Original Research Paper

Volume - 16 | Issue - 01 | January - 2026 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

General Surgery

DYNAMIC CELIAC ARTERY COMPRESSION CAUSING POSTPRANDIAL ISCHEMIA: A SURGICAL CASE OF MEDIAN ARCUATE LIGAMENT SYNDROME

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ABSTRACT **Background: Median Arcuate Ligament Syndrome (MALS)** is a rare vascular compression disorder caused by extrinsic compression of the celiac artery by a low-lying median arcuate ligament. This compression results in foregut ischemia and typically presents with postprandial abdominal pain, nausea, vomiting, and unintentional weight loss, often leading to diagnostic delay due to nonspecific symptoms. **Case Report:** An 18-year-old female presented with a one-month history of recurrent postprandial vomiting, upper abdominal pain, and significant weight loss. Clinical examination revealed a thin, poorly nourished patient with epigastric tenderness. Computed Tomography angiography revealed focal narrowing of the proximal celiac artery with a characteristic hook-shaped appearance, consistent with median arcuate ligament compression. Dynamic duplex ultrasonography demonstrated elevated celiac artery velocities with significant respiratory variation. The patient underwent median arcuate ligament release, initially attempted laparoscopically and subsequently converted to a mini-laparotomy to achieve complete decompression. **Discussion:** The diagnosis of Median Arcuate Ligament Syndrome relies on a combination of classical postprandial symptoms and dynamic imaging modalities such as Doppler ultrasonography and computed tomography angiography. As MALS is a diagnosis of exclusion, other gastrointestinal and hepatobiliary pathologies must be ruled out prior to diagnosis. Surgical decompression of the celiac artery by releasing the median arcuate ligament remains the cornerstone of management, with favourable outcomes reported in appropriately selected patients. **Conclusion:** Median arcuate ligament syndrome should be considered in young patients presenting with unexplained postprandial abdominal pain, vomiting, and weight loss. Early diagnosis using dynamic imaging and timely surgical decompression of the celiac artery can result in complete symptom resolution and significant improvement in quality of life.

KEYWORDS : Median Arcuate Ligament Syndrome, Celiac Artery Compression, Postprandial Ischemia, Dynamic compression, Dynamic Imaging, Median Arcuate Ligament Release

INTRODUCTION

Median Arcuate Ligament Syndrome (MALS), also known as **Celiac Artery Compression Syndrome or Dunbar Syndrome**, is an uncommon cause of chronic postprandial abdominal pain resulting from extrinsic compression of the celiac artery by the median arcuate ligament. The median arcuate ligament is a fibrous arch formed by the diaphragmatic crura and typically passes superior to the origin of the celiac axis. In some individuals, a low-lying ligament causes dynamic compression of the celiac artery, particularly during expiration, leading to compromised blood flow to the foregut.

Although anatomical celiac artery compression may be detected incidentally in asymptomatic individuals, only a small proportion develop clinically significant symptoms. MALS predominantly affects young, thin females and presents with vague gastrointestinal complaints, often mimicking functional or organic gastrointestinal disorders. Consequently, diagnosis is frequently delayed, and patients undergo extensive investigations before the underlying vascular etiology is identified. [1]

The pathophysiology of MALS remains controversial, with proposed mechanisms including mesenteric ischemia due to vascular compression and neurogenic pain secondary to irritation of the celiac plexus. Surgical decompression remains the definitive treatment in symptomatic patients, with favourable outcomes reported following complete release of the median arcuate ligament. [2]

We herein present a rare surgical case of MALS in an adolescent female, emphasizing diagnostic challenges and surgical management.

CASE REPORT

An 18-year-old female patient, a college student, with no significant past medical or surgical history, presented to our surgical outpatient department with chief complaints of recurrent vomiting and postprandial upper abdominal pain for the last one month. The pain was localized to the epigastric region, insidious in onset, dull aching to occasionally colicky in nature, mild to moderate in intensity, and persisted throughout the day. The pain was characteristically aggravated following food intake and minimally relieved with analgesics. The vomiting episodes were non-projectile, non-bilious, containing food particles, occurred immediately after meals, and were preceded by nausea, with a frequency of approximately 15–20 episodes per day. The symptoms were associated with reduced appetite, generalized weakness, and significant unintentional weight loss of 5 kg (35kgs to 30kgs) over a period of two months. There was no history of radiation of pain, altered bowel habits, hematemesis, melena, jaundice, excessive alcohol intake, tobacco use, or illicit drug consumption.

On general examination, the patient was thin built and poorly nourished, with a body mass index of 14.07 kg/m². Vital parameters were stable. Abdominal examination revealed a soft abdomen with localized tenderness in the epigastric and right hypochondrial regions. There was no guarding, rigidity, palpable mass, or organomegaly. Bowel sounds were normal on auscultation, and no abdominal bruit was appreciated.

Routine blood investigations were within normal limits. Upper Gastrointestinal Endoscopy revealed Lax Lower Esophageal Sphincter. Computed tomography angiography of the abdomen (Fig. 1a, 1b) revealed focal narrowing of the proximal celiac artery with a characteristic hook-shaped appearance due to median arcuate ligament impingement, without evidence of atherosclerosis or distal flow compromise. The patient was further evaluated with dynamic duplex ultrasonography of the mesenteric vessels (Fig. 2), which demonstrated elevated peak systolic velocity of the celiac artery

exceeding 200 cm/s, suggestive of dynamic celiac artery compression.

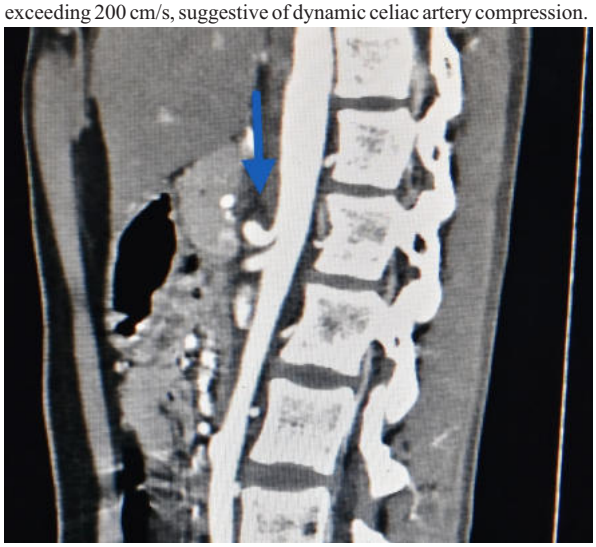


Fig. 1a: CT Angiogram image showing "Hook sign"

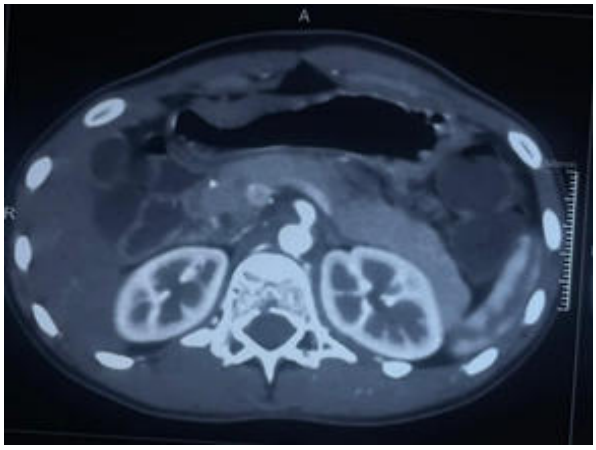
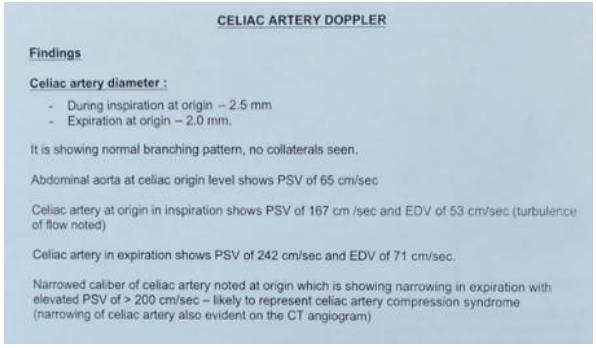


Fig. 1b: CT Angiogram image showing focal narrowing of proximal celiac artery



CELIAC ARTERY DOPPLER

Findings

Celiac artery diameter :

- During inspiration at origin – 2.5 mm
- Expiration at origin – 2.0 mm.

It is showing normal branching pattern, no collaterals seen.

Abdominal aorta at celiac origin level shows PSV of 65 cm/sec

Celiac artery at origin in inspiration shows PSV of 167 cm /sec and EDV of 53 cm/sec (turbulence of flow noted)

Celiac artery in expiration shows PSV of 242 cm/sec and EDV of 71 cm/sec.

Narrowed caliber of celiac artery noted at origin which is showing narrowing in expiration with elevated PSV of > 200 cm/sec – likely to represent celiac artery compression syndrome (narrowing of celiac artery also evident on the CT angiogram)

Fig. 2: Celiac artery doppler report showing elevated PSV > 200cm/sec

With the diagnosis of Median Arcuate Ligament Syndrome, the patient was planned for surgical release. Diagnostic laparoscopy followed by median arcuate ligament release was attempted. However, due to difficult anatomical access and inadequate visualization, the procedure was converted to a mini-laparotomy to achieve complete release of the median arcuate ligament and adequate decompression of the celiac artery. Intraoperatively, a thickened and hypertrophied median arcuate ligament was seen compressing the celiac artery origin.

The immediate postoperative recovery was uneventful. Patient was discharged on 2nd postoperative day with stable vitals, healthy sutures and very minimal pain. Patient experienced complete resolution of postprandial pain and vomiting. At one-month follow-up, she had gained 2 kgs and reported significant improvement in appetite and overall well-being.

DISCUSSION

Median Arcuate Ligament Syndrome (MALS) is an uncommon and frequently underdiagnosed vascular compression disorder caused by extrinsic compression of the celiac artery by a low-lying median arcuate ligament (Fig. 3). While radiological evidence of celiac artery compression may be present in a notable proportion of the general population, only a minority of individuals develop symptoms, underscoring the importance of correlating imaging findings with clinical presentation. Recent literature emphasizes that MALS should not be diagnosed solely on anatomical compression but rather as a clinico-radiological entity after exclusion of more common gastrointestinal causes. [1]

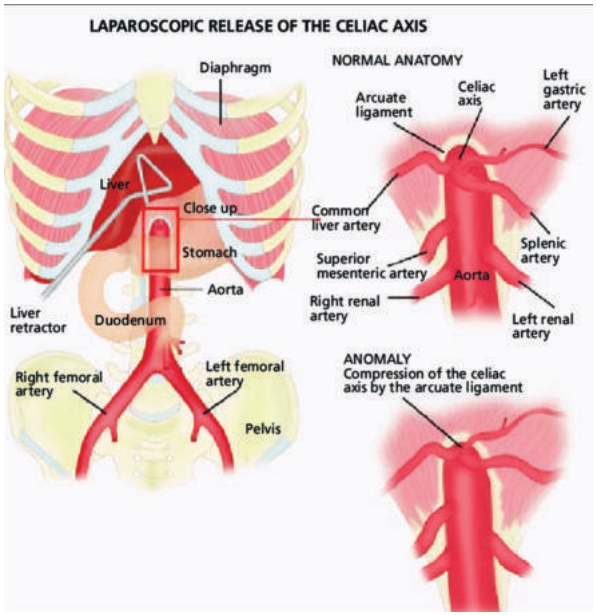


Fig. 3: Diagramatic depiction

Epidemiologically, MALS predominantly affects young, thin females, a pattern consistently reported across historical and contemporary studies. [2,3] The classical symptom constellation includes postprandial epigastric pain, nausea, vomiting, early satiety, bloating, and unintentional weight loss. These symptoms frequently result in food avoidance (sitophobia), leading to progressive malnutrition and reduced quality of life. Systematic reviews and meta-analyses have demonstrated that more than 70% of carefully selected patients experience significant symptomatic improvement following surgical intervention, reinforcing the role of surgery in appropriately diagnosed cases. [2,5] Our patient's demographic profile and symptom pattern align closely with these established characteristics.

The pathophysiology of MALS remains complex and multifactorial. One proposed mechanism involves mesenteric ischemia resulting from dynamic compression of the celiac artery, which is accentuated during expiration due to caudal movement of the diaphragm. This leads to reduced blood flow to the foregut during periods of increased metabolic demand, particularly after meals. [1,6] Another widely accepted hypothesis suggests a neurogenic component, wherein compression or irritation of the celiac plexus and ganglion contributes to chronic abdominal pain independent of the degree of vascular stenosis. [3,7] The coexistence of vascular and neurogenic mechanisms likely explains the variable symptom severity and inconsistent correlation between imaging findings and clinical presentation.

Diagnosis of MALS remains challenging and is widely regarded as a diagnosis of exclusion. Patients often undergo extensive evaluation for functional dyspepsia, peptic ulcer disease, biliary pathology and motility disorders before MALS is considered. Dynamic duplex ultrasonography serves as an important non-invasive screening tool by demonstrating elevated peak systolic velocities of the celiac artery during expiration with normalization on inspiration. Computed tomography angiography and magnetic resonance angiography with three-dimensional reconstruction provide definitive anatomical confirmation, with the characteristic focal proximal narrowing and "hook-shaped" configuration of the celiac artery on sagittal images considered pathognomonic. [1,4,6]

Surgical decompression of the celiac artery remains the cornerstone of treatment for symptomatic MALS. Median arcuate ligament release can be performed via open, laparoscopic, or robotic approaches. Minimally invasive techniques have gained popularity due to reduced postoperative pain, shorter hospital stay, and faster recovery. Recent institutional series and multicenter studies have demonstrated excellent short- and mid-term outcomes with laparoscopic and robotic release when complete decompression is achieved. [4-8] However, conversion to an open or mini-laparotomy approach may be necessary in cases with difficult anatomy, dense fibrotic tissue, or inadequate visualization to ensure complete release, as was required in our patient. Despite favourable outcomes in most patients, a subset may experience persistent or recurrent symptoms following ligament release. Proposed reasons include incomplete decompression, residual fixed celiac artery stenosis, or predominant neurogenic pain. In such cases, adjunctive interventions such as endovascular angioplasty, stenting, or vascular reconstruction may be required. Long-term follow-up studies suggest that careful patient selection, complete ligament division, and addressing associated vascular pathology are critical determinants of sustained symptom relief. [5-8]

This case highlights the importance of maintaining a high index of suspicion for MALS in young patients presenting with unexplained postprandial abdominal pain, recurrent vomiting, and significant weight loss after exclusion of common etiologies. Early diagnosis using appropriate dynamic imaging and timely surgical intervention can lead to dramatic symptomatic improvement and prevent prolonged morbidity. Increased awareness among clinicians is essential to reduce diagnostic delay and unnecessary investigations.

CONCLUSION

Median Arcuate Ligament Syndrome is a rare and frequently overlooked cause of postprandial abdominal pain, vomiting, and weight loss, especially in young, thin females. Owing to its nonspecific presentation, diagnosis is often delayed and requires exclusion of more common gastrointestinal conditions. Dynamic imaging modalities such as duplex ultrasonography and computed tomography angiography are essential for confirming celiac artery compression. Surgical decompression by complete release of the median arcuate ligament remains the definitive treatment and can result in significant symptomatic relief and improved quality of life when performed in appropriately selected patients.

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