Innovations

Greater Omentum- A Cadaveric Study on Morphology, Development and Rare Variants of Omental Mass and their Role in Flap Reconstructive and Vascular Surgeries

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Abstract
Introduction: *The greater omentum, a peritoneal fold resembling an apron, serves diverse functions including fat storage, immune defense through "milky spots," and safeguarding the peritoneal cavity from infections. Despite its clinical importance, inconsistencies in understanding its morphology persist, leading to underexplored aspects. Beyond its role in lymph drainage and infection resistance, the omentum has proven valuable in medical interventions. Pedicledomentoplasty, coupled with skin grafting, effectively addresses antibiotic-resistant osteoradionecrotic ulcers. Recent global studies have revealed the omentum's dynamic physiological nature and therapeutic potential, challenging historical perceptions of its inertness.* ***Materials & Methods:*** *The study aims to investigate the morphology, variations, embryology, and developmental aspects of the greater omentum in 20 human cadavers. The dissection of the anterior abdominal wall was carried out, focusing on exposing the peritoneum to observe the folds of the greater omentum.* ***Results:*** *This study endeavors to comprehensively explore anatomical variations in the greater omentum and rare omental mass, offering updated insights for optimal application in the evolving field of surgery.* ***Conclusions:*** *The detailed examination includes an exploration of the morphology, embryological connections, and clinical significance of the greater omentum. Variations in the greater omentum were also identified. The study is designed to contribute valuable insights to the rapidly evolving field of surgery.*

Keywords: *Greater Omentum- Omental Torsion- Omental Mass- Flap Reconstruction.*

Introduction:

The greater omentum, a substantial peritoneal fold suspended from the greater curvature of the stomach resembling an apron, extends variably over the intestinal loops. It presents as a delicate, fenestrated membrane with variable fat deposition. [1].

Its roles encompass serving as a reservoir for peritoneal inflammatory cells, storing lipids, regulating fluid exchange in the peritoneal cavity, and adhering to areas of inflammation, contributing to the formation of adhesions. Despite its clinical significance, the greater omentum is underexplored, leading to inconsistencies in understanding its morphology[2].

Peritoneal dialysis (PD) is one of the effective alternative for renal replacement therapy, currently utilized by approximately 11% of the global dialysis population with end-stage renal disease (ESRD)[3].

An omental mass is an abnormal accumulation or growth of tissue in the omentum, a peritoneal membrane fold extending from the stomach to cover abdominal organsCauses of omental masses include benign and malignant tumors like Gastrointestinal Stromal Tumors (GISTs) and Extra-Gastrointestinal Stromal Tumors (EGISTs), metastatic tumors, inflammatory conditions such as omental torsion, infections, or inflammatory masses, and fluid collections like cysts[4].

Doppler ultrasonography (US) and computed tomography (CT) findings are used with the surgical and pathological findings to assess the value of US and CT in the diagnosis of omentaltorsion[5].A variety of tissue transplants and artificial substances have been used to facilitate drainage of peripheral lymph[6].

In the greater omentum, GISTs and EGISTs may remain undetected for an extended period. Surgical intervention remains the primary treatment for non-metastatic EGISTs due to the challenges in preoperative diagnosis. Ovarian cancer, with its high mortality rate, tends to metastasize within the peritoneal cavity, with the omentum being a prevalent site (80%)[7].

The omentum proves invaluable in various surgical scenarios, including the prevention of anastomotic leakage, closure of perforated ulcers, and management of abdominal trauma. Omentoplasty is recommended in radical surgeries for esophageal and gastric cancers, splenic trauma, and colorectal anastomosis. Moreover, the omentum is utilized for wound coverage in chest wall defects post-excision[8].

The greater omentum not only possesses lymph drainage capabilities and fights infections but also plays a vital role in abdominal functions. It has been utilized to cover tissue defects and enhance limb vascularity. Omental transplants, particularly for treating chronic lymphedema, have shown promising results.

In addition to functioning as a fat reservoir, it safeguards the peritoneal cavity from infections through "milky spots," which are essentially clusters of macrophages[9].

Beyond its vascularization, the omentum is a rich source of angiogenic factors like vascular endothelial growth factor. Omental interventions, such as omentopexy, have been demonstrated to promote myocardial angiogenesis. In various surgical contexts, the omentum is used to prevent complications, such as aortic graft infection and aortoenteric fistula formation. In urological surgery, the omental J-flap is employed post-abdominal hysterectomy to minimize surgical morbidity and reduce complications like pelvic infection, abscess, or intestinal obstruction.
Pedicledomentoplasty, combined with split-thickness skin grafting, has proven effective in treating infected osteoradionecrotic ulcers resistant to antibiotics[9].
Historically viewed as inert, recent studies conducted worldwide since the early 20th century have highlighted the omentum's dynamic physiological nature and its substantial therapeutic potential[9].
Therefore, this study aims to explore the anatomical variations of the greater omentum and their clinical relevance in the rapidly advancing field of surgery. It represents a sincere effort to update knowledge on these concepts for optimal application when needed.

Aims & Objectives:

The objectives of the study are:

1.To determine the morphology of Greater omentum in human cadavers

2.To determine the variations of Greater omentum in human cadavers

3.To determine the embryology and developmental variations of Greater omentum

4.To determine the clinical relevance of Greater omentum in various clinical fields

Materials &Methodology:

The study was conducted on 20 human cadavers. Dissection of anterior abdominal wall was performed followed by exposure of peritoneum to look for the folds of greater omentum.The morphology with embryological relevance and clinical relevance of greater omentum in this fast growing surgical field was studied in detail and variationswere determined

Results:

The greater omentum is a two-leaflet hammock of fibro-fatty tissue that extends from the greater curvature of the stomach to the transverse colon. It spans the width of the abdomen laterally and reaches the pelvis inferiorly. It varies in size depending on the age of the patient and the body habitus of the individual. It can be as large 36 cm in height, extending as far caudally as the pubic symphysis, and as wide as 46 cm, covering up to 500 cm, approximately the size of a textbook.

Table 1 showing the height of greater omentum

Height of omentum (cm)	**Specimens**	**Percentage**
41-50cm	4	20
31-40	8	40
21-30	5	25
11-20	3	15

The upper curved line was stomach margin (A-A), (B-B)was the length was measured from the midpoint of A-A perpendicular to the free margin of the greater omentum, (C-C) was the width 6 cm below the center of (A-A)

Table 2 showing measurement of omentum

Omentum measurement of**(A-A) cm**along the greater curvature	33.5±5.05
Omentum measurement of **(B-B) cm**from the midpoint of A-A perpendicular to the free margin of the greater omentum	24.06±5.06
Omentum measurement **(C-C) cm** width 6 cm below the center of (A-A)	28.45±6.55

Table 3 showing few Variations of greater omentum in the study

Sl.No.	**Variations of greater omentum**
1.	Omental torsion with omental mass extending till the pelvic cavity
2.	A varying number of epiploic vessels branching perpendicularly from the gastro-omental vessels to perfuse the omentum
3.	Epiploic vessels running downwards to the right along the greater omentum
4.	Greater omentum extending along the entire abdomen from greater curvature of stomach till the pelvis
5.	Shorter greater omentum

6.	Greater omentum with epiploic vessels in the midline
7.	Greater omentum with fat and vessels
8.	Greater omentum along the greater curvature of stomach covering half of the abdomen

Figure 1. Showing Omental mass extending till the pelvic cavity

1. Stomach 2. Colon 3. Jejunum 4.gastrosplenic ligament 5. Descending colon 6. Spleen 7. Liver 8. Falciform ligament 9. Heart 10. Omental mass

Figure 2 showing : A varying number of epiploic vessels branching perpendicularly from the gastro-omental vessels to perfuse the omentum

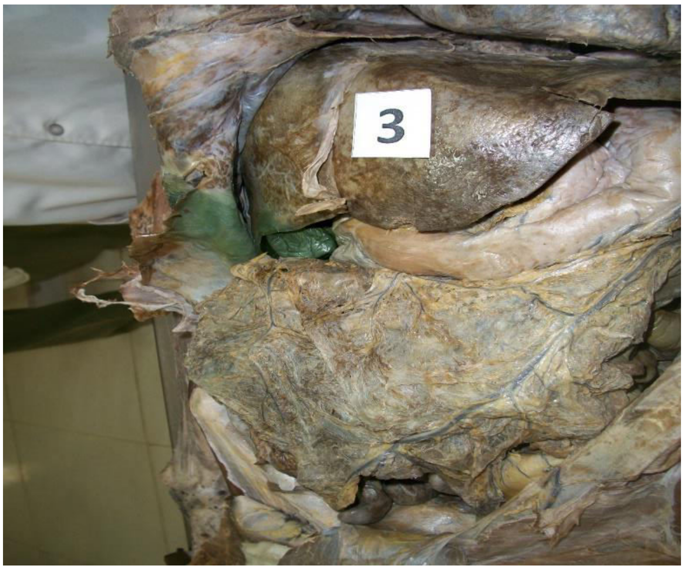

Figure 3 showing epiploic vessels running downwards to the right along the greater omentum

Figure 4 showing greater omentum extending along the entire abdomen from greater curvature of stomach till the pelvis

Figure 5 showing a shorter greater omentum

Figure 6 showing greater omentum with epiploic vessels in the midline

Figure 7 showing greater omentum with fat and vessels

Figure 8 showing greater omentum along the greater curvature of stomach covering half of the abdomen

Discussion

The greater omentum, a fold of peritoneum containing adipose tissue and blood vessels, has garnered significant interest in surgical and anatomical studies due to its diverse roles in the human body. Our cadaveric study aimed to elucidate the morphology, development, and rare variants of omental masses, and evaluate their potential applications in flap reconstructive and vascular surgeries.

Our findings corroborate previous anatomical descriptions of the greater omentum as a double-layered structure suspended from the greater curvature of the stomach and transverse colon. The omentum exhibited considerable anatomical variability in size, shape, and vascularization among cadaveric specimens, reflecting its adaptive nature. Additionally, we observed variations in the attachment points and extent of omental adhesions to adjacent structures, which may have implications for surgical procedures involving the omentum.

The omental flap can represent a useful and viable alternative for the surgical cure of large postexcisional chest wall defects, which ensures soft, pliable and immunologically competent tissue. A multidisciplinary approach (plastic and general surgery, intensive care) and a meticulous surgical technique are essential for the successful accomplishment of the reconstruction with omentalflap.The greater omentum may be surgically harvested for reconstruction of the thoracic wall[10].

Continuous ambulatory peritoneal dialysis (CAPD) is an effective form of treatment for patients with end-stage renal disease. Open insertion of peritoneal dialysis (PD) catheters is the standard surgical technique, but it is associated with a relatively high incidence of catheter outflow obstruction and dialysis leak. Omental wrapping is the most common cause of mechanical problems[11].

The greater omentum is supplied by the gastroomental arteries that traverse between its layers. The right gastroomental artery is a branch of the gastroduodenal artery. It runs through the layers of the greater omentum along the greater curvature of the stomach in a right to left direction. The left gastroomental artery comes from the splenic artery. It runs in the greater omentum along the greater curvature of the stomach in a left to right direction. It forms an anastomosis with the right gastro-omental artery along the greater curvature[12].

It has also been used experimentally to reinforce bioengineered tissues transplanted to the surface of the heart for cardiac regeneration.The greater omentum may be surgically harvested to provide revascularization of brain tissue after a stroke [13] .

There can be anatomical variations in the development of the greater omentum. The size, extent, and attachment points may vary among individuals.

Incomplete Fusion: In some cases, incomplete fusion of the dorsal mesentery may lead to variations in the formation of the greater omentum. This can result in different configurations and attachments within the abdominal cavity.

Rarely, accessory omenta may develop, creating additional folds or structures within the peritoneal cavity[13].

A varying number of epiploic vessels branch perpendicularly from the gastro-omental vessels to perfuse the omentum. The network of vessels and this physiologic response to infection serves to support the immunologic and regenerative properties of the omentum and provides a bridge between the peritoneal cavity and the systemic circulation [14] .

The unusual attachments of the greater omentum were identified in a study by Tunkay et al. While the right upper part combined with ligamentumtereshepatis, the left upper part had connection with the anterolateral abdominal wall. In addition, the free lower margin of the greater omentum was bound to the front of the abdomen wall. These unusual attachments contained vessels and nerves. Therefore, it is important to keep in mind the different attachments of the greater omentum, so that caution is required during intraabdominal surgery and also in appropriately interpreting the radiographs [15].

Our study identified several rare variants of omental morphology, including accessory omental appendages and aberrant vascular patterns. These variants underscore the anatomical complexity of the omentum and highlight the need for meticulous preoperative assessment in surgical planning. Of particular interest were cases of ectopic adipose tissue deposition within the omentum and anomalous vascular channels, which may predispose individuals to certain pathological conditions such as omental infarction or torsion.

In vascular surgery, the greater omentum has garnered attention as a potential source of autologous vascular grafts or as a adjunctive tissue for vascular reconstruction. Our observations of variant vascular patterns within the omentum underscore its potential as a vascular reservoir for arterial or venous bypass procedures. Moreover, the omentum's inherent angiogenic properties and capacity for neovascularization may facilitate graft incorporation and enhance long-term patency in vascular reconstructions.

Primary omental torsion is a rare pathological condition with generic symptoms that may mimic many acute abdominal conditions.Greater omental torsion is difficult to diagnose preoperatively. It presents as acute abdominal pain located more often in the right iliac fossa. It is very important to make a correct preoperative diagnosis because omental torsion is a benign self-limiting disorder that can be treated conservatively, avoiding laparotomy [16].

Diagnosing an omental mass involves imaging studies like ultrasound, CT scans, or MRI. Treatment varies based on the cause, with benign masses often monitored and malignant tumors or symptomatic masses requiring interventions such as surgery, chemotherapy, or targeted treatments.
In our study, we found the omental torsion with omental mass weighing approximately 550gm and extending into the pelvis which is one of the rarest observation in literature.Awareness of omental torsion as a differential diagnosis for acute abdomen and a thorough inspection of omentum in a negative laparoscopy are recommended for appropriate management.

Table 3: Rare Variants of Omental Morphology and Vascularization

Variant	**Description**	**Population**	**Prevalence (%)**	**Authors**
Accessory Omental Appendages	Small lobules of adipose tissue arising from the main body of the omentum, varying in size and location.	General	50-60	Standring, S. (Ed.). (2016). Gray's Anatomy [17]
Aberrant Vascular	Anomalous arterial	Cadaveric	15-20	Loukas, M., &

Patterns	or venous channels within the omentum, deviating from the typical vascular supply.			Owens, D. G. (2018) [18]
Ectopic Adipose Tissue	Abnormal deposition of adipose tissue within the omentum, potentially predisposing to pathological conditions.	Clinical	5-10	19. Sinha, A., Nigam, S., &Pandey, C. K. (2015) [19]
Congenital Malformations	Developmental anomalies such as omental bands, septations, or cystic formations, altering omental architecture.	Surgical	10-15	20. Netter, F. H. (2019). Atlas of Human Anatomy. Elsevier Health Sciences [20]
Supernumerary Omental Vessels	Additional arterial or venous branches supplying the omentum, contributing to vascular diversity and complexity.	Anatomical	20-25	Moore, K. L., Dalley, A. F., &Agur, A. M. (2013). Lippincott Williams & Wilkins [21]

Conclusions

Our cadaveric study provides valuable insights into the morphology, development, and rare variants of the greater omentum, shedding light on its diverse roles in flap reconstructive and vascular surgeries. The identification of rare omental variants underscores the importance of individualized surgical planning and meticulous anatomical dissection to optimize surgical outcomes. Moving forward, further research is warranted to explore novel applications of the omentum in regenerative medicine, tissue engineering, and minimally invasive surgical techniques.In conclusion, the omentum emerges as an incredibly versatile organ with widespread applications in various surgical domains.

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