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VARIATION ASSESSMENT OF COELIAC TRUNK BRANCHING PATTERN IN CHANGED BOWEL HABITS, ABDOMINAL PAIN & KIDNEY/ADRENAL PATHOLOGIES PATIENTS

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Abstract:

Objective: *To assess frequency variations in coeliac trunk branching pattern with the help of 3D Multi-Detector Computer Tomographic Angiography in the subjects affected with changed bowel habits, abdominal pain and kidney or adrenal pathologies.*

Method: *Our cross-sectional research was conducted on 160 patients in the age bracket of (20 – 60) years without the incidence of abdominal pain at Services Hospital, Lahore (February, 2016 to September, 2018) in department of Radiology for abdominal 3-dimensional multi-detector computed tomographic angiography. Non-probability convenience sampling technique was used to collect the samples. The inclusion criteria were the subjects who were having pancreatic or abdominal vascular lesions and possess serum creatinine levels less than 1.4 mg/ dl with no hepatobiliary pathologies. The exclusion criterion was those patients who were affected by vasculitis, abdominal malignancy distorting vascular anatomy and atherosclerosis. The subjects who were having history of allergic reaction to contrast agents, having history of liver transplant or upper abdominal surgeries and ladies who were pregnant were also dropped from the study. Uflacker's classification was utilised to classify Coeliac trunk variations into eight types. SPSS was used for Statistical analysis. Frequencies and percentages were used for data presentation.*

Results: *The presence of Classical coeliac trunk (type I) was seen in one hundred and thirty-four (83.9 %) subjects from the total subject population. Coeliac trunk variations were manifested in twenty-six (16.1 %) subjects. Type V and II were 2nd commonest variations in nine cases each with 5.6 %. they were followed by five cases of type VII with the percentage of 3.1. Type III, IV and VI demonstrated variations in one (0.6 %) subject each with the percentages of 0.6. We did not find any indication of Type VIII in our study.*

Conclusion:

This study has indicated normal configuration of coeliac trunk (classic or type I coeliac trunk) in 83.9 % subjects. coeliac trunk variations were reported in 16.1 % subjects.

Key Words: *Laparoscopy, arterial-venous anastomosis, multi-detector computed tomography, celiac artery, anatomic variations.*

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INTRODUCTION:

In order to carry out different clinical, diagnostic and surgical procedures, the physicians and radiologists are required to be conversant with upper abdominal vascular anatomy [1]. Anatomical changes of coeliac trunk are of poignant importance in various clinical complications such as radiological abdominal interventions, liver transplants, penetrating injuries to the abdomen and laparoscopic surgery [2]. Resultantly, it is imperative to have know-how of coeliac trunk and related variations taking a toll on a certain population [3]. The first anterior visceral branch of abdominal aorta is coeliac trunk. It comes up just under the aortic hiatus at T12/L1 vertebral level [3, 4]. There are 3 classical branches of coeliac trunk. They are named as common hepatic, splenic artery and left gastric [5]. Earlier conducted studies have proved that coeliac trunk variations are embryological in its foundation. The single Pakistani based research has demonstrated anatomic variations of coeliac trunk in 11.8 cases [6]. A longitudinal anastomosis takes place amongst 4 roots of vitelline arteries or omphalomesenteric artery. The 2 roots in the centre vanish however a longitudinal anastomosis connects fourth and first roots. Splenic, left gastric and hepatic arteries arise from this longitudinal anastomosis [7, 8]. Fourth root is normally detached from longitudinal anastomosis that develops future superior mesenteric artery. When such division takes place at a more proximal level, one of the branches is displaced to superior mesenteric artery. When there is disappearance of fourth and first root, a coeliac mesenteric trunk is developed [7, 9-11]. Any faulty fusion of omphalomesenteric arteries may potentially display variations in the course of embryonic phase [12]. There is a dire need of immaculate coeliac trunk description and its branches to evade vascular injuries during upper abdominal laparoscopic surgeries. Such descriptions are of vital importance for physicians in the overall wellbeing of patients. Since MDCTA has proved to be carrying perfect modality, it is a replacement for traditional angiography for preoperative imaging [13]. It has different positive aspects such as imaging acquisition speed, increase in high spatial resolution and expanded patient coverage [14]. Multi-Detector computed tomography angiography is a useful tool when used with digital images processing by software means as it is quite appealing due to its non-invasiveness [15]. With the invention of CT technology, the conditions such as coeliac trunk variations and pathologies are diagnosed in great numbers. In the patients with pancreatic and hepatobiliary neoplasms, CT angiography is used noninvasively for preoperative staging and vascular mapping. MDCTA is useful in the immaculate description of atherosclerotic plaques, collateral vessels and abdominal splanchnic vessels' stenosis [15].

METHODS:

Our cross-sectional research was conducted on 160 patients in the age bracket of (20 – 60) years without the incidence of abdominal pain at Services Hospital, Lahore (February, 2016 to September, 2018) in department of Radiologyfor abdominal 3-dimensional multi-detector computed tomographic angiography. fNon-probability convenience sampling technique was used to collect the samples. WHO sample size calculator was utilised to calculate a sample size of one hundred and thirty-eight subjects in which prevalence was kept at ten percent, limit of error at five percent and confidence level ninety-five percent [3, 17, 18]. In order to have valid results, sample size was enhanced to one hundred and sixty cases $n = z^2P(1-P)\ d^2$ in which z= standard error of mean, n= number of samples, d= absolute precision and P= prevalence. 160 was total sample in the study. $N= z2pq/d^2$ was the formula used in which Confidence level 95 % and Precision as 0.05. The inclusion criteria were the subjects who were having pancreatic or abdominal vascular lesions and possess serum creatinine levels less than 1.4 mg/ dl with no hepatobiliary pathologies [18]. The exclusion criterion was those patients who were affected by vasculitis, abdominal malignancy distorting vascular anatomy and atherosclerosis. The subjects who were having history of allergic reaction to contrast agents, having history of liver transplant or upper abdominal surgeries and ladies who were pregnant were also dropped from the study. The study at hand was approved by Ethics Review Committee. Each subject was asked for informed consent. A questionnaire which was based on demographic profile such as medical/surgical history, gender and age was filled accordingly. Multi-detector computed tomographic angiography (MDCTA) was carried out. By using automatic dose modulation technique (Real Exposure Control, Toshiba Medical Systems) in the arterial phase, all CT examinations were executed on a sixteen-slice MDCT (multi-detector computed tomographic) scanner (Toshiba 16 slicer Alexion, Japan). Administration of contrast material was carried out. Supine position was adopted by the subjects on CT scanner platform. Instructions regarding holding the breath for fifteen seconds were passed. Scan initiation followed it. To define the arterial pattern, analysis was executed in axial plane with reconstruction techniques in the sagittal and coronal planes in multi-planar reformatting images (MPR), along with three dimensional reconstructions with volume rendered (VR) and maximum intensity projection (MIP) techniques. Five millimetres were

the thickness of slice in order to assess coeliac trunk and its branches. Attainment of the Images was carried out from the dome of the diaphragm to the pubic symphysis in craniocaudally fashion. Numerous classifications regarding coeliac trunk variations have been suggested in literature. Recently, common usage of Uflacker's classification is reported in the year 1997 [2, 19]. According to him, branching pattern of coeliac trunk variations was classified into eight types.

SPSS was used for Statistical analysis. Calculation of frequencies and percentages was ensured in connection with coeliac trunk branching variations including gastro splenic trunk, coeliac-mesenteric trunk, classic coeliac trunk, hepato-gastric trunk, hepato-splenic trunk, coeliac-colic trunk, no coeliac trunk and hepato-splenomesenteric trunk.

RESULTS:

From the total sample of one hundred and sixty subjects the trifurcation of coeliac trunk (classic coeliac trunk) was observed in one hundred and thirty-four (83.9 %) cases. Coeliac trunk variations were manifested in twenty-six (16.1 %) subjects. In order to classify the variations, Uflacker's classification was used. Gastro-splenic and hepato-splenic trunk) were 2nd commonest variations in nine cases each with the percentage of 5.6 each. They were followed by five cases of type VII (coeliac-colic trunk) with the percentage of 3.1. Type III, IV and VI demonstrated variations in one (0.6 %) subject each with 0.6 %. We did not find any indication of Type VIII (coeliac-colic trunk) in our study.

Table – I: Uflacker's Classification

Types	Description
Type I	Classic coeliac trunk
Type II	Hepatosplenic trunk
Type III	Hepatogastric trunk
Type IV	Hepatosplenomesenteric
Type V	Gastrosplenic trunk
Type VI	Coeliac-mesenteric
Type VII	Coeliac-colic trunk Type VIII No coeliac trunk

Table – II: Frequencies of different types of coeliac trunk in our population according to Uflacker's classification

Types	Description	No	Percentage
Type I	Classic coeliac trunk	134	83.9
Type II	Hepatosplenic trunk	9	5.6
Type III	Hepatogastric trunk	1	0.6
Type IV	Hepatosplenomesenteric	1	0.6
Type V	Gastrosplenic trunk	9	5.6
Type VI	Coeliac-mesenteric	1	0.6
Type VII	Coeliac-colic trunk	5	3.1
Type VIII	No coeliac trunk	0	0

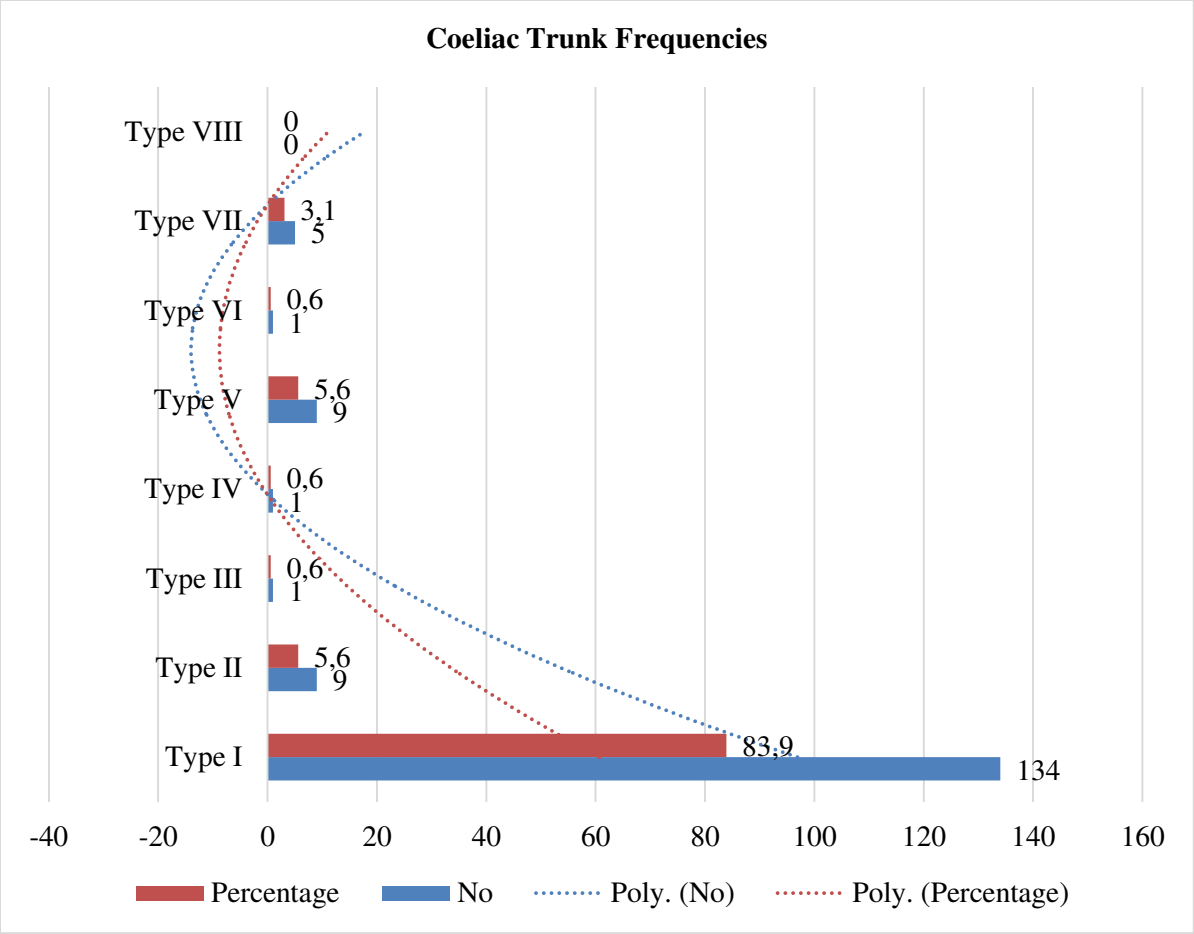
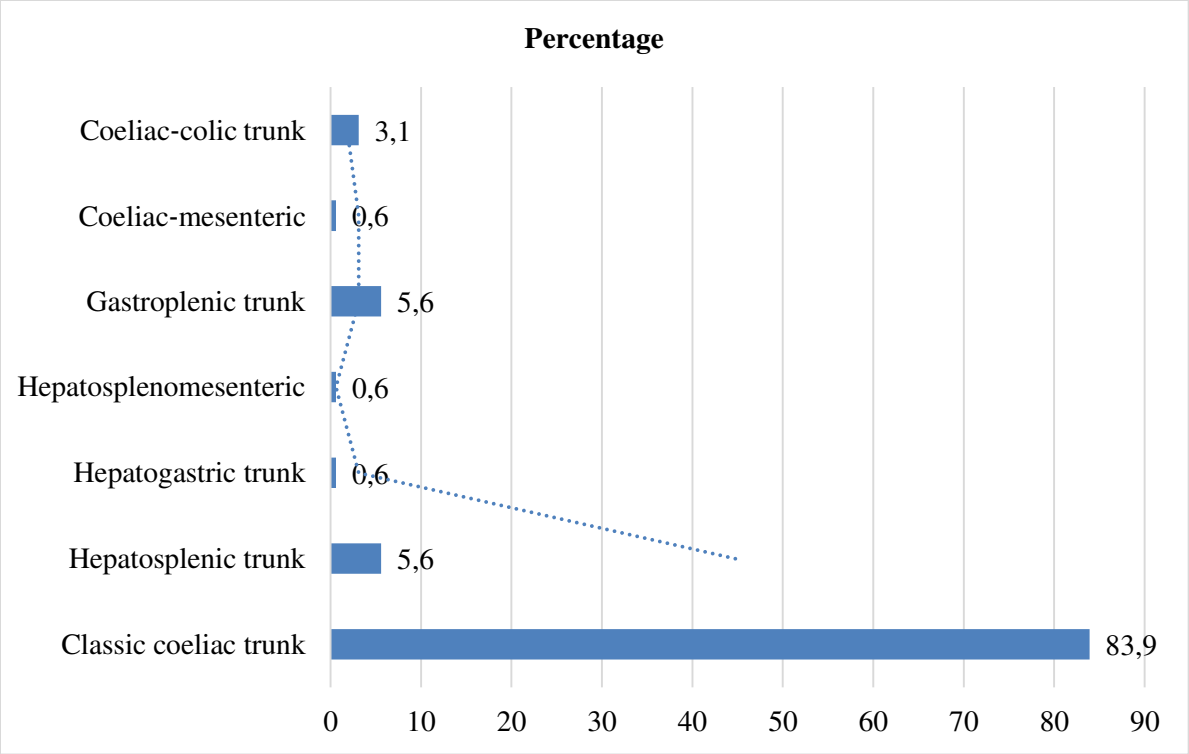


Table – III: Coeliac trunk type variation

Coeliac Trunk Types	Percentage
Classic coeliac trunk	83.9
Hepatosplenic trunk	5.6
Hepatogastric trunk	0.6
Hepatosplenomesenteric	0.6
Gastroplenic trunk	5.6
Coeliac-mesenteric	0.6
Coeliac-colic trunk	3.1



DISCUSSION:

The aim of the study at hand was to assess frequency variations in coeliac trunk branching pattern with the help of 3D Multi-Detector Computer Tomographic Angiography in the subjects affected with changed bowel habits, abdominal pain and kidney or adrenal pathologies. It was expected that ample knowledge about these variations will be a useful tool in decreasing the chances of acute diseases in the process of abdominal surgeries and interventional radiological procedures. Before any laparoscopic procedure, CT scans are normally carried out pre-operatively. Such scans are mainly focused on visceral pathologies. On the contrary, vascular variations are overlooked. Serious complications may arise in the absence of adequate knowledge about such variations. Earlier literature indicates frequency variations of coeliac trunk branching pattern from lower (7.3 %) to higher (43.7 %) in Polish and Russian populations respectively [19, 20]. Our findings are akin to Asian studies results. An Indian based study by Babu et al. displayed frequency of 19.65 percent [21]. Another Indian study demonstrated a frequency of fourteen percent [12]. A Chinese and Korean study displayed coeliac trunk variations frequency 10.2 % and 10.9 % respectively [17, 22]. The differences in the variations in coeliac trunk branching pattern may be due to ethnic and genetic differences. Three branches are given off by a classical coeliac trunk which includes splenic artery [19], left gastric artery and common hepatic artery. Our study indicated that the presence of classical coeliac trunk (type I) was seen 83.9 % in the total subject population. Coeliac trunk variations were manifested with the percentage of 16.1 amongst the subjects. A Spanish study resulted in the presence of Type I in 90.5 % cases [23]. A Serbian research on MDCTA has revealed the presence of type I coeliac trunk with the percentage of seventy-eight [24].

Classic coeliac trunk pattern presence decreases numerous complications in the course of endovascular embolization or surgery related procedures. Prevalence of classical trifurcation was reported with the percentage of 62.5 in a Turkish based research [25]. Type V and II were the commonest variations in nine cases each with the percentage of 5.6 each. A separate origin of left gastric artery and a hepato-splenic trunk are denoted by Type II. Natsume et al. from Japan and Song et al. from Korea have presented an equivalent prevalence of type II variation that is 4.6 percent and 4.4 percent respectively [22,26]. A common origin of left gastric artery and splenic artery with an anomalous hepatic artery origin is denoted by Type V. In our study, a frequency of 5.6 percent was shown related to this type of variation. An Indian based research has reported type V as the most common variation (4 percent) of coeliac trunk [27]. On contrary, a few western based studies have documented the decreasing frequency of type V and type II. A lower frequency of type II in the Polish population was reported by Torres et al with the percentage of 2.2.

Tanka et al. noted a lower frequency of type V in Albanian population with the percentage of 01 [28]. In our population, type VII (coeliac-colic trunk) was the second most frequent variation was recorded with the percentage of 3.1. Type VII is created when the central colic artery arises from the coeliac trunk rather than superior mesenteric artery. Irrespective of its lower frequency, it can pave ways for complications in the process of transverse colon surgery [19]. Prevalence of coeliac-colic trunk was recorded with the percentage of 04 in an Indian based study [27]. In our study, the percentage of the frequency recorded was 0.6 each (one case in every type) in case of type IV (hepato-splenomesenteric trunk), type III (hepato-gastric trunk) and type VI (coeliac-mesenteric trunk). A cadaveric study based on Indian population indicated Type III frequency as two percent (only one case) [11]. On the other hand, a Brazilian study recorded type III frequency as 1.7 % [3]. One percent incidence of hepato-gastric trunk was recorded in a Turkish population [19]. During the course of pancreatic surgeries, the presence of type IV appears extremely significant. If there is presence of type IV, duodenum blood supply can only flow from the superior mesenteric artery. If there is any accidental ligation of SMA or common trunk, the occurrence chances of necrosis or Ischemia of duodenum or liver are self-evident [19]. Both Japanese and Korean studies have reported this variation with the percentage of 0.7 [22, 29]. A higher prevalence of type IV variation was reported in Croatian population with the percentage of 4 [30].

Arc of Bühler's is considered the general source of the superior mesenteric artery (type VI) and coeliac trunk [31]. Before mapping out pancreaticoduodenectomy for peripancreatic and pancreatic cancer treatment, it is imperative to acquire sufficient awareness about this sort of variation. Perioperative morbidity is enhanced from twenty to thirty percent in case of type VI variation presence [19]. Nonetheless, immaculate identity of coeliac-mesenteric trunk can render a helping hand in opting for the improved surgical strategy and thus can evade the death occurrences and iatrogenic injury chances. Our population displayed the presence of Type VI with the percentage value of 0.6. Comparatively, the western based researches have documented higher prevalence of type VI variation in comparison with Asian populations. Type VI variation prevalence was reported as 4 %, 3 % and 3.3 % in countries such as Croatia, Serbia, and USA respectively [24, 30, 32]. Koreans and Japanese studies indicated low prevalence of type VI variation i.e. 1.1 % and 0.7 % respectively [22, 29]. Not a single case of type VI variation was observed in an Indian based study [33]. Coeliac trunk was not found in type VIII whereas left gastric, splenic and common hepatic arteries arise directly from the abdominal aorta. Our study found no case of type VIII which was reported the same in an Indian based study too [33]. On the other hand, Polish and Turkish based studies documented type VIII variation as 0.1 % and 1 % respectively [2, 19].

CONCLUSION:

By summing up the data, we concluded that the study at hand has indicated normal configuration of coeliac trunk (classic or type I coeliac trunk) in 83.9 % subjects. Coeliac trunk variations were reported in 16.1 % subjects.

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