

Detection of Vertebral Level of Origin of Classical Celiac Trunk by Using 3D Multidetector Computed Tomography Angiography in Subset of Karachi Population

Rosheena Nabeel Khan¹, Sadaf Shaheen¹, Maria Mohiuddin², Nabeel Qutub Khan³, Tahir Hussain¹ and Abdul Rehman⁴

ABSTRACT

Objective: To evaluate the vertebral level of origin of Celiac Trunk by using Multidetector Computed Tomography Angiography (MDCTA).

Study Design: Cross-sectional study.

Place and Duration of Study: This study was conducted at the Radiology Department, Ziauddin University Hospital, Clifton Karachi, from March 2017 to August 2017.

Materials and Methods: Total 160 individuals was taken, 75 (46.9%) females and 85 (53.1%) males without any abdominal and vascular diseases who visited to Radiology Department, Ziauddin University Hospital, Clifton Karachi, for Abdominal 3D Computed Tomography Angiography. Subjects who were recruited in this study were referred to radiology department because of different indications like altered bowel habits, abdominal aches, adrenal and renal pathologies. In this study origin of celiac trunk at vertebral level was analyzed in both sexes. SPSS version 20 was used for statistical analysis. Data is showed in frequencies and percentages.

Results: At T12 vertebral level, classical celiac trunk was present in (37%) 49 out of 160 individuals while in 28 (21%) individuals classical celiac trunk found between T12- L1 level. In 24 (18%) individuals classical celiac trunk lies between T11-T12 vertebral levels. Classical celiac trunk in 17 (13%) individuals and 16 (12%) individuals were found at T11 and L1 vertebral levels respectively. There was no association were found between gender ($P= 0.592$).

Conclusion: The current study reports that classical celiac trunk found at T12 vertebral level in 37% individual and 12% at L1 level. Vertebral level of origin of celiac trunk between gender is not statistically significant.

Key Words: Multidetector computed tomography, anatomic variations, lymph nodes, celiac artery, Interventional.

Citation of article: Khan RN, Shaheen S, Mohiuddin M, Khan NQ, Hussain T, Rehman A. Detection of Vertebral Level of Origin of Classical Celiac Trunk by Using 3D Multidetector Computed Tomography Angiography in Subset of Karachi Population. Med Forum 2021;32(3):59-63.

INTRODUCTION

Celiac trunk is the first ventral visceral branch of abdominal aorta that arises at vertebral level of T12/L1, just below the aortic hiatus^(1, 2). Variations in the celiac trunk's vertebral level of origin requires individualization as it can influence when dealing with

treatment modality of carcinoma of stomach, pancreas & hepatobiliary tree because the draining lymph nodes at risk lie close to the vessel⁽³⁻⁵⁾

Interventional radiologists have to be cautious about the celiac trunk's position. In cases where insertion of catheter is necessary, vertebral level of origin of celiac trunk provides it as a landmark for proper localization and positioning of its orifice. When performing therapeutic and diagnostic angiographies, the interventional radiologists should be aware of different branching pattern and variations of celiac trunk⁽⁶⁾.

Celiac plexus lie at the vertebral level of origin of celiac trunk which consists of a dense network of ganglia is present on the anterolateral surface of aorta. Patients who present with upper abdominal carcinoma, chronic pancreatitis, agonizing retroperitoneal tumors and chronic abdominal aches are prescribed for celiac plexus block, if they are not responding to narcotic analgesia even in higher doses⁽⁷⁾.

Comprehensive radiological and anatomical assessment of level of origin of celiac trunk is essential for the diagnosis of celiac artery compression syndrome

¹. Department of Anatomy, United Medical and Dental College, Karachi.

². Department of Anatomy / Physiology³, Hamdard College Medicine and Dentistry, Karachi.

¹. Department of Anatomy, Sindh Medical University.

Correspondence: Dr. Rosheena Nabeel Khan, Assistant Professor of Anatomy, United Medical and Dental College, Karachi.

Contact No: 0322-2822855

Email: rosheenakhan12@gmail.com

Received: June, 2020

Accepted: November, 2020

Printed: March, 2021

(CACS) or median arcuate ligament (MAL) syndrome⁽⁸⁾. It is a rare disorder which is clinically characterized by postprandial intestinal pain (caused by insufficient blood supply to gastrointestinal organs), vomiting and weight loss⁽⁹⁾. CACS is external compression of celiac trunk by MAL. MAL also compress celiac ganglion⁽⁹⁾.

Carcinoma is one of the principal factor of death in Pakistan, and hepatobiliary cancers are the most common malignancies observed in male adults⁽¹⁰⁾. Gastric carcinoma is the 4th most common malignancy in world⁽¹¹⁾ and most common cancer in Asia⁽¹²⁾ while pancreatic cancer is the 11th most common cancer globally⁽¹³⁾. Lymph node removal is essential for gastric⁽¹²⁾ and pancreatic cancers⁽¹⁴⁾. Identification of vascular variations is important preoperatively because vessels are considered to be the landmark for lymph node removal⁽¹²⁾.

It is fundamental to know the level of origin of celiac trunk when dealing with hepatic tumors and liver transplant surgeries. The median arcuate ligament connects the diaphragmatic crura on each side of the aortic hiatus. The median arcuate ligament is found at T12 - L1 level and bridges the crura of the diaphragm just anterior to the aorta⁽¹⁾. The ligament usually passes superior to the origin of the celiac axis⁽¹⁵⁾ (Figure 1 A). A low insertion of median arcuate ligament or high origin of celiac trunk may cause extrinsic compression⁽³⁾ (Figure 1 B).

Celiac artery compression syndrome (CACS) or Median arcuate ligament (MAL) syndrome has clinical and anatomical importance in which celiac axis extrinsic compression may lead to, nausea or vomiting, postprandial epigastric aches and weight loss (often related to "food fear" or fright of pain provoked by eating). Symptoms may be due narrowing and compression of the celiac axis, which leads to compromise in flow of blood. Patients with this syndrome, in most cases need surgery to achieve celiac trunk decompression where detailed anatomy of this region is essential⁽⁸⁾ as MAL syndrome is related to level of origin of celiac trunk⁽¹⁶⁾.

Knowledge of level of origin of celiac trunk is important during celiac plexus block and lymph nodes removal during upper abdominal visceral malignancies⁽⁷⁾. To block this plexus, the celiac trunk is a landmark for needle placement⁽¹⁷⁾, so it is important to know the exact anatomic position of celiac trunk in terms of vertebral level of origin for localization of celiac plexus.

MATERIALS AND METHODS

It is a cross-sectional study which was performed from March 2017 to August 2017. Samples were collected through Non-probability convenience sampling technique. A sample size of 138 subjects were calculated by using WHO sample size calculator

keeping prevalence at 10%^{3,17,18}, with bound of error at 5% and confidence level of 95%. Sample size was 160 where, $n = z^2 P(1-P)/d^2$ where n = number of samples, z = standard error of mean, P = prevalence and d = absolute precision. Formula used was $N = z^2 pq/d^2$, with Prevalence 10%, Precision 0.05 and Confidence level 95%. In this study 160 individual were taken, aged between 20-60 years. Patients who were recruited in this study was referred to the radiology department for abdominal contrast CT (computed tomographic) examination for various indications. Persons having age between 20-60 years (males and females) with serum creatinine level of less than 1.4mg/dl with no hepatobiliary pathologies, pancreatic or abdominal vascular lesions were included in the study. Patients having pancreatic or abdominal vascular lesions, hepatobiliary pathologies, or previous history of liver transplants, any history of upper abdominal malignancies and surgeries, abdominal malignancy distorted vascular anatomy, atherosclerosis and vasculitis were excluded. Persons having previous history of any allergic reaction to contrast agents and pregnant women were excluded from this study

This study was conducted after approval from Ethics Review Committee of Ziauddin University. Informed consent was obtained from each participant and a questionnaire based on their demographic profile, including age, gender and medical/surgical history was filled out. MDCTA (multidetector computed tomographic angiography) of abdominal aorta was taken. All CT examinations were performed on a 16-slice MDCT (multidetector computed tomographic) scanner (Toshiba 16 slicer Alexion, Japan) using the automatic dose modulation technique (Real Exposure Control, Toshiba Medical Systems) in the arterial phase. Contrast material was administered. The subject was asked to lie in supine position on the platform of CT scanner and was instructed to hold his/ her breath for 15 seconds and then the scan was initiated. In order to define the arterial pattern, analysis was performed in axial plane with reconstruction techniques in the coronal and sagittal planes in multiplanar reformatting images (MPR), as well as by 3D reconstruction with maximum intensity projection (MIP) and volume rendered (VR) techniques. The slice thickness was taken as 5 mm to evaluate the origin of coeliac trunk and its branches. Images were acquired from the dome of the diaphragm to the pubic symphysis in craniocaudal fashion.

Data was analyzed on SPSS version 20. Frequencies and percentages were calculated for level of origin of coeliac trunk. In order to identify the level of origin of celiac trunk, vertebrae was observed in craniocaudally fashion in coronal, axial and sagittal plane. 12th rib was also considered which is attached to 12th thoracic vertebra in an axial plane (Figure 2).

RESULTS

Vertebral Level of Origin of Celiac Trunk: Classical celiac trunk was found at T12 vertebral level in 49 individuals (37%), between T12-L1 vertebral level in 28 individuals (21%), between T11-T12 vertebral level in 24 individuals (18%), at T11 vertebral level in 17 individuals (13%) and at L1 vertebral level in 16 individuals (12%) (Table 1). No significant association was found between gender ($P=0.592$) (Table 2).

Table No.1: Frequencies of different level of origin of celiac trunk

Level of origin of classical CT	n (%)
T11	17 (13%)
T12	49 (37 %)
T11 to T12	24 (18%)
T12 to L1	28 (21%)
L1	16 (12%)

CT (Celiac Trunk), n=number of individuals.

Table No.2: Frequencies of different levels of origin of celiac trunk with respect to gender

Level of origin of CT	Males	Females	p-Value
T11	6(35.3)	11(64.7)	0.592
T12	28(57.1)	21(42.9)	
T11 to T12	14(58.3)	10(41.7)	
T12 to L1	15(53.6)	13(46.4)	
L1	9(56.2)	7(43.8)	

CT (Celiac Trunk). p-value ≤ 0.05 was considered significant.

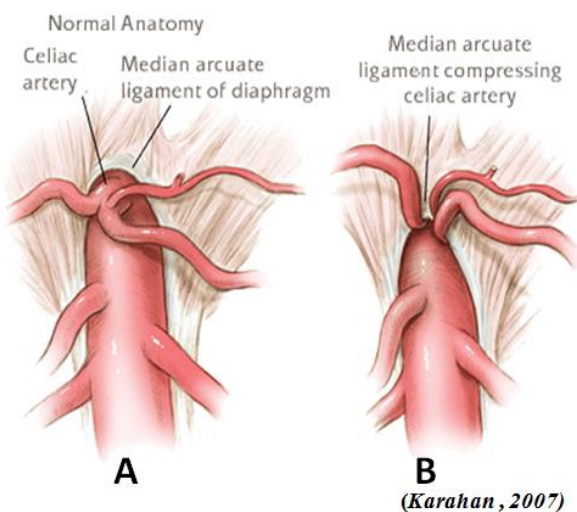


Figure No.1 A: Showing(normal) anatomy of median arcuate ligament (MAL) of diaphragm B: Showing (abnormal) anatomy of median arcuate ligament compressing celiac trunk.



Figure No.2: Showing MDCT scan (MPR) and (MIP) sagittal contrast CT enhanced image depicts Celiac Trunk originate at T12 vertebral body.

DISCUSSION

Variation found in vertebral level of origin of celiac trunk needs individualization which can influence when dealing with treatment planning of carcinoma of stomach, pancreas & hepatobiliary tree as the lymph nodes at risk lie adjacent to this vessel^{(3)(4, 5)}.

Interventional radiologist should be aware of the position of the celiac trunk as the vertebral level could serve as a landmark for the localization of its orifice in cases where a catheter is to be inserted into it⁽⁶⁾.

The celiac plexus (CP) is deeply located in the retroperitoneum, overlying the anterolateral surface of the aorta, at the level of the celiac trunk, comprising a dense network of ganglia that varies considerably in size, number and positioning^(7, 18), between the levels of T12-L1 disc space and L2⁽¹⁹⁾.

Our results showed that classical celiac trunk was found most frequently at T12 vertebral level i.e. in 49 out of 134 individuals (37%). Our results are comparable to other studies conducted in India and New York where the frequency of vertebral level of celiac trunk origin was found to be at T12 level in (40%) and (34%) individuals respectively^{(5), (17)}. Study conducted in Turkey also showed most frequent level of origin of celiac trunk at T12 (in 79.8% individuals). However, our results are in contrast with those of studies done on Albanian and Thai population where T12 was found to be the 2nd most frequent level of origin of celiac trunk⁽²⁰⁾.

We found 2nd most frequent level of origin of classical celiac trunk between T12-L1 vertebral level i.e. in 28 out of 134 individuals (21%). Comparable frequencies of celiac trunk origin between T12-L1 in Indian and American population⁽⁵⁾.

In the present study 18% individuals showed 3rd most frequent level of origin of classical celiac trunk between T11-T12 intervertebral disc. Similar results have been reported in an Indian study⁽⁵⁾.

In the present study 13% individuals showed the level of origin of classic celiac trunk at T11 vertebral level. A study conducted in Turkey showed 3.8% frequency of celiac trunk origin at T11 vertebral level⁽²¹⁾. We could not find any other study reporting the origin of celiac trunk at T11 vertebral level.

In the present study the lowest frequency of level of origin of celiac trunk was found to be at L1 vertebral level in 12% of our sample. An Indian study has also reported comparable frequency of origin of celiac trunk at L1 vertebral level i.e. in 12% individuals⁽⁵⁾. A study conducted on Thai population also showed frequency of L1 vertebral level of celiac trunk origin to be the lowest in their study⁽²²⁾. However, a previous study from USA showed the level of origin of classical celiac trunk at L1 vertebral level to be the 3rd most frequent level in their study with the frequency of 28.5%⁽¹⁷⁾.

Our results showed that level of origin of celiac trunk did not show any significant difference between gender. A previous study also did not show any significant difference between gender in vertebral level of emergence of celiac trunk⁽⁷⁾.

CONCLUSION

This is the first study conducted in Pakistan on vertebral level of origin of Celiac trunk on MDCTA. From the above discussion it has been evident that level of origin of celiac trunk showed variations among different populations and ethnic groups. Our results are closer to Indian population. Thus, we suggest that level of origin of celiac trunk should be evaluated on MDCTA carefully before any laparoscopic procedures.

Author's Contribution:

Concept & Design of Study: Rosheena Nabeel Khan
Drafting: Abdul Rehman, Nabeel Qutub Khan

Data Analysis: Tahir Hussain, Sadaf Shaheen

Revisiting Critically: Rosheena Nabeel Khan,
Final Approval of version: Maria Mohiuddin

Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Borley NR. Abdomen and Pelvis. In: S S, editor. Gray's Anatomy The Anatomical basis of clinical practice. Fortieth ed 2008.p.1073-193.
2. Hiremath R, Aishwarya K, PAILOOR A. CT angiographic diagnosis of hepatosplenomesenteric trunk—a rare variation. 2014.
3. Özbülül NI. CT angiography of the celiac trunk: anatomy, variants and pathologic findings. Diagnostic and Interventional Radiol 2011; 17(2):150.
4. Ms. Pooja Pant RM, Haritha Kumari N, Dr.Aruna Mukherjee. Variant Anatomy of the Coeliac Trunk and Its Branches. GRA - Global Research Analysis 2013;2(6):179-80.
5. Hafezji HM, Gupta DS. A study of morphometric variations of celiac trunk using computed tomographic angiography. Ind J Clin Anatomy and Physiol 2016;3(1):86-90.
6. Panagouli E, Venieratos D, Lolis E, Skandalakis P. Variations in the anatomy of the celiac trunk: a systematic review and clinical implications. Annals of Anatomy-Anatomischer Anzeiger 2013;195(6):501-11.
7. Pereira GAM, Lopes PTC, Santos AMPVd, Pozzobon A, Duarte RD, Cima AdS, et al. Celiac plexus block: an anatomical study and simulation using computed tomography. Radiologia brasileira. 2014;47(5):283-7.
8. Karahan OI, Kahriman G, Yikilmaz A, Ok E. Celiac artery compression syndrome: diagnosis with multislice CT. Diagn Interv Radiol 2007;13(2):90-3.
9. Chou JW, Lin CM, Feng CL, Ting CF, Cheng KS, Chen YF. Celiac artery compression syndrome: an experience in a single institution in Taiwan. Gastroenterol Research Practice 2012;2012.
10. Badar F, Mahmood S. Hospital-based cancer profile at the Shaukat Khanum Memorial Cancer Hospital and Research Centre, Lahore, Pakistan. J Coll Physicians Surgeons Pakistan 2015;25(4):259-63.
11. Daniyal M, Ahmad S, Ahmad M, Asif HM, Akram M, Ur Rehman S, et al. Risk factors and epidemiology of gastric cancer in Pakistan. Asian Pac J Cancer Prev 2015;16:4821-4.
12. Osaki T, Saito H, Murakami Y, Miyatani K, Kuroda H, Matsunaga T, et al. Usefulness of preoperative assessment of perigastric vascular anatomy by dynamic computed tomography for laparoscopic gastrectomy. Yonago Acta Medica 2015;58(4):157.

13. Ilic M, Ilic I. Epidemiology of pancreatic cancer. *World J Gastroenterol* 2016;22(44):9694.
14. Lee H, Heo JS, Choi SH, Choi DW. Extended versus peripancreatic lymph node dissection for the treatment of left-sided pancreatic cancer. *Annals Surgical Treatment and Res* 2017;92(6):411-8.
15. Horton KM, Talamini MA, Fishman EK. Median arcuate ligament syndrome: evaluation with CT angiography. *Radiographics* 2005;25(5):1177-82.
16. Gümüş H, Gümüş M, Tekbaş G, Önder H, Ekici F, Çetinçakmak MG, et al. Clinical and multidetector computed tomography findings of patients with median arcuate ligament syndrome. *Clinical Imaging* 2012;36(5):522-5.
17. Yang IY, Oraee S, Viejo C, Stern H. Computed tomography celiac trunk topography relating to celiac plexus block. *Regional Anesthesia and Pain Med* 2011;36(1):21-5.
18. Kambadakone A, Thabet A, Gervais DA, Mueller PR, Arellano RS. CT-guided celiac plexus neurolysis: a review of anatomy, indications, technique, and tips for successful treatment. *Radiographics* 2011;31(6):1599-621.
19. Nitschke AM, Ray Jr CE, editors. *Percutaneous neurolytic celiac plexus block. Seminars in interventional radiology: Thieme Medical Publishers*; 2013.
20. Marjeta Tanka EA. Anatomical Variations of Celiac Trunk Anatomy and their Clinical Importance *Int J Sci Res (IJSR)* 2015;4(12):12-4.
21. Sürücü H, Oto A, Gokoglu A, Celik H, Ozdemir B, Besim A. Anatomy of the celiac trunk examined by CT imaging of 104 individuals. *Morphologie: bulletin de l'Association des anatomistes* 2003;87(277):33-5.
22. Chanasong R, Putiwat P, Roboon J, Sakulsak N. Accessory hepatic artery arising from celiac trunk: an incidence in a Thai cadaver. *Int J Morphol [Internet]* 2014:1136-39.