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Original Article

Radiology Section

Clinical Significance of Celiac Trunk and Superior Mesenteric Artery Diameter Following Computed Tomography

SIDDARTH RAGUPATHI[1], GOWRISH PREM KUMAR[2]

ABSTRACT

Introduction: The celiac trunk and superior mesenteric arteries are the first and second anterior branches of the abdominal aorta. Knowledge of the anatomy and dimensions of these vessels is mandatory for interventional radiologists and vascular surgeons. There are a number of anatomical variations of the celiac trunk.

Aim: To evaluate whether there is an alteration in the dimension of the celiac trunk and the distance between celiac trunk and Superior Mesenteric Artery (SMA) in the presence of anatomical variants.

Materials and Methods: This cross-sectional study was conducted on 150 patients who were referred to the Radiology Department for Contrast Enhanced Computed Tomography (CECT) of the abdomen between September 2019 to February 2020. The diameter of the celiac trunk, SMA and the distance between celiac trunk and SMA were measured. Those who had previous history of any abdominal surgeries or mass lesions were excluded from the study.

Results: Celiac trunk variants were observed in 39 patients in our study. The mean diameter was 6.57±1.35 mm in those with normal celiac axis anatomy as compared to a mean of 6.82±1.53 mm in patients with variants (p=0.33). The mean diameter of the SMA was 14.28±7.07 mm in females whereas in males it was 11.88±5.21 mm. The distance between the celiac trunk and SMA was 21.92±7.96 mm in those with normal celiac trunk anatomy and 22.29±5.95 mm in those with a variant anatomy (p=0.79).

Conclusion: There is no difference in the dimension of the celiac trunk and distance between celiac trunk and SMA in the presence of anatomical variants. This is important for planning interventional procedures involving cannulation, stenting and anastomosis of the vessel.

Keywords: Aorta, Gastric artery, Hepatic artery, Intervention, Splenic artery, Vascular

INTRODUCTION

The celiac trunk and superior mesenteric arteries are the first and second anterior branches of the abdominal aorta. The celiac trunk arises at the level of first lumbar vertebra while the SMA arises a few centimetres below it. Sometimes they arise from a common trunk known as the celiaco-mesenteric trunk [1]. The hepatic artery, gastric and splenic arteries commonly arise from the celiac trunk. There are a number of variations in the origin of these branches like gastric artery originating from aorta, absence of a proper hepatic artery with trifurcation of common hepatic artery into right and left hepatic and gastroduodenal arteries [2]. Some of other variants are middle colic artery originating from celiac trunk, right hepatic artery from SMA etc., [2].

Knowledge of the anatomy and dimensions of these vessels is mandatory for interventional radiologists and vascular surgeons. It is important for the vascular surgeons to know the vessel dimensions and length in order to perform anastomosis and also to select appropriate catheter size for procedures such as stenting. There are many studies determining the prevalence of variations in the celiac trunk branches and the diameters of the celiac trunk and its branches [3-11]. But there is paucity of studies available to determine the significance of diameter of the celiac trunk and its branches in normal and anatomical variant except for one cadaveric study [2]. The present study is aimed to evaluate whether there is a clinically significant change in the dimension of the celiac trunk and the distance between celiac trunk and SMA in the presence of anatomical variants.

MATERIALS AND METHODS

This cross-sectional study was conducted in Vinayaka Mission Medical College, Karaikal from September 2019 to February 2020 after obtaining approval from the Institutional Ethical Committee.

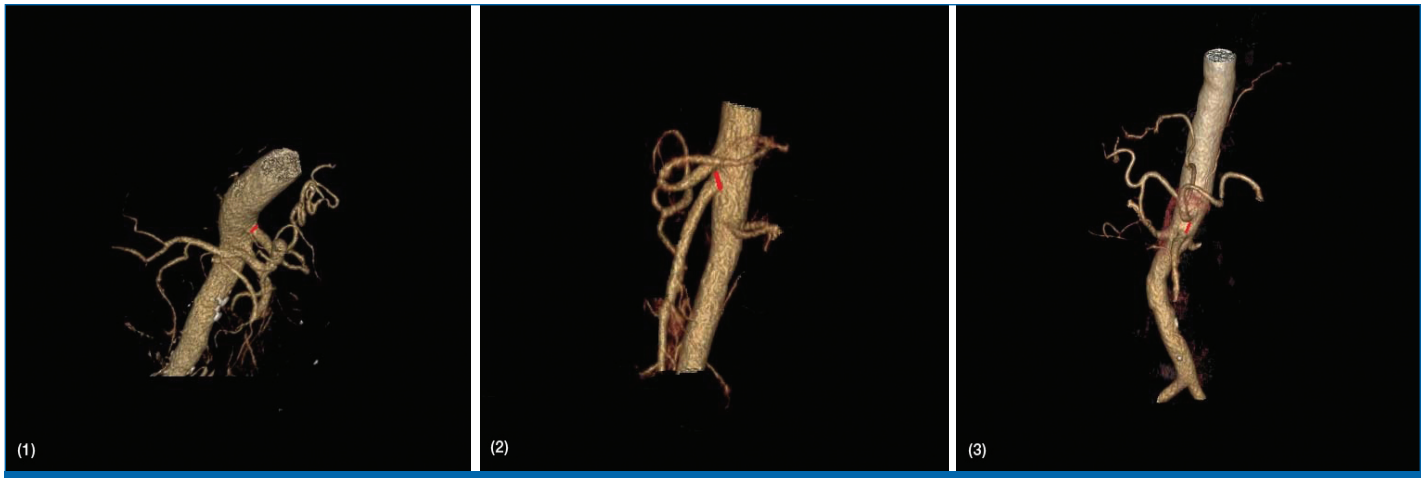
Inclusion and Exclusion criteria: A total of 150 consecutive patients (aged 20-60 years) who were referred for a Contrast Enhanced Computed Tomography (CECT) of the abdomen with any clinical indication like abdominal pain etc., were selected. However, those patients with previous history of abdominal surgeries and those with suspected cirrhosis, upper abdominal mass lesions were excluded from the study.

All CT examinations were performed using a 16-slice Multidetector Computed Tomography (MDCT) scanner (Medical Health Care GE Work Station RDW 4.3, GE, USA). Technical features of MDCT were as follows: 16 mm×1 mm collimation, minimum slice thickness of 0.625, gantry rotation time of 320 ms, kV of 120 and mAs of 320. A bolus of 80-100 mL of non-ionic iodinated contrast agent (ultravist-300) followed by 50-60 mL of normal saline was injected by means of an 18-gauge intravenous catheter through an antecubital vein or a vein in the forearm at a flow rate of 4-6 mL/seconds.

The celiac trunk dividing into common hepatic, left gastric and splenic arteries includes the normal anatomy while the variant anatomy includes the origin of any of these branches from aorta or SMA or common celiaco-mesenteric trunk etc., [2]. A total of 150 patients were included in the study in which the celiac axis anatomy and its diameter, SMA diameter and the distance between the two were measured using the arterial phase sequence. The diameter of the celiac artery and SMA were measured at its origin and the distance between them was measured using 3D reconstruction and multiplanar reformation, maximum intensity projection and volume rendering images by two separate experienced radiologists [Table/Fig-1-3].

STATISTICAL ANALYSIS

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS version 23.0). Independent t-test was used to compare the mean diameters and dimensions between the two



[Table/Fig-1]: A 3D reconstructed image of the abdominal aorta depicting measurement of the celiac trunk diameter at its origin.
[Table/Fig-2]: A 3D reconstructed image of the abdominal aorta depicting measurement of Superior Mesenteric Artery (SMA) diameter at its origin.
[Table/Fig-3]: A 3D reconstructed image of the abdominal aorta depicting measurement of distance between the celiac trunk and the Superior Mesenteric Artery (SMA) between the inferior margin of the celiac trunk and the superior margin of the SMA. (Images from left to right)

groups (the normal anatomy and variant anatomy groups). The p-value <0.05 was considered statistically significant.

RESULTS

A total of 150 patients were included in which 77 male and 73 female patients were there. About 39 patients had variant anatomy for the celiac trunk and its branches and 111 patients had normal anatomy of the celiac trunk. In 18 patients left hepatic artery orignating from left gastric artery was found, which was most common variant anatomy. The left gastric artery was found to be arising from abdominal aorta in seven patients, accessory splenic artery from left gastric artery in six patients and four patients each had the right hepatic artery originating from SMA and left hepatic artery arising directly from the celiac artery.

The celiac trunk diameter measured between 3.6 and 10.9 mm with a mean of 7.06±1.47 mm in males and mean of 6.19±1.18 mm in females [Table/Fig-4,5].

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Celiac trunk diameter	77	3.6	10.9	7.065	1.4774
Celiac trunk to SMA distance	77	6.4	37.5	21.610	8.3666
SMA Diameter	77	3.0	25.0	11.881	5.2132

[Table/Fig-4]: Diameter of celiac trunk, Superior Mesenteric Artery (SMA) and the distance between the two vessels in males.

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Celiac trunk diameter	73	3.0	8.3	6.193	1.1801
Celiac trunk to SMA distance	73	5.7	33.1	22.447	6.4362
SMA Diameter	73	4.0	33.0	14.288	7.0736

[Table/Fig-5]: Diameter of celiac trunk, Superior Mesenteric Artery (SMA) and the distance between the two vessels in females.

Patients having normal anatomy of celiac axis were found to have a mean diameter of 6.57±1.35 mm and those with a variant anatomy had 6.82±1.53 as their mean diameter which was not significant (p-value=0.33) [Table/Fig-6]. Similarly, the distance between celiac trunk and SMA was 21.92±7.96 mm in those with normal celiac trunk anatomy and 22.29±5.95 mm in those with a variant anatomy. This was not statistically significant [Table/Fig-7].

Celiac trunk anatomy	N	Mean	Std. Deviation	Std. Error mean	p-value
Normal	111	6.575	1.3589	0.1290	0.335
Variant	39	6.828	1.5360	0.2460	

[Table/Fig-6]: Diameter of the celiac trunk in relation to its anatomy.
Independent t-test used

Celiac trunk anatomy	N	Mean	Std. Deviation	Std. Error mean	p-value
Normal	111	21.921	7.9638	0.7559	0.790
Variant	39	22.292	5.9567	0.9538	

[Table/Fig-7]: Distance between celiac trunk and Superior Mesenteric Artery (SMA) in relation to anatomy.
Independent t-test used

DISCUSSION

There are a few studies that detail the relation between the celiac artery variants and the celiac artery diameter. A study by Silveira LA et al., measured the celiac artery diameter and found that there is a mild reduction in the diameter in the presence of a variant anatomy of the celiac axis [2]. In this study, there is actually a mild increase in the celiac trunk diameter and the distance between the celiac trunk and SMA among the patients with variant anatomy. However, it is not significant though.

In 2014, Yadav SP et al., has done a cadaveric study on the celiac trunk variations and the diameters of various abdominal aortic branches including the distance between the celiac trunk and SMA [12]. The significance of anatomical variants and the diameters of these vessels was not reported in their study. The morphometry of celiac trunk including its distance from SMA as well as diameter of SMA was evaluated by Tanka M and Abazaj E, in 2015 [3]. They included 133 patients and they found the celiac artery length to be 1.17 to 4.5 cm, diameter: 0.4 to 1.13 cm; distance from SMA: 0.4 to 2.15 cm; while the diameter ranges of SMA: 0.51 to 1.05 cm which is similar to the values obtained in our study.

There are a lot of studies done by both anatomists and radiologists regarding the prevalence of celiac axis anatomical variations and diameters of the abdominal aortic branches across various parts of the country and the world [2-8]. A study by Prakash et al., found prevalence of variations in celiac trunk branches found the origin of the gastric artery proximal to the bifurcation of the coeliac trunk into the common hepatic and splenic arteries in 76% of cadavers [4]. In this study, the most common variant was found to be the left hepatic artery originating from left gastric artery in 18 cadavers. Sankar KD et al., reported a rare variation of the celiac trunk dividing into hepato-gastric and hepato-splenic trunk and its branches [13].

To the best of our knowledge, this study is the first study describing the celiac trunk and SMA diameters in the South Indian population. This data on vessel diameters will be useful for early identification of aneurysms in this population. This data will also be useful for interventional radiologists and surgeons in case of procedures such as liver transplantation and other abdominal surgeries which might require vessel anastomosis or stenting.

Limitation(s)

Limitation of our study is the small sample size. A larger prospective study would be required in order to generalise our findings.

CONCLUSION(S)

There is only a minimal increase in the celiac trunk diameter and the distance between the celiac trunk and SMA in the presence of anatomical variants. This knowledge will be useful in abdominal surgeries involving anastomosis of these vessels, stenting and organ transplantation.

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PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Radiology, Vinayaka Mission Medical College, VMRF, Karaikal, Pondicherry, India.
2. Assistant Professor, Department of Radiology, Vinayaka Mission Medical College, VMRF, Karaikal, Pondicherry, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Siddarth Ragupathi,
10/25, Banadurai South Street, Kumbakonam, Tamil Nadu, India.
E-mail: rsidd1111@gmail.com

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