Right Gastroepiploic Artery: Omental Flap

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25.1 Introduction

The greater omentum is a well-vascularized fatty apron, coined the "abdominal policeman" in 1906 by the surgeon Rutherford Morrison (1). Its use as a flap has evolved with time, ever since its first described use in the protection of intestinal anastomosis in 1888. The first free omental flap was performed by McLean and Buncke in 1972 where a large scalp defect was reconstructed with omentum and covering skin graft (2). This greatly expanded its potential indications for recipient sites which were previously limited by pedicle length.

The omentum has unique properties which convey specific advantages to its use as a flap. It has the ability to promote neo-angiogenesis and tissue healing in regions to which it is applied, a critical benefit to ischemic and inflamed tissues. Studies have demonstrated the omentum to be a rich source of growth factors, inflammatory mediators, and pluripotent stem cells (3). Another favorable characteristic is its high lymphoedema absorptive capacity and amorphous structure, easily able to fill cavity defects.

The indications for free or pedicled omental flaps are vast. Common recipient sites include head and neck defects, locally advanced breast cancer, prevention of lymphoedema in radical lymph node dissections, and treatment of deep sternal wound infections. It is also important to note a number of important relative contraindications for the use of the omentum, for instance, previous major abdominal operations, portal hypertension, and a history of gastric outlet obstruction.

25.2 Anatomy

The omentum is a double layer of the peritoneum, attached to the greater curvature of the stomach and transverse colon, hanging to cover the contents of the abdominal cavity. Its blood supply is derived from the branches of celiac trunk, namely, the right and left gastroepiploic arteries (Fig. 25.1). The right gastroepiploic artery is typically dominant compared to the left and is the largest terminal branch of the gastroduodenal artery (GDA). The gastroepiploic veins accompany the gastroepiploic arteries and drain into the portal system.

The GDA arises from the common hepatic artery in 75% of cases; it may also branch from the right or left hepatic artery and can rarely arise from the superior mesenteric artery. It runs posterior to the proximal duodenum, along the lower margin of the pylorus, and then along the greater curvature of the stomach between the layers of the omentum as the right gastroepiploic artery (RGEA). Its termination is variable; most commonly it terminates at the middle of the gastric curvature; however, in 30% of patients, there is a well-developed continuous arcade with the left artery. There are several gastric and omental branches arising from the gastroepiploic arcade. The omental branches course inferiorly providing the omentum with its arterial supply and forming secondary anterior and posterior arcades. The right gastroepiploic vein (RGEV) runs parallel to the RGEA along the greater curvature of the stomach joining the superior mesenteric vein near its junction with the splenic vein.

Anatomical studies have demonstrated a variation in size of the RGEA along its course. The diameter varies from 3.0 mm at origin to 1.5 mm at middle of the greater curvature. Its flow rate also varies considerably between patients, with an average of 55.78 ml/min (4). This corresponds to a

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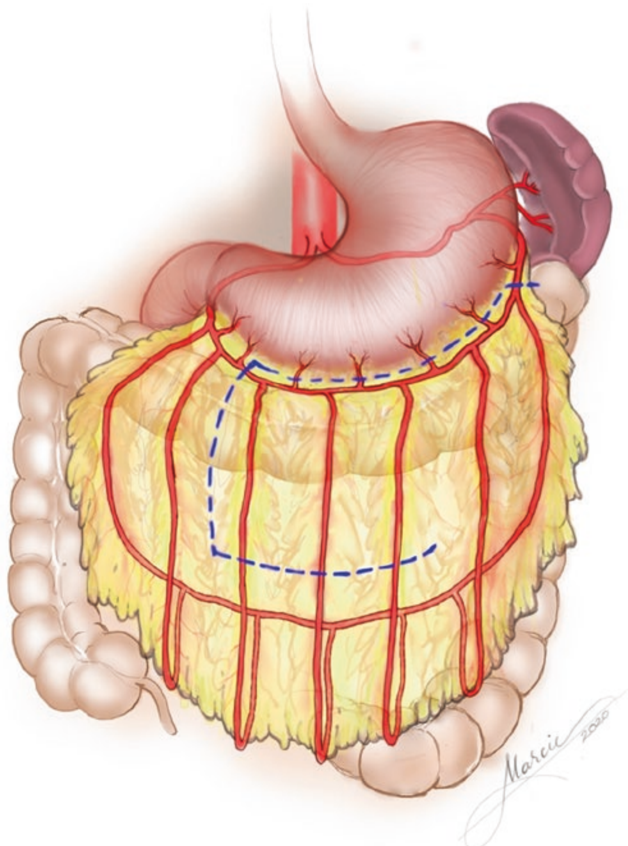

Fig. 25.1 Anatomical overview of anatomy of the greater omentum (Courtesy of Marcie Bunalade, 2020, All rights retained)

greater flow rate than other commonly used flaps, for example, the latissimus dorsi flap based on the thoracodorsal artery with an estimated in situ flow rate of 16.6 ml/min (5).

25.3 Preoperative Investigation

To date it has not been possible to calculate omental volume from preoperative investigations. Anatomical studies in cadavers have demonstrated considerable variation in its size with average dimensions of 34 cm wide by 24 cm in length (6). The omental flap size, however, correlates roughly with patient's height and weight but not significantly enough to accurately predict flap volume. The best predictor of omental volume is total body fat content, and obese individuals will have excessive volumes when compared to a malnourished cachectic patient. Some groups have suggested the use of a diagnostic laparoscopy prior to reconstruction in order to gauge omental volume and any conflicting abdominal pathology such as significant adhesions from prior surgery or trauma.

Preoperative evaluation of the omental blood supply is recommended if easily accessible. CT angiography has been shown to be an effective tool in the assessment of the anatomical properties of the RGEA (7). It can ensure suitability for its use as a flap prior to mini laparotomy is performed. Alternative ultrasonographic evaluation of the GEA is also feasible (8). Pulsatile flow and diameter can be recorded from upper median views of the abdomen, negating the need for IV contrast when contraindicated.

25.4 Flap Design and Markings

Flap design and arterial supply are determined by distance to the recipient site. If the pedicled flap does not have sufficient length to reach the site via the right gastroepiploic artery and primary arcade, the flap can be lengthened further. This is done through division of the primary arcade and use of the secondary arcade. The feeding arcade can be further skeletonized to aid delivery of the flap. Delivery route must also be taken into consideration preoperatively; a window may be made in the diaphragm for this purpose but must be of sufficient size to prevent torsion or compression of the pedicle.

25.5 Core Surgical Techniques in Flap Dissection

An upper midline laparotomy is a standard access for the greater omentum. Previous abdominal surgeries or disease may have resulted in adhesions which need to be divided and taken down before the omentum can be fully assessed. Integrity and blood flow through the omentum can be assessed through manual pulse check or with a handheld Doppler probe.

Mobilization of the omentum from the transverse colon is first achieved through dissection along the avascular embryonic fusion plane; care is taken to avoid damage to middle colic arterial branches. This dissection is aided by cephalad retraction of the omentum with countertraction on the transverse colon (Fig. 25.2). The omentum can then be delivered through the midline incision to aid planning of the size of the graft.

The left gastroepiploic artery and vein are commonly ligated near the spleen, if basing the flap blood supply on the dominant right gastroepiploic artery. However, in some situations, e.g., left-sided chest wall defects, excessive stretch on the right-sided pedicle may dictate the use of the left gastroepiploic artery instead. The omentum is carefully dissected from the stomach along the greater curvature in a left to right direction, dividing tributaries between the arcade and gastric wall (Fig. 25.3). We prefer to divide these vessels with ligation rather than use powered instruments to avoid thermal injury to the arcade. The arcade is mobilized to the level of the pylorus. An optional running stitch along the greater cur-

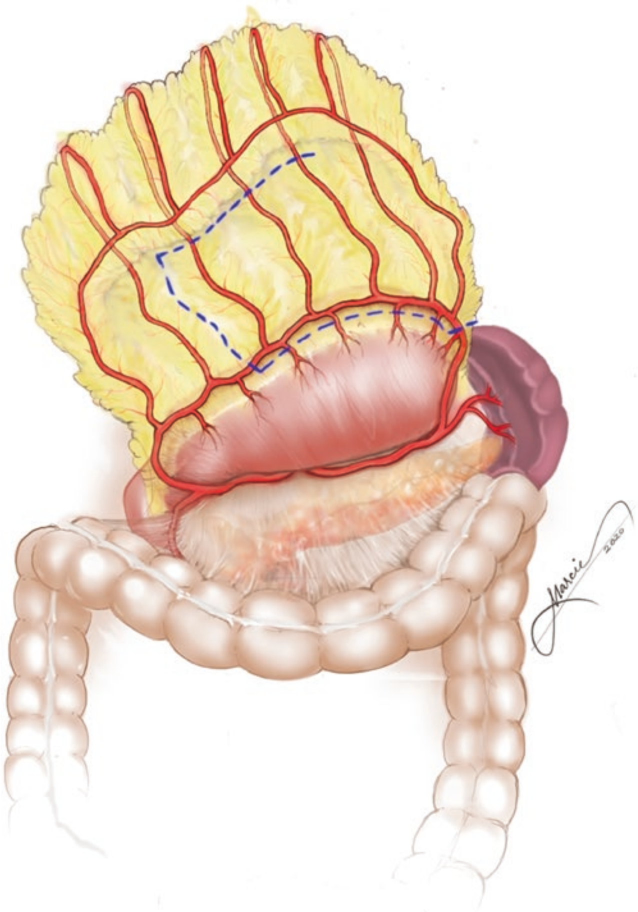

Fig. 25.2 Separation of the greater omentum from the transverse colon (Courtesy of Marcie Bunalade, 2020, All rights retained)

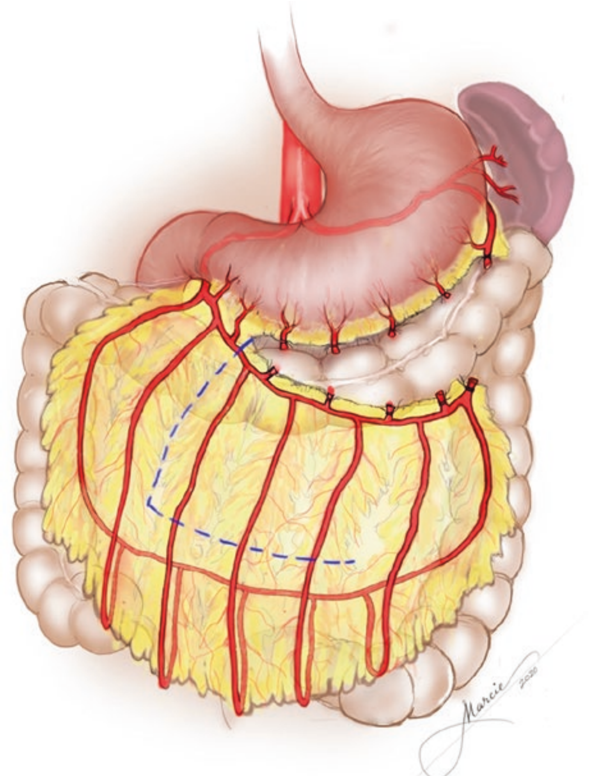

Fig. 25.3 Mobilization of the greater omentum from the stomach (Courtesy of Marcie Bunalade, 2020, All rights retained)

vature is recommended to peritonize the denuded area and provide additional security to ligated stumps.

The omentum can now be assessed as to whether it will reach the desired recipient site. If this is not possible, the pedicled omental flap can be lengthened through the division of the anterior epiploic arteries basing the blood supply on the secondary anterior and posterior omental arcades (Fig. 25.4). Passing the omentum through the laparotomy wound should be avoided, for target sites within the thorax creation of a window in the anterior diaphragm can be created to allow passage of the flap (Fig. 25.5). A free omental flap is possible for remote coverage. In these instances, the right gastroepiploic artery and vein are carefully denuded under magnification. Once the recipient site is ready, the vascular pedicle can be divided between ligatures and re-anastomosed at the distant site. Following transposition, the flap can be secured along its perimeter with absorbable interrupted or a running stitch.

Although open harvesting of the omental flap is described above, it is important to mention laparoscopic harvesting of the omental flap (LHOF) which was first described by Costa

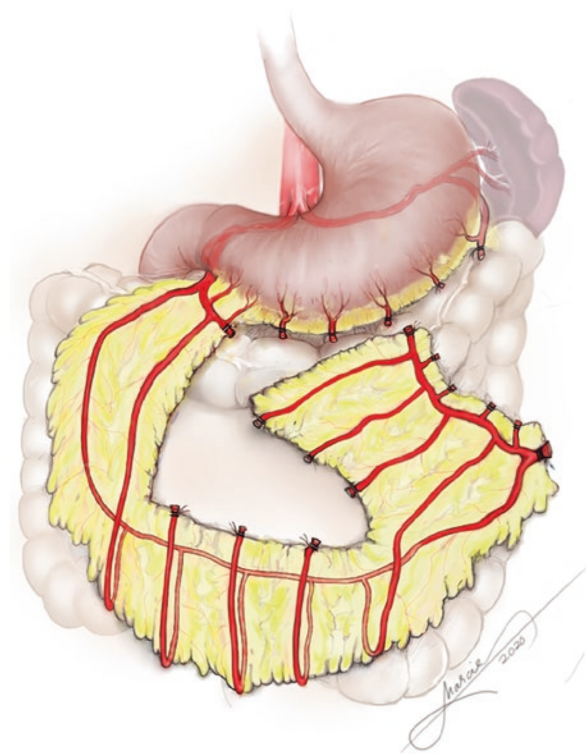

Fig. 25.4 Elongation of the pedicled greater omentum flap (Courtesy of Marcie Bunalade, 2020, All rights retained)

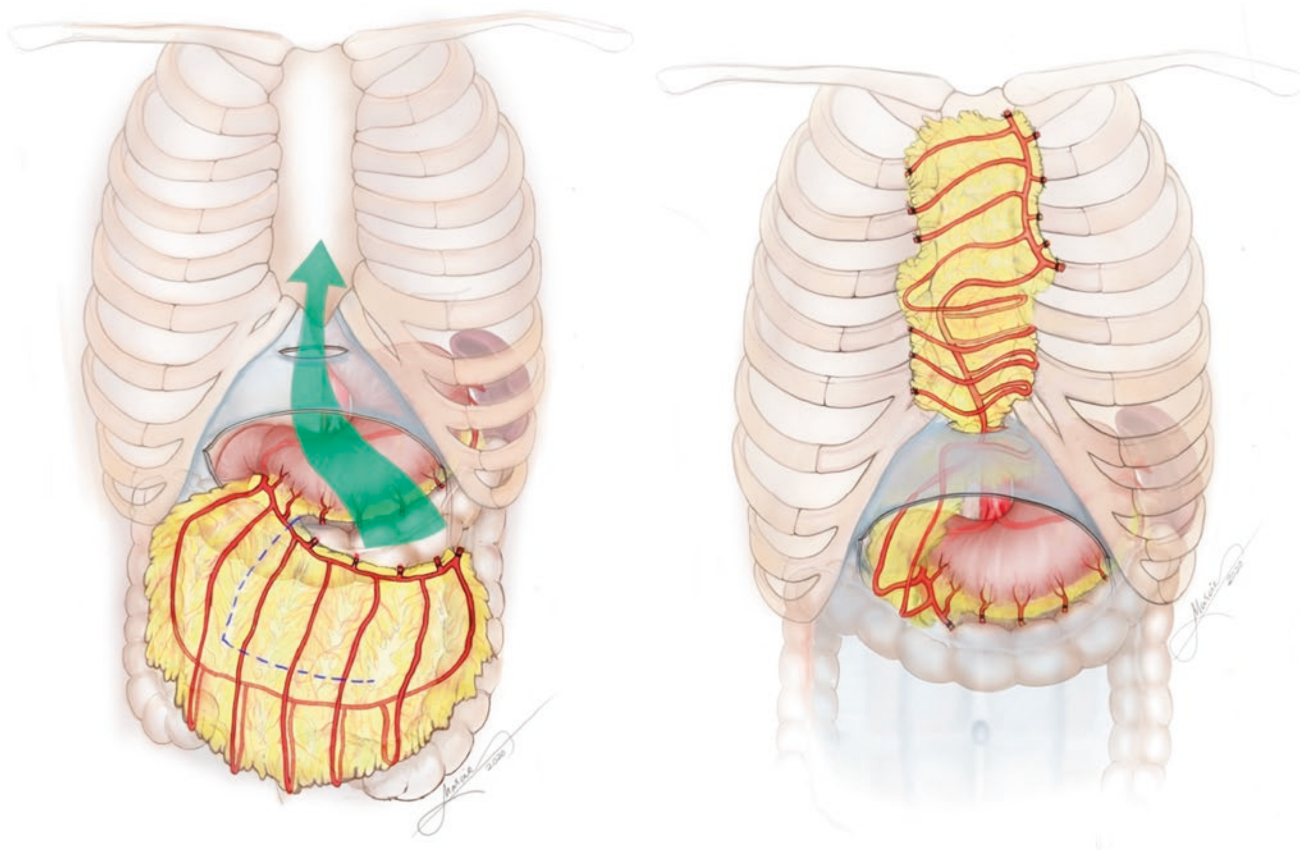

Fig. 25.5 (**a**, **b**) Delivery of pedicled omental flap to recipient site (Courtesy of Marcie Bunalade, 2020, All rights retained)

in 1998. It has since become a popular technique in breast reconstructive surgery with evidence supporting its safety and success rates (9). Laparoscopic harvesting significantly reduces donor site morbidity, with no midline scar and reduction in adhesions and incisional hernias rates, and therefore may be preferable if the requisite laparoscopic skills are available to the harvesting team.

25.6 Flap Raise: A Step-by-Step Guide

Step 1 Upper midline incision is made or less commonly a transverse incision over epigastric quadrant. Adhesions are taken down and omentum carefully separated from the abdominal wall. Its blood supply via the right and left gastro-epiploic arteries can be assessed with a handheld Doppler probe.

Step 2 The greater omentum is then separated from the transverse colon along embryologic fusion plane. In this way the omentum is fully mobilized and graft size can be planned.

Step 3 If basing the flap off of the dominant right gastroepiploic artery, the left can be ligated near the spleen. The greater omentum is then dissected from the stomach along the greater curvature preserving gastroepiploic arcade.

Step 4 The pedicled flap can be lengthened by dividing anterior epiploic arteries and maintaining its blood supply through secondary anterior and posterior omental arcades. Blood supply maintained through first two omental branches from the primary arcade.

Step 5 Greater omentum flap can be delivered through a window in the anterior portion of the diaphragm into thoracic cavity to avoid risk of hernias. The omental flap is secured with an absorbable interrupted or running stitch around its perimeter, with additional stitches to secure the pedicle taking care not to damage the feeding vessels.

25.7 Clinical Scenario: The Use of the Greater Omentum in Deep Sternal Wound Infections (DSWI) and Nonunion of the Sternum

Deep sternal wound infections (DSWI) are a rare (1%) but devastating complication of cardiac surgery. The use of the greater omentum as a salvage flap in DSWI is well described in the literature. We include here the case of a 64-year-old patient with chronic sternal nonunion and infection following coronary artery bypass surgery. The patient required bilateral internal mammary arteries for grafting which limited the options for sternal reconstruction with a pectoralis or rectus flap. He underwent sternal fixation with insertion of titanium StraTos bars (MedXpert, Germany) and an overlying pedicled omental flap (in Fig. 25.6) to promote healing. He made a complete and uneventful recovery, with no evidence of further infection of instability.

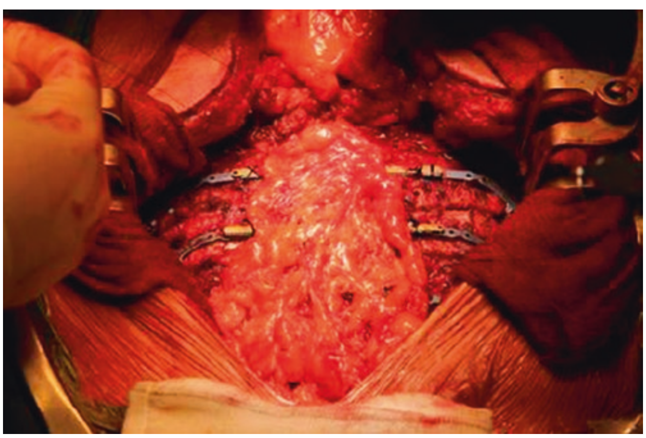

Fig. 25.6 An omental flap placed over titanium StraTos bars for chronic sternal nonunion

25.8 Pearls and Pitfalls

Pearls

- The omentum's unique angiogenic and immunological properties can promote wound healing even in hostile recipient sites with prior radiation exposure and infection.
- Perioperative antibiotics are deemed necessary in omental flaps due to transfer of fat tissue which increases risk of infection.
- Heparinization of patients for 5 days to preserve flap microcirculation in free flaps is recommended.
- When dividing small gastric branches, it may be advisable to use traditional ties and ligation over electrocautery to prevent inadvertent damage to the primary arcade.
- Postoperative use of portable Doppler sonography is particularly useful as a flap monitoring tool.

Pitfalls

- It is advisable to avoid use of the omentum in previous abdominal surgery or disease.
- Be mindful of omental atrophy (can be up to 50% in 3 months) when considering the size of flap required for the defect.
- The omentum is considered a "salvage flap" by many given the perceived donor site morbidity associated with harvesting.
- Common intra-abdominal complications following omental harvesting include ventral incisional hernias, gastric outlet obstruction, and intra-abdominal abscess formation; these may be reduced with laparoscopic harvesting technique.
- Free transfer of the omentum enables definitive closure of the peritoneal cavity, which can reduce abdominal complications.

25.9 Selected Reading

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