrointestinal (GI) tract, such as esophagectomy, gastrectomy, pancreatectomy, and transverse colectomy, it is imperative to have a thorough knowledge of the omental bursa (or: lesser sac) in order to perform an adequate dissection of those organs and an appropriate lymphadenectomy. Yet the surgical anatomy of the omental bursa seems very complex as the rotational embryological development of the upper abdominal organs results in a crossroads of these organs with accompanying vessels and lymph nodes [1], hence making surgery around these organs quite difficult.

Our observation and dissection of the omental bursa during MIS prompted a descriptive study of this area, based on laparoscopic observation, with the aim to devise an understandable surgical anatomical concept.

From our surgical-anatomic point of view we deemed the following two points important to know: (1) What are the boundaries of the omental bursa? (2) Which of the varying approaches to the omental bursa bring about the most complete lymphadenectomy?

H.J.F. Brenkman (✉) • J.P. Ruurda
R. van Hillegersberg
Department of Surgical Oncology, University Medical Center Utrecht, Utrecht, The Netherlands
e-mail: H.J.F.Brenkman@umcutrecht.nl

N.I. van der Wielen • D.L. van der Peet • M.A. Cuesta
Department of Surgery, Vumc, Amsterdam, The Netherlands
e-mail: ma.cuesta@vumc.nl

R.L.A. Bleys
Department of Anatomy, University Medical Center Utrecht, Utrecht, The Netherlands

M.S. van Leeuwen
Department Radiology, University Medical Center Utrecht, Utrecht, The Netherlands

J.J. Scheepers
Department of Surgery, Reinier de Graaf Hospital, Delft, The Netherlands

13.1.1 Laparoscopic Gastrectomy

The surgical steps to perform a laparoscopic gastrectomy are

1. Omentectomy
2. Lymphadenectomy
3. Resection of the organ (distal or total gastrectomy)
4. Reconstruction by anastomosis

Cancer deposits and presence of cancer cells in lymph nodes in the greater omentum varies between 5 and 10% of the patients and it is associated with a relative worse prognosis. In laparoscopic gastrectomy, omentectomy is still a part of the procedure [1, 2].

M.A. Cuesta (ed.), *Minimally Invasive Surgery for Upper Abdominal Cancer*,
DOI 10.1007/978-3-319-54301-7_13

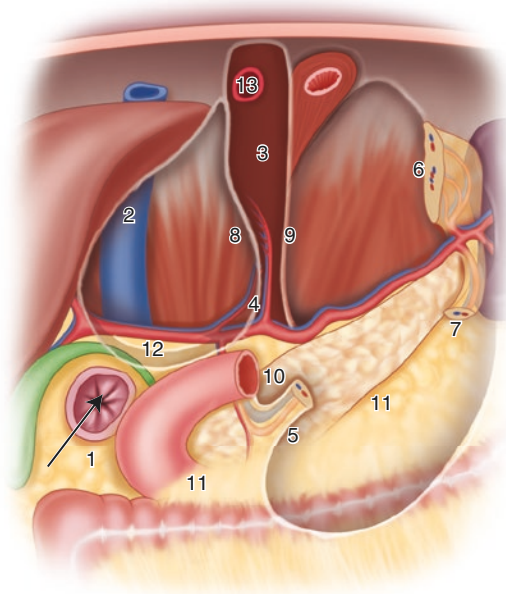
In order to perform the steps 2 and 3, surgical approach and knowledge of the omental bursa is essential.

13.2 Surgical Anatomy of the Omental Bursa

A schematic anterior view of the bursa is shown in Illustration 1. If the omental bursa is visualized as a square box, the anterior aspect of the omental bursa consists of the hepatogastric ligament (pars flaccida), the posterior wall of the stomach (main part), the gastrocolic ligament with the gastroepiploic vessels, and the gastrosplenic ligament with the short gastric vessels.

At the posterior wall, at the most cranial part, the gastropancreatic fold, from the aorta to the lesser gastric curvature, contains the celiac trunk and left gastric vessels and divides the cranial part of the omental bursa in two compartments (Fig. 13.1). The right space is commonly named the superior recess, whereas the left space is commonly known as the splenic recess. The connection between the superior recess and the splenic recess takes place at the level of the pancreas just caudal to the celiac trunk; this part of the omental bursa is called the vestibulum. During MIS, one enters the superior recess by opening the hepatogastric ligament (pars flaccida), and the splenic recess by opening the gastrocolic or gastrosplenic ligament.

From caudal to cranial, the posterior wall and floor of the splenic recess consists of the transverse mesocolon up to the inferior edge of the pancreas, the splenorenal ligament with the splenic artery and vein, and more cranially the retroperitoneum (covering the left adrenal gland and left kidney) up to the diaphragm. The left lateral wall is formed in the upper part by the gastrosplenic ligament, the short gastric vessels fold and the left gastroomental fold (Fig. 13.1). These two folds contain the short gastric vessels and the left gastroepiploic vessels, respectively originating from the distal splenic artery and running upward and downward to the greater gastric curvature. At the level of the head of the pancreas the right gastroomental fold, containing the right gastroepiploic vessels (originating from the gastroduodenal artery once this artery has passed under the duodenum) forms the right inferior side of the omental bursa (Fig. 13.2).



1 - foramen Winslow
2 - inferior vena cava
3 - gastropancreatic fold
4 - celiac trunk
5 - right gastroomental fold
6 - short gastric fold
7 - left gastroomental fold
8 - left recess
9 - splenic recess
10 - pancreas
11 - transverse mesocolon implantation
12 - hepatoduodenal ligament
13 - aorta

Fig. 13.1 Illustration of the bursa omentalis. (*1*) Foramen Winslow. (*2*) Inferior vena cava. (*3*) Gastropancreatic fold. (*4*) Celiac trunk. (*5*) Right gastroomental fold. (*6*) Short gastric fold. (*7*) Left gastroomental fold. (*8*) Left recess. (*9*) Splenic recess. (*10*) Pancreas. (*11*) Transverse mesocolon. (*12*) Hepatoduodenal ligament. (*13*) Aorta

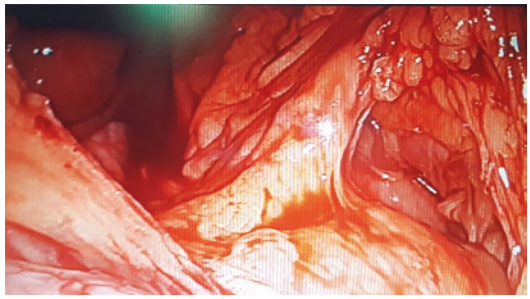


Fig. 13.2 Gastropancreatic plica (fold)

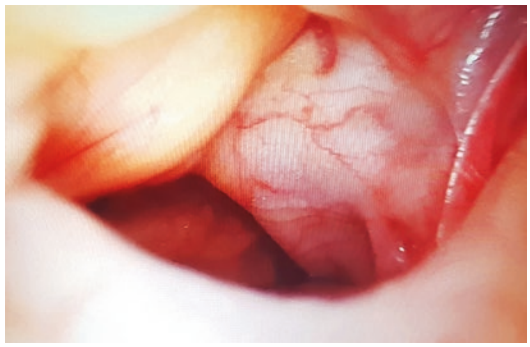


Fig. 13.3 Foramen of Winslow

This inferior part of the omental bursa is named the inferior recess. During MIS, one enters the inferior recess by opening the gastrocolic ligament or after omentectomy during laparoscopic gastrectomy.

At the superior recess and from caudal to cranial the posterior wall consists of the inferior vena cava and the caudate lobe (segment 1) of the liver up to the right crus of the diaphragm. The anterior side of the hepatoduodenal ligament is located inside the omental bursa and forms the most distal part of the superior recess (Fig 13.1). The greater sac of the peritoneal cavity and the omental bursa are connected through the omental foramen (foramen of Winslow). Boundaries of the foramen of Winslow are as follows: it is bounded cranially by the caudate lobe, caudally by the first part of the duodenum, ventrally by the hepatoduodenal ligament, and dorsally by the inferior vena cava (Illustration 1). In this way, both the anterior and posterior aspects of the hepatoduodenal ligament are covered by peritoneum of the omental bursa. After entering the omental foramen (Fig. 13.3), one enters the vestibulum of the omental bursa.

13.2.1 Lymphandenectomy for Gastric Cancer

The celiac trunk forms part of the posterior wall of the omental bursa (gastropancreatic fold, Fig. 13.2) and is covered by peritoneum, fat and lymph nodes. All D2 lymph nodes (LN) according to the Japanese classification are in relation with the celiac trunk or its branches (left gastric artery, splenic artery and the hepatic artery) whereas the D1 LN are located at the greater and lesser curvatures. D2 lymphadenectomy includes the groups number 8a–12a whereas in distal gastrectomy the groups number 8a–11p [3].

13.2.2 Surgical Approach of the Omental Bursa

During minimally invasive upper GI surgery, the omental bursa can be opened in three ways:

1. by incision of the hepatogastric ligament (pars flaccida of the lesser omentum).
2. through the gastrocolic and gastrosplenic ligament, and
3. by opening the transverse mesocolon at the level of the pancreas.

The first option starts by opening the lesser omentum and retraction of the stomach to the left, so that the superior edge of the pancreas can be visualized. Opening of the peritoneum above the pancreas permits dissection of the common hepatic artery and from there dissection proceeds up to the liver along the right gastric artery up to the level of proper hepatic artery.

At that point, lymphadenectomy is done starting with groups number 9, 8a and 12a up to the right crus of the hiatus along the portal vein and inferior vena cava. Proceeding from the common hepatic artery to the left, the celiac trunk is approached, the

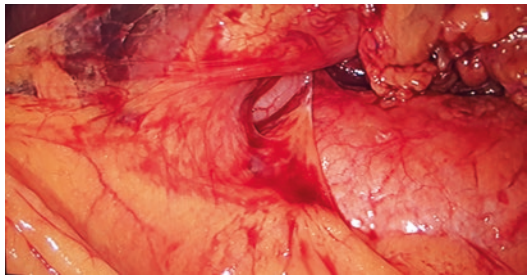


Fig. 13.4 Right gastroomental fold

left gastric vein and artery are dissected free and then divided (lymphadenectomy of group 7). The next step is to continue the lymphadenectomy along the splenic artery—as far as possible—on the superior edge of the body of the pancreas. In this way, all the D2 lymph nodes groups 11p, and 11d are excised "en bloc" with exception of station 10 located at the splenic hilum. Important to note is that LN groups, numbers 6 (D1), 10 (D2) and 12a (D2), considered as "extreme groups" and difficult to resect during gastrectomy are located at the edge of the omental bursa, as they lay inside the right gastroomental fold (Fig. 13.4b) and the hilum of the spleen and liver respectively. The gastroomental fold (with the right gastroepiploic vessels, number 6) have to be dissected free from the transverse mesocolon in order to be identified and the other two groups have to be approached at the hilum of both organs, liver (number 12a) and spleen (number 10) respectively.

The second option starts by entering the omental bursa through the gastrocolic and gastrosplenic ligament. This permits a good approach of the celiac trunk with its three arterial branches, but to a lesser extent visualization of the lymph nodes along the hepatic artery to the hilum of the liver. In many cases a combination of both approaches is necessary. The first two approaches are used in Upper GI surgery, being the approach through the gastrosplenic ligament used to create any type of fundoplication during surgery for Gastroesophageal Reflux disease. The last option, the opening of the transverse mesocolon at the level of the distal pancreas, is used in colorectal surgery for mobilization of the splenic flexure.

13.3 Discussion

A comprehensive concept of the live surgical anatomy is necessary for ensuring anatomical accuracy as well as reproducible radical surgery resections for cancer.

During MIS of the Upper GI tract, including esophageal, gastric and duodeno-pancreatic resections, the omental bursa may be a difficult area to visualize and to dissect when surgeons try to perform an adequate celiac trunk and branches lymphadenectomy and resection of the involved organ. It is a complex area in which during the ontogenesis the embryological anatomy developed into a crossroads of important vessels and digestive organs.

Particularly for the Upper GI surgeon—dedicated to MIS of the Upper GI tract—having a comprehensive knowledge of the omental bursa is imperative. MIS of the Upper GI organs is increasingly performed and certain interventions, such as the esophagectomy, gastrectomy and pancreatectomies are being evaluated through randomized controlled trials [4–6]. Our aim was to describe the surgical boundaries of the omental bursa, with surgical landmarks and folds that have to be visualized and dissected, and demonstrating how to perform an adequate lymphadenectomy followed by an oncological resection of the involved organ.

Moreover, the two ways for approaching the omental bursa, first through the lesser omentum and second through the gastrocolic ligament, are described. Both are not exclusive and in many events a combination of both approaches can help for gaining an adequate lymphadenectomy.

In conclusion, it appears that dissection of structures surrounding the bursa by MIS can be demanding because of the complex anatomy [7]. We have argued that having knowledge of the surgical anatomy and landmarks of the resection will enable a more adequate and reproducible surgical resection during Upper GI MIS. The conclusion can be that the advantages gained by MIS, such as visualization and magnification, contribute to a more complete knowledge of the omental bursa with its central location in the upper abdomen.

References

1. Haverkamp L, Brenkman HJ, Ruurda JP, et al. The oncological value of omentectomy in gastrectomy for cancer. J Gastroint Sur. 2016;20:885–90.
2. Jongerius EJ, Boerma D, Seldenrijk KA, et al. Role of omentectomy as a part of radical surgery for gastric cancer. Br J Surg. 2016;10:1497–503.
3. Japanese Gastric Cancer Association. Japanese gastric cancer treatment guidelines 2010 (ver. 3). Gastric Cancer. 2011;14(2):113–23.
4. Wang M, Cai H, Meng L, Cai Y, Wang X, Li Y, et al. Minimally invasive pancreaticoduodenectomy: a comprehensive review. Int J Surg. 2016;35:139–46.
5. Haverkamp L, Brenkman HJ, Seesing MF, Gisbertz SS, van Berge Henegouwen MI, Luyer MD, et al. Laparoscopic versus open gastrectomy for gastric cancer, a multicenter prospectively randomized controlled trial (LOGICA-trial). BMC Cancer. 2015;15(1):556-015-1551-z.
6. Straatman J, van der Wielen N, Cuesta MA, Gisbertz SS, Hartemink KJ, Alonso Poza A, et al. Surgical techniques, open versus minimally invasive gastrectomy after chemotherapy (STOMACH trial): study protocol for a randomized controlled trial. Trials. 2015;16:123-015-0638-9.
7. Larsen W. Development of the gastrointestinal tract. In: Sherman L, Potter S, Scott W, editors. Human embryology. 3rd ed. Churchill: Livingstone; 2001. p. 235–64.