Background

- The median arcuate ligament (MAL) is a fibrous band which traverses the aorta cephalad to the celiac artery and bridges the crura of the diaphragm.
- MAL syndrome (MALS) is a rare disease thought to be due to compression of the celiac artery and nerve plexus.
- Laparoscopic MAL release has become a widely adopted treatment due to its advantages over an open approach; however, it still carries the risk of significant bleeding given the procedure requires dissection of dense tissue directly overlaying major vascular structures.

Purpose

We aim to describe our technical approach to laparoscopic MAL release of
- 1) Creation of a “landing zone” on the aorta
- 2) Distal-to-proximal dissection from the branch vessels to the landing zone
- 3) Operative Steps and Technique

Method

- Retrospective review of five MALS cases that underwent surgical treatment with a laparoscopic MAL release
- Cases chosen due to availability of operative video recordings and to demonstrate variant cases in presentation, operative findings, and outcomes.

Preoperative Evaluation

- Extensive workup often completed prior to surgical consultation
- Initial diagnostic imaging: Abdominal CT angiogram preferred
- In the absence of other etiologies, findings consistent with celiac artery compression or narrowing without arteriosclerosis is suggestive of MALS
- Confirmatory imaging: Mesenteric duplex measuring celiac artery velocity 1) at rest, 2) with expiration, and 3) deep inspiration
- The following exploratory findings along with a decrease in velocities with deep inspiration are diagnostic of MALS:
  - Celiac artery peak systolic velocity (PSV) of ≥ 350 cm/s at expiration
  - 210% change in pulse volume amplitude between inspiration and expiration
  - Celiac artery deflection angle of 50°

Operative Steps and Technique

1) Creation of a “Landing Zone” on the Aorta

- Division of diaphragmatic muscle fibers overlying the aorta to clear off a proximal “landing zone” for subsequent vascular dissection
- This cleared area of aorta will be the target end point of later dissection from distal-to-proximal on the celiac trunk

2) Retrograde Dissection from the Branch Vessels to the Aorta

- Identify branches of the celiac trunk
- Depending on the patient’s anatomy, the starting point for dissection may vary (Fig 1)
- Dissection proceeds towards the celiac trunk with the "landing zone" on the proximal aorta in view
- Divide all of the fibrous and neuronal tissue overlying the vessels down to the vascular adventitia (this tissue is thought to be the cause of symptoms in MALS patients)

3) Use of Laparoscopic Ultrasound

- To identify the exact location of the takeoff of the celiac artery
- To ensure complete release of the more lateral fibers that, if left behind, may have continued to compress the neurovascular structures in the area (Fig 2)

At the conclusion of the case, the takeoff of the celiac artery and its trunk should be completely dissected free anteriorly (Fig 3)

Results

- 5/5 procedures successfully performed laparoscopically without significant hemorrhage
- 5/5 patients had ≥1 clinical follow-up visit and 4/5 patients (80%) had a follow-up mesenteric duplex ultrasound (Table 1)
- 5/5 patients experienced some improvement in symptoms in the immediate post-operative period
- Of the four patients that had follow-up imaging, all four had decreased celiac artery velocities compared to their preoperative values, with an average of 270 cm/s.
- 2/5 patients reported persistent symptoms within 1-3 months postoperatively despite improved velocities

Conclusion

We demonstrate our laparoscopic MAL release technique that utilizes a proximal “landing zone” on the aorta, dissection from the distal branch vessels to the proximal landing zone, and liberal use of intraoperative ultrasound to identify the precise location of celiac artery takeoff. We feel this approach may help minimize risk of vascular injury and ensure a complete release of the dense tissue overlying the anterior portion of the celiac artery at its takeoff from the aorta.

Limitations & Future Directions

- This study aimed to detail our technical approach and is not intended to be a case review; however, the number of cases included is still a limitation.
- In the future we would like to study a larger cohort to better study outcomes, as well as predictors of outcomes.

References


Figure 1. Example of various anatomy showing the right atrial branch (below) coming off of the celiac trunk (black), the aorta (red), the left gastric artery (blue) and the common hepatic artery (green).

Figure 2. Laparoscopic ultrasound used to identify the exact location of the takeoff of the celiac artery (the larger red circle highlights the aorta, while the smaller red circle outlines the celiac artery). This study aimed to detail our technical approach and is not intended to be a case review; however, the number of cases included is still a limitation.

Figure 3. Conclusion of case displaying the takeoff of the celiac artery completely dissected free anteriorly.