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Case Report

Surgery Section

# Real time Imaging (Intraoperative Doppler) in Median Arcuate Ligament Syndrome Management: A Case Report

PREM SHAH[1], HARYAX PATHAK[2], BHASHA VAIDYA[3]




## ABSTRACT

Median Arcuate Ligament Syndrome (MALS) is a rare cause of chronic abdominal pain due to coeliac trunk compression, typically affecting middle-aged women. Surgical decompression is the gold standard, but technical failure or recurrence poses a significant challenge. The authors report a rare case of recurrent MALS in a 31-year-old male who presented with severe, persistent abdominal pain 1.5 years after an initial laparoscopic ligament release. Preoperative Computed Tomography (CT) and Doppler Ultrasound (DUS) confirmed the recurrence, showing coeliac trunk kinking and a markedly elevated Peak Systolic Velocity (PSV) of 235 cm/sec. Due to dense adhesions from the previous procedure, the patient underwent a re-do surgery via open laparotomy. The key to successful re-operation was the use of intraoperative DUS to precisely localise the coeliac trunk amidst fibrotic tissue. Following complete surgical decompression of the artery, the intraoperative PSV immediately dropped to 80 cm/sec, confirming adequate flow restoration. The patient experienced complete, sustained symptom resolution at the 6-month follow-up. The present case highlights that intraoperative DUS is a vital tool for ensuring the completeness of coeliac axis decompression, especially in complex, re-operative settings where persistent adhesions obscure anatomical planes.

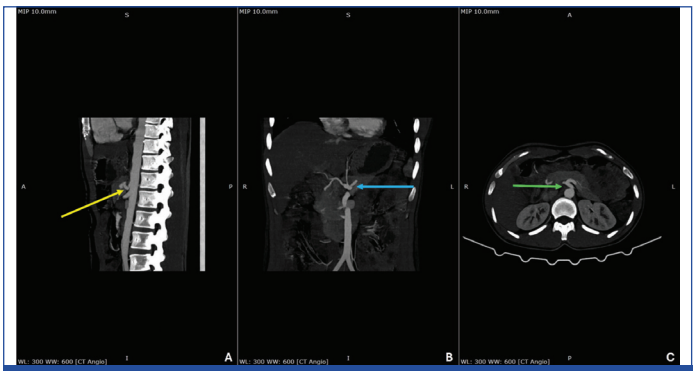

**Keywords:** Coeliac artery compression syndrome, Dunbar syndrome, Intraoperative ultrasound, Vascular compression syndrome

## CASE REPORT

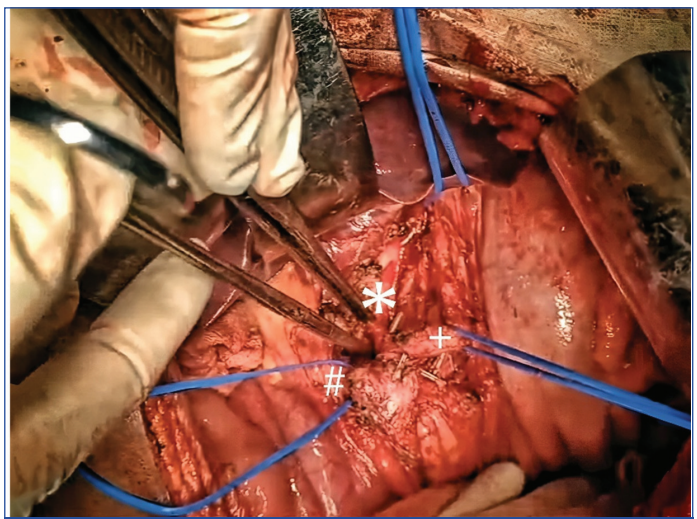
A 31-year-old male, with no known co-morbidities, presented with a complaint of generalised abdominal pain, nausea and vomiting for 1.5 years, aggravated in the past 1 month. On examination, the patient had mild, generalised abdominal tenderness, with no other positive findings. The patient had a history of hospital admission for similar symptoms two years ago and was diagnosed with Median Arcuate Ligament Syndrome (MALS) and subsequently underwent laparoscopic surgery for the same. He was free of symptoms for a short period of time (approximately 6 months) following the surgery but developed recurrent symptoms 1.5 years ago. His laboratory parameters (haemogram, liver function tests, renal function tests) were within normal limits.

He was evaluated by a Computed Tomography (CT) scan of the abdomen and pelvis that revealed narrowing of the proximal coeliac artery with anteroinferior kinking and narrowing of the coeliac trunk, as seen in [Table/Fig-1]. The superior and inferior mesenteric arteries were unremarkable with no stenosis. Preoperative ultrasound Doppler imaging revealed mild kinking of the coeliac trunk at its origin, with Doppler values showing PSV of the coeliac trunk at origin of 235 cm/sec and PSV of the coeliac trunk post-kinking of 222 cm/sec. He was diagnosed with MALS with prior inadequate release of the MAL.

Intraoperatively, a diagnostic laparoscopy showed dense adhesions in the region of the coeliac axis and lesser sac owing to a previous history of surgery. The crural fibres of the diaphragm were densely adherent to the aorta till the origin of the coeliac axis, with fibrotic tissue encasing the coeliac axis. The proximal portion of the coeliac trunk was buried under the sub adventitial plane of the aorta. The decision was made to go for open surgery in view of adhesions. Intraoperative Doppler was done to localise the coeliac trunk and the PSV was measured, which was 235 cm/sec at the origin. The left gastric artery and common hepatic artery were dissected and looped and followed till coeliac trunk. The fibres encasing the coeliac trunk were dissected, freeing the coeliac trunk from the subadventitial plane of the aorta [Table/Fig-2].

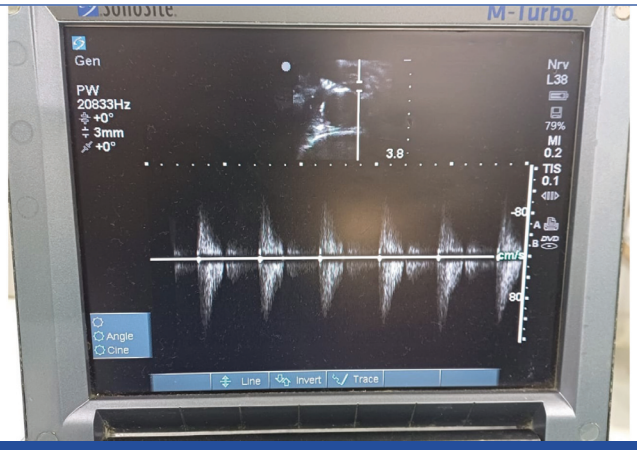



**[Table/Fig-1]:** Computed tomography scan showing anteroinferior kinking of the coeliac axis at its origin. (a) Sagittal section (yellow arrow); (b) Coronal section (blue arrow); (c) Axial section (green arrow).




**[Table/Fig-2]:** Intraoperative image showing the freed coeliac trunk (*); the common hepatic artery (#) and the left gastric artery (+) looped.

Intraoperative ultrasound Doppler imaging revealed reduction in peak velocity at origin of coeliac trunk down to 80 cm/sec, with no kinking as compared to the preoperative Doppler [Table/Fig-3].




**[Table/Fig-3]:** Intraoperative ultrasound Doppler following release of coeliac axis showing reduction in PSV down to 80 cm/sec.

Postoperatively, the patient made an uneventful recovery, with complete resolution of symptoms and no residual complaints on follow-up for up to six months.

## DISCUSSION

The median arcuate ligament typically crosses above the coeliac axis origin, joining the two diaphragmatic crura. However, in rare cases, the ligament may cross in front of the artery; compressing the coeliac axis, impairing blood flow and producing symptoms [1]. MALS predominantly affects women between the ages of 30 and 50 years, with a female-to-male ratio of approximately 4:1. The present syndrome causes angina and pain in the abdomen, nausea, vomiting and classical post-prandial upper abdominal pain because of compression of the proximal portion of the coeliac artery [2].

Radiological diagnosis is established by DUS, Computed Tomography Angiography (CTA) of the abdomen, magnetic resonance angiography and newer modalities such as selective catheter angiography. The characteristic focal narrowing in the proximal coeliac axis is seen on CTA in patients with MALS. The distinctive hooked appearance of the focal constriction can help differentiate MALS from other causes of coeliac artery stenosis, like atherosclerosis. Collateral vessels and post-stenotic dilatation are among the features of MALS [3]. The CT scan of the present patient showed luminal narrowing at the origin of the coeliac artery. However, no post-stenotic dilatation was seen. DUS highlights an increase in PSV at the origin of the coeliac trunk during expiration and exhibits kinking of the coeliac trunk, while CTA gives a comprehensive evaluation of the coeliac trunk anatomy, pre-stenotic and post-stenotic dilatation and differentiates MALS from an aneurysm, thus making both DUS and CTA necessary investigations for diagnosis and aiding in surgical management [3].

Colour Doppler US evaluation allows for dynamic, direct documentation of variations in calibre, colour signal, aorto-mesenteric angle, spectral window and PSV of the coeliac trunk with changes in the respiratory phase. During the deep inspiratory phase, normal colour Doppler features are generally detected. Yet, during the expiratory phase, an abnormal (acute) deflection angle typically appears, with colour aliasing in the proximal lumen of the coeliac trunk and an increase in PSV and end-diastolic velocity. A PSV over 200 cm/s during the expiratory phase or a ratio more than 3:1 of PSV of the coeliac artery to aorta in the expiratory phase is a Doppler criterion for diagnosis of Dunbar syndrome [4].

Surgical decompression of the coeliac trunk remains the gold standard for management of MALS. Surgical decompression may be conducted via laparotomy or laparoscopic approaches. Laparoscopic decompression affords minimally invasive surgical decompression, reduced complications and improved surgical outcomes, with lower recurrence rates, but also has high conversion to open surgeries owing to bleeding [5].

Do MV et al., conducted a retrospective review of patients operated for MALS, comparing laparoscopic and robotic approaches and concluded that while robotic surgeries are a viable option, there is no significant difference in operative outcomes between the two, with a shorter operative duration for laparoscopic surgeries [6]. Another innovative approach to MALS surgery was described by Petersen AS van et al., wherein they performed a retroperitoneal endoscopic release of the coeliac trunk with minimal complications and excellent postoperative results [7].

The use of intraoperative DUS has been extensively described in literature and is an increasingly beneficial tool that enhances surgical precision and clinical outcomes. Hayano K et al., describe a case of a 52-year-old female with epigastric pain and vomiting following meals. She was diagnosed with coeliac artery compression syndrome on contrast-enhanced computed tomography. She underwent laparoscopic MAL division for the same and intraoperative transabdominal ultrasound Doppler was done to confirm complete decompression of the coeliac axis. Following an uneventful postoperative course, she was discharged on postoperative day 11 [8]. Another similar case was reported by Tsujimoto H et al., wherein a 52-year-old female with MALS was treated with laparoscopic decompression of the MAL, which was confirmed with the disappearance of the preoperative post-stenotic dilatation via an intraoperative DUS [9]. A novel approach was recently described by Bayat I et al., in 2020. They operated on a female for MALS laparoscopically and used Intravascular Ultrasound (IVUS) via a brachial artery puncture to access the coeliac axis. Laparoscopic division of the fibres was performed, guided by IVUS, ensuring complete division of the ligament and resolution of the compression [10]. Such cases demonstrate the invaluable assistance that intraoperative DUS provides for surgical management of MALS.

## CONCLUSION(S)

The MALS is a rare anatomical anomaly that causes significant and at times debilitating distress in patients and requires precise diagnosis and surgical management. Intraoperative DUS is one of the most effective tools for ensuring the completeness of MALS surgery.

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**PARTICULARS OF CONTRIBUTORS:**
1. Consultant, Department of Gastrointestinal Surgery, Shree Krishna Hospital and Pramukh Swami Medical College, Bhaikaka University, Karamsad, Anand, Gujarat, India.
2. Senior Resident, Department of General Surgery, Shree Krishna Hospital and Pramukh Swami Medical College, Bhaikaka University, Karamsad, Anand, Gujarat, India.
3. Intern, Department of General Surgery, Shree Krishna Hospital and Pramukh Swami Medical College, Bhaikaka University, Karamsad, Anand, Gujarat, India.

**NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:**
Dr. Haryax Pathak,
Senior Resident, Department of General Surgery, Shree Krishna Hospital and Pramukh Swami Medical College, Bhaikaka University, Karamsad, Anand-388325, Gujarat, India.
E-mail: haryax0909@gmail.com

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