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ORIGINAL ARTICLE

Trauma of the mesentery. Anatomy and diagnosis

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Abstract

Mesenteric lesions in abdominal trauma are encountered in 3% of the cases. Diagnosis of these lesions is difficult, which translates into important delays until surgery that affects patient survival. The short-term consequences of mesenteric lesions translate in bowel ischemia or important blood loss. If a lesion is confirmed after imagistic investigations, one must have complete knowledge of the anatomy and the particular distribution of the main arterial and venous trunks to predict the region of the small bowel that will have to be observed or resected if surgery is required. The aim of our study was to demonstrate this particular distribution of blood vessels through cadaver dissection and to note the resources available to diagnose such lesions.

Keywords: mesentery anatomy, trauma of the mesentery, diagnosis of mesenteric trauma

Introduction

Taken as a whole, the mesentery represents one of the largest structures in the abdominal cavity, thus, due to this fact, it associates an increased risk of lesions. Abdominal trauma, either blunt or penetrating can disrupt the continuity of the mesentery with dire implications for the patients if these are not identified in proper time by the physician [**1**].

The incidence of mesentery lesions revolves around 2,5% of all trauma of the abdomen. Not surprisingly, penetrating trauma such as gunshots wounds (75%) and stabbings (20%) represent the major causes of mesentery injuries due to peritoneal penetration [**2**].

A rapid deceleration in vehicle accidents represents the main cause of mesentery injuries and blunt abdominal trauma [**3**].

The clinical diagnosis of these lesions if difficult as specific signs such as peritoneal irritation are present in only half of the alert and non-comatose patients, also signs and symptoms can be obscured by other concomitant lesions such as trauma to the head, spine or pain suppressing medication.

When a trauma patient arrives at the hospital with clear signs of abdominal injury, the physician should first consider a possible mesenteric injury. The presence of the seat-belt sign is surprisingly indicative of intestinal/ mesenteric lesions. The main problem with mesenteric injury is that it serves as a pathway for the blood vessels to arrive at the small intestine so if it is ruptured, the blood supply is hampered with rapid subsequent necrosis. Also, large hematomas can evolve within the mesentery if the diagnosis is not on focus. Thus, proper knowledge of the anatomy of the distribution of the blood vessels in the mesentery is keen for a correct diagnosis and rapid treatment (**Fig. 1-4**). One must know how the blood vessels travel and which regions of the small intestine are irrigated by them (**Fig. 1-4**).

The aim of our study was to bring forth the physiopathology of mesenteric trauma along with the distribution of arterial blood vessels along the mesentery, which was demonstrated on cadavers.

Material and method

The anatomical study was performed on 4 cadavers. The dissections were done in collaboration with the Anatomy Department of "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania.

Results

The mesenteric circulation consists of 3 major arterial sources: celiac trunk, superior mesenteric artery, and inferior mesenteric artery together with the superior mesenteric vein and inferior mesenteric vein connected by arterioles, capillaries, and venules. This series of vessels is defined as the splanchnic circulation and ensures arterial blood and drainage of venous blood from the digestive tract. The celiac trunk supplies blood to the stomach, proximal duodenum, specific segments of the pancreas, spleen, and liver. The duodenum, the entire small intestine receives blood from the superior mesenteric artery. The entire distribution of the superior mesenteric artery to the digestive tract it is made through the mesentery.

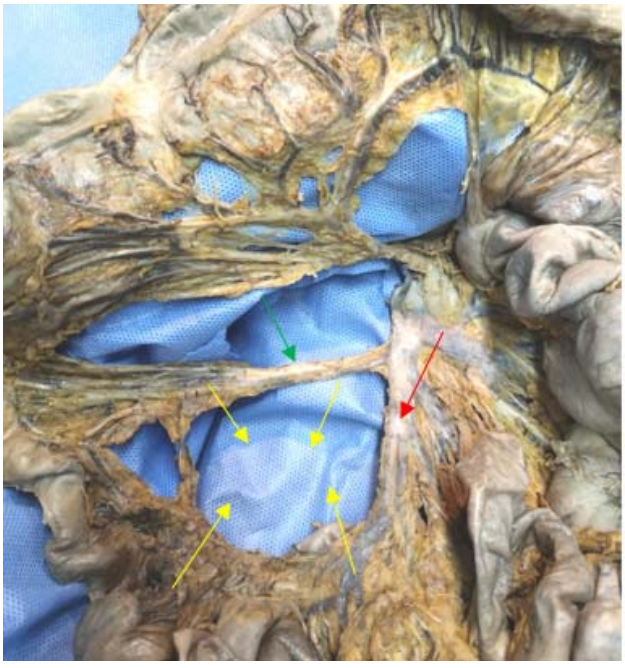

Fig. 1 A dissection of the main vascular arches that aims to demonstrate the spatial distribution at the level of the mesentery

The image describes the dissection of the mesentery at the right of the inferior mesenteric artery. The trunk of the ileocolic artery (red arrow), the right colic artery (green arrow), and the spatial distribution of multiple vascular anastomoses between them, can be observed. Also, the vascular anastomosis between the last ileal branch and the ileocolic artery that ensures proper blood supply to the terminal ileum, can be observed. The avascular plane of Treves is shown in the center of the image. A tear or rupture at this level is usually not followed by bowel ischemia due to the lack of arterial vessels in this region.

Fig. 2 Image that describes the main trunk of the superior mesenteric artery (blue arrow) and vein and the distribution of the vascular arches (red arrow) towards the jejunum and ileum through the mesentery which, in this case, was removed through dissection. The lateral and posterior location of the venous system in comparison to the arterial distribution, can be observed. This fact has an important implication in dissection and trauma.

Fig. 3 Description of the multiple levels of arterial arches - Level 1 (red arrow), level 2 (yellow arrow), level 3 (green arrow). It can be noted that Level 2 and 3 arches are distributed along with the jejunal and ileum loops. A dissection or blind ligation of bleeders should be avoided at the level 1 arches.

Fig. 4 demonstrates the arborescent distribution of blood vessels in the mesentery, which has been removed by dissection. The trunk of the superior mesenteric artery and vein (red arrow), can be observed. This observation has important implications in trauma, as a hematoma towards the base of the mesentery can cause compression on the main vascular trunks. Also, a rupture of the mesentery at this level can have dire implications for the patient. Blind dissection and ligation should always be avoided towards the root of the mesentery.

Discussion

The bowel and the mesentery represent the structures most frequently involved in blunt abdominal trauma (BAT) after the liver and the spleen [**4**].

Abdominal trauma is complex. The location of the most frequent mesenteric lesions is at the level of the most fixed portion: the jejunum near the ligament of Trietz is the most frequently injured followed by the terminal ileum, due to the Toldt fascia of the ascendant colon [**5**].

The mechanism through which lesions are produced includes compression, tearing or

explosion due to a sudden increase in pressure. The results are subsequent hematoma, active bleed, or tear [**3**].

Delayed diagnosis of a mesenteric lesion is associated with an increased rate of mortality and morbidity largely because of hemorrhage secondary to peritonitis due to perforation of the small intestine. If the patient is in shock, the clinical diagnosis will be extremely difficult. It has been shown that surgery in abdominal trauma, based solely on clinical examination, has led to an unnecessary laparotomy rate of up to 40% [**6**].

Due to the afore-mentioned reasons, multiple concurrent diagnostic tests should be done, such as peritoneal lavage, CT, ultrasonography or angiography.

Unconfirmed mesenteric lesions are the main culprit for delayed surgical intervention after abdominal trauma. A delay of only 5 hours until intervention can affect survival indexes [**7**].

These patients have to be quickly diagnosed and CT has emerged as an option, but it has a false negative rate of up to 13% [**8**].

Keeping these aspects in mind, non-therapeutic laparotomy can be used, but this has a perioperative morbidity of up to 41%, so it should be used with extreme care [**9**].

In this regard, several tools have been proposed to evaluate patients with inconclusive CT-lesions for early laparotomy. The BIPS (Bowel Injury Prediction Score) has been proposed with good initial results as it takes into account multiple variables such as abdominal wall tenderness, CT mesenteric lesions, and white blood cell count. In addition, patients with a BIPS value of 2 have an increased risk of up to 19 times greater for mesenteric lesions than patients with a normal BIPS score [**10**].

Another tool that can be used by the physician is peritoneal lavage with a sensitivity of up to 90%, to confirm the presence of hemoperitoneum, but it is misses retroperitoneal active bleeding or hematomas. Also, what should also be taken into account is that it is an invasive procedure with the risk of bowel perforation. Moreover, this procedure should be avoided if a future CT-evaluation is planned, as newly introduced air in the peritoneal cavity alongside with the lavage liquid can alter the results.

FAST ultrasonography can also be used, is cheap, does not irradiate, and can monitor evolving lesions such as the size of hematomas or the levels of free abdominal liquid. Besides the mentioned advantages, ultrasonography has other disadvantages such as: it is operator dependent; the evaluation of the organs is hard to be performed if the patient has a thick abdominal wall, due to air distended bowels, it can also alter the results of the investigation [**11**].

At present, Multidetector CT is the best resource to evaluate a suspicion of mesenteric injury, but the patients need to be hemodynamically stable. It has a sensitivity of up to 95% and a specificity of up to 100% [**12,13**].

Arterial and venous contrast material such as iodine should and needs to be used to identify active bleeding sites or lack of adequate perfusion in different structures. It should be noted that a late phase CT reevaluation should be obtained, and consists of a 5-minute delay after contrast infusion and image acquisition for low debit bleeders [**14,15**].

The trauma of the mesentery manifests itself in a wide variety of alterations that range from a small hematoma to complete rupture or avulsion from the abdominal wall or from the intestinal loops. Usually, mesenteric lesions are classified according to surgical implication as major or minor lesions [**16**].

Minor lesions usually require conservative treatment and observation and are defined as contusions or small hematomas. Major lesions require urgent surgical care and are defined as complete ruptures of avulsion with subsequent small bowel ischemia and peritonitis [**17**].

As a recommendation, bleeding with extravasation of the contrast substance, thickening of the bowel wall with edema or hematoma are indicative of advanced injury of the mesentery or of the associated intestinal loop and require urgent surgical intervention. In contrast, an isolated mesenteric hematoma with no vascular repercussion on the intestinal wall, such as increased thickness, requires close observation and repeated CT as ischemia can occur due to extrinsic compression [**18**].

The CT signs that are indicative of a mesenteric lesion in trauma are the following: extravasation of the contrast substance, the presence of free abdominal fluid usually located intermesenteric, acute termination of arterial of venous blood vessels. These signs are not always present at first evaluation as it is already known, a trauma patient requiring multiple evaluations. It the following lesions are confirmed, future evaluations should focus on the mesentery: mesenteric edema, hematoma, or segmental small bowel thickening. Although it is rarely the case, a differential diagnosis may be required if there is diffuse wall thickening with shock bowel from the subsequent edema.

Conclusion

In conclusion, a good knowledge of the structure and the distribution of the arterial and venous vessels through the mesentery is of utmost importance for a positive outcome in cases of abdominal trauma. With these aspects in mind, one should avoid blind dissection or blind ligation of bleeding vessels at the root of the mesentery. Contrast enhanced multidetector CT is at present the main imagistic resource to identify structural lesions of the mesentery after abdominal trauma. Treatment options vary from conservative treatment to surgical resection. One should keep in mind that continuous dynamic and clinical or paraclinical evaluations at different time intervals are mandatory for a trauma patient.

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Conflict of Interest statements

Authors state no conflict of interest.

Informed Consent and Human and Animal Rights statements

Informed consent has been obtained from all individuals included in this study.

Authorization for the use of human subjects

Ethical approval: The research related to human use complies with all the relevant national regulations, institutional policies, is in accordance with the tenets of the Helsinki Declaration, and has been approved by the authors' institutional review board or equivalent commitee.

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