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Prevalence of Median Arcuate Syndrome on Ct Angiography in Asymptomatic Patients

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ABSTRACT:

Background/aim: To detect prevalence of Dunbar syndrome/ celiac axis syndrome (compression of celiac artery by median arcuate ligament) /median arcuate ligament syndrome (MALS) in asymptomatic patients.

Materials and methods: This study is doneBetween January 2015 and May 2021 a total of 1110 patients who underwent MDCT angiography in Saveetha medical college were retrospectively analyzed.

Results:

- Typical signs : of MALS seen in a total of 22(2.1%) patients.
- Out of them, were 18 (1.6%) were male and 4 (0.3 %) were female.
- The mean age : 45 years (range: 20 to 70 years)
- The incidence in celiac artery stenosis: 20% to 50% in 16 Patients (1.45%) & 51% to 90% in 6 patients (0.54%). Post-stenotic dilatation was reported in 16 patients (1.45%).
- Collaterals: observed in 1 Patient (0.09%).
- Celiac axis compression (> 50%) luminal narrowing of the celiac artery by the MAL was found in 7 (0.63%) .

Conclusion: MDCT angiogram visualization made the diagnosis of Median Arcuate Ligament Syndrome easy

Median arcuate ligament, celiac artery/axis compression syndrome, celiac trunk, Dunbar syndrome, MDCT.

I. INTRODUCTION

Dunbar syndrome is a rare disease occurred in 0.4% of the population[3, 10], According to previous study 2.4–8% in asymptomatic celiac artery compression .[3]

Compression of celiac axis by median arcuate ligament (MAL) ,first described by Harjola in 1968.[1]

MALS develops secondary to compression of the celiac trunk, occurs mainly during expiration[4], near where the celiac artery separates from the aorta. It is considered as serious if this also occurs in inspiration.

The syndrome is clinically shows triad:

1) Postprandial abdominal pain,
2) Epigastric bruit which increases in expiration,
3) Weight loss[5]

Patients with clinical symptoms radiologically show the extrinsic compression (> 50%)[1] of the celiac axis by the arcuate ligament by vascular imaging .

ANATOMY

The **celiac trunk / celiac artery/ celiac trunk** originates from the abdominal aorta., between T12- L1 vertebrae level .[2] It further divides into three arteries: left gastric artery, splenic artery and hepatic artery & supply stomach, spleen, pancreas, liver, and duodenum.

The **diaphragmatic crura** –

- Right crus - anterior surface of the L1–L4[6] vertebral bodies
- Left crus - L1- L2 lumbar vertebral bodies[6]

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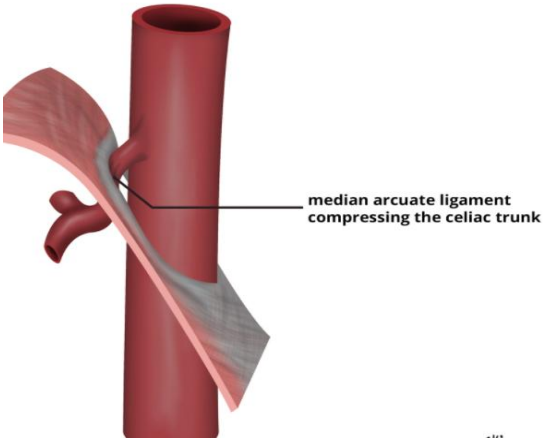
- crura arise from the intervertebral disks & anterior longitudinal ligament.
- The crura pass superior, anterior to surround aortic opening to join the central tendon of diaphragm.[6]

The **median arcuate ligament –** MAL is a fibrous arch [7,8], unites at Crura of diaphragm on both sides of aortic hiatus. The ligament usually passes over the aorta at the level of the L1 vertebral body, superior to the origin of the celiac axis. In some patients, approximately 10%–24% [6]of people, ligament can lie low , so cross over proximal portion of the celiac axis, leads to indentation. In this patients, the ligament can compress the proximal celiac axis and cause symptoms.



II. MATERIALS AND METHODS:

Background/aim:
This study aims to evaluate the prevalence of findings of median arcuate ligament syndrome (MALS) in multi-detector computed tomography (MDCT).

Type of study:
This was a **descriptive, non-controlled anatomic study.** The images obtained by MDCT in 1100 asymptomatic individuals were **retrospectively** examined.

Age:
The median age was 45 years (range, 20-70 years). Informed consent was not seen, due to using of existing medical data.

Materials and Methods

A total of 22 Patients who presented to our department were radiologically diagnosed with MALS following MDCT examination with angiography out of 1110 patients.

All the patients were examined by MDCT using a Philips Ingueinity 128 slice CT scanner. Images obtained by CT angiogram were analyzed for the presence of MALS. CT angiogram was studied retrospectively in 1110 patients between January 2015 and May 2021 and the results were analyzed.

The scanning area taken between the diaphragm and the iliac crest. Images were of kVp 120, mAs 300–400 value, 5 mm collimated cross-section thickness, 1 mm reconstruction interval, and a pitch value between 1 and 1.5.

All examinations were performed with the patients in the supine position and automatic injection of 100 mL of iohexol (omnipaque) or 100 mL of iopromide at a rate of 5 mL/s through the right antecubital vein, through single breath-holding at 65 s.

The MDCT images were transferred to the study center ISP. The images were evaluated as multi-plane and three-dimensional (3D) angiographic images. Every patient's images were evaluated with respect to rates of celiac artery stenosis, post-stenotic dilatation, collaterals formation and the results were registered.

The Parameters :

- MAL thickness > 4 mm is abnormal [7]
- Angle of emergence (AE) [1]- calculated near Origin of the celiac axis from the aorta
- Fold angle (FA)[1] - Angle of upward / downward shift of the celiac axis before its first branch &
- Presence of stenosis >50%[1] at origin of celiac axis.

CT reformatted image sagittal view - Angle of emergence (AE) of celiac axis from abdominal aorta (Deivamani-1902080019)

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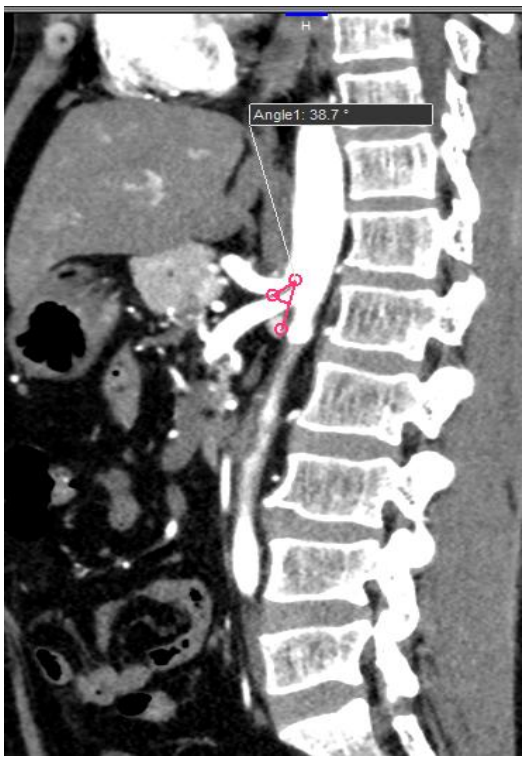
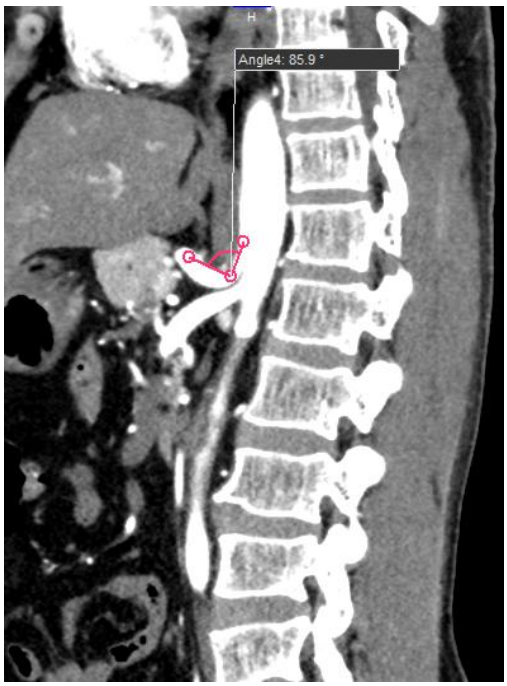
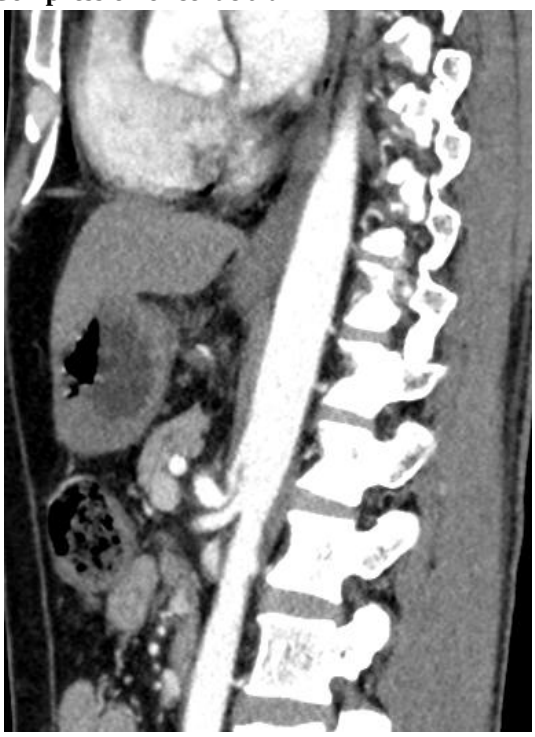


CT reformatted image sagittal view - Angle of shift of celiac axis before its 1st branch (Fold angle)



CT reformatted image sagittal view showing - Compression of celiac trunk



Epidemiology

CACS occurs in totally around 0.4%[3] of population, 2.4-8%[3] in asymptomatic patients according to previous studies. In Previous studies,

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All patients who has no symptoms of CACS turns out 7.3% patients had celiac axis stenosis, in 55% the etiology was extrinsic compression by the median arcuate ligament.

This study confirms symptom-free occurrence of CACS in a retrospective analysis of 1100 patients who underwent MDCT for various medical indications. 22 patients (2.1 %)in this study show compression of the celiac artery by ligament.

Exclusion:

CT study performed on non-Indian patients or obtained outside hospitals. Patients < 18 years old were excluded.

CT angiogram was performed in 1110 patients (male - 750, female -350) between 1st January 2016 and 31st May 2021 and the results were analyzed.

III. DISCUSSION

The **median arcuate ligament –** MAL is considered as a fibrous arch [7 , 8] which unites at Crura of diaphragm on both sides of aortic hiatus . The location of the MAL is variable , it can indent leads to downward angulation of the celiac trunk, so termed non-obstructive anatomic variant or sometimes leads to mesenteric ischemia.

Dunbar et al. linked this anatomic anomaly with clinical symptoms of intestinal angina in 1965 , so this MALS goes by his name.

The exact patho-physiology of this disease is not known, but primary cause is external compression of the celiac artery by a low-lying MAL (abnormally). The compression worsens with expiration as the diaphragm moves down leads to worsen the compression of celiac trunk.

MALS diagnosis in CTA: Characteristic focal narrowing of the proximal celiac axis with a "hooked" / J shaped appearance[1, 7] due to inferior displacement of the celiac trunk by MAL, most commonly seen/preferred in sagittal views .

Due to attachment of MAL to diaphragmatic crura, variable position of MAL & degree of compression of the celiac axis changes during different phases of respiration. So, images are best acquired in end-inspiratory phase, where true compression can be identified

Additional findings : post-stenotic dilatation and collaterals [6] may be seen.

CTA may also identify associated other vascular abnormalities like anatomic abnormalities or mesenteric thrombosis/ atherosclerosis

Management: Celiac decompression via release of median arcuate ligament laparoscopically.

RADIOLOGIC DIAGNOSIS

Currently, CECT is gold standard for celiac artery compression syndrome. So test performed both in inspiration as well as expiration, because largest compression of the median arcuate ligament seen during deep expiration.

Characteristic features: celiac artery stenosis, significant hooked appearance of the artery in 3D in sagittal plane, with post-stenotic dilatation of proximal celiac artery.

CT Angiography

New thin-section multi-detector CT scanners, along with 3D software, used to obtain high-resolution images of the aorta and its branches. To detect MALS, 3D imaging is needed. The findings of this syndrome is not assessed in axial plane alone so sagittal plan is optimal

In 3D we can also see actual median arcuate ligament & note its thickness, also identify characteristic focal narrowing of celiac trunk giving hooked appearance[6].

CT is typically performed during inspiration. Look for associated post-stenotic dilatation or collateral vessels, [10]also.

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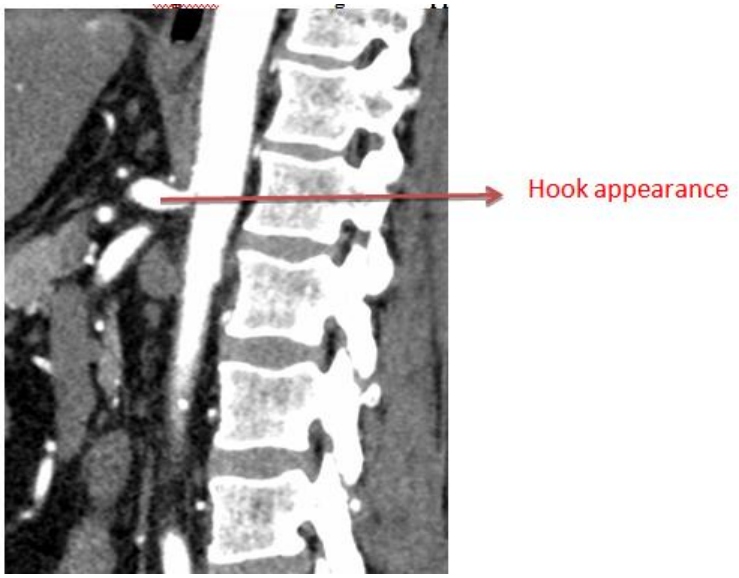
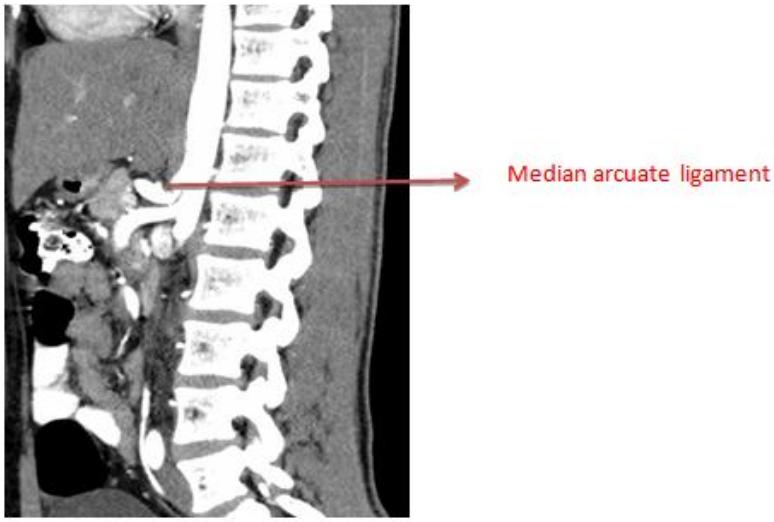
CT reformatted sagittal view showing - Hook appearance



CT reformatted sagittal view showing median arcuate ligament compressing celiac trunk proximally



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CT reformatted coronal view showing Collateral formation

IV. RESULTS:

S L. no.	Name/ ID	Age /sex	AE (in degrees	MA Lthickness(mm)	FA (foldangle) degree	Indendationsite	MAL lumbarlevel	Celiacaxis originlevel	Relationb/w MAL & celiacaxis origin	Poststenoticdilatation	% Stenosis	Pancreaticoduodenalarcadecollateralpathways
1	**1808260055**	58 /M	93	5.4	80	Osteo prox.	L2	L1	Below	yes	30%	No
2	**1902080019**	42 /M	38	6.6	85	Osteo prox.	L1	T12	Below	yes	25%	No
3	**1902160039**	22 /M	25	3.7	54	Proximal	L1	T12	Below	yes	60%	yes
4	**1801120047**	56 /M	11	6mm	94	Ostial stenosis	L1	L1	Below	yes	50%	No
5	**1801160072**	42 /M	35	5.5	82	Ostial	L1	T12	Same	No	20%	No
6	**1802210102**	50 /M	29	4mm	55	Ostial	L1	L1	Same	yes	60%	No
7	**1911230207**	21 /M	29	3.5mm	75	Focal osteoproximal	T12-L1	T12	Below	yes	50%	No
8	**2103260754**	29 /M	45	4mm	90	Ostial	L1	L1	Below	No	70%	No

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9	**1700010279**	53 /F	44	4.4	67	Proximal	L1(inf)	L1(mid)	Below	yes	70%	No
10	**2011200770**	68 /M	21	2mm	105	Proximal	L1	T12	Below	yes	50%	No
11	**2103120024**	20 /M	17	4.1	65	Ostial	L1	L1	Same	yes	70%	No
12	**1803270136**	42 /M	11	4.8	102	Ostial	L1	T12	Below	yes	50%	No
13	**1808100312**	33 /M	36	2.2	56	Ostial	T12	T12	Below	yes	60%	No
14	**1909160306**	27 /M	74	1.4	51	Ostial	L1	L1	same	No	20%	No
15	**1811250010**	58 /M	19	3.5	116	Osteo prox	T12	T12	Below	No	20%	No
16	**2007070107**	50 /M	19	2mm	111	Osteo Prox	L2	L1	Below	yes	20%	No
17	**1804300834**	50 /M	10	2mm	65	Osteo prox.	L1	T12	Below	yes	65%	No
18	**1911060034**	67 /F	50	2.5	61	Ostial	L1	L1	Same	yes	35%	No
19	**2104050990**	55 /F	22	4mm	71	Osteo prox.	L1	T12	Below	yes	50%	No
20	**2001060139**	45 /F	56	3.5	93	Ostial	L1	L1	Same	No	30%	No
21	**1811050264**	66 /M	26	7mm	91	Osteo prox	T12	T12	Below	No	25%	No
22	**2002080655**	51 /M	22	5mm	123	Ostial prox.	T12-L1	T12-L1	Same	Yes	30%	No

Stenosis rates obtained as a result of radiological investigations.[1]

Celiac artery stenosis	Stenosis 20-50% Stenosis 51-90%	16 (72.7%) 6 (27.2%)
Poststenoticdilatation	Total : 16	
Collateralvascularstructures	Total : 1	

- **Typical signs**: of MALS seen in a total of 22 (2.1%) patients.
- Out of them, were 18 (1.6%) were male and 4 (0.3 %) were female.
- **The mean age** : 45 years (range: 20 to 70 years)
- **The incidence in celiac artery stenosis**: 20% to 50% in 16 Patients (72.7%) & 51% to 90% in 6 patients (27.2%). Post-stenotic dilatation was reported in 16 patients (1.45%).
- **Collaterals**: observed in 1 Patient (0.09%).

Celiac axis compression (> 50%) luminal narrowing of the celiac artery by the MAL was found in 7 (0.63%)

V. CONCLUSION:

MALS is a rare vascular pathology. The diagnosis of median arcuate ligament syndrome in MDCT visualization made the diagnosis of MALS easy before the arrival of any clinical symptoms in asymptomatic individuals .

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