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Original Research Article

Anatomical variant origin of suprarenal arteries from coeliac trunk development, and its clinical significance

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ABSTRACT

Background: One of the most vascular organ in the body Adrenal gland being highly variant in vasculature and tough to approach, its knowledge needs to be updated regularly. Anatomists, Surgeons and Radiologists will be benefitted with this study and improves the quality of care provided to patients by reducing morbidity and mortality.
Methods: This study was done on 48 formalin fixed cadavers (33 males, 15 females) in the department of anatomy, between 2014-2019. Coeliac trunk was skeletonized, and branches traced looking for suprarenal arterial branches.
Results: Superior Suprarenal Artery originated from Inferior phrenic artery in 13(27%) cases, and these Inferior phrenic arteries were arising from the Coeliac trunk, and in one (2.03%) case Superior suprarenal artery was arising directly from Coeliac trunk and which had even replaced the Middle Suprarenal Artery. None of the Middle and Inferior Suprarenal Artery came from coeliac trunk.
Conclusions: Knowledge of Superior Suprarenal Arterial variations while doing surgeries, and during radiological interventions in and around the lesser sac, and involving the Coeliac trunk helps the clinicians in reducing the morbidity and mortality.

Keywords: Adrenal gland, Coeliac trunk, Inferior phrenic artery, Middle suprarenal artery, Superior suprarenal artery

INTRODUCTION

Adrenal gland is one of the most vascular organ in the body having its vascular supply from different vessels and very well known for its vascular anatomical variations. Constantly changing anatomy of adrenal glands and its size makes surgeons extra precocious while operating in and around the gland. It is of great significance for anatomists and surgeons to be updated with the variations in vasculature to prevent untoward intra operative and post-operative complications, and during radiological vascular interventions.

Adrenal glands are supplied by Superior Suprarenal Artery (SSA), Middle Suprarenal Artery (MSA) and Inferior Suprarenal Artery (ISA). SSA usually arises from Inferior Phrenic Artery (IFA) a branch from Abdominal Aorta (AA), MSA from lateral aspect of AA at the level of superior mesenteric artery, and ISA from Renal Artery (RA) and occasionally from accessory renal artery. Commonly adrenal glands have variant arterial architecture.[1] Aortographic presentation of exact origin of glandular arteries forms the basis for the selective angiographic approach to the gand.[2]

Many case reports have been reported of origin of IPA and SSA from Coeliac Trunk (CT) but a detailed study on Suprarenal artery from CT has not been done and which is emphasized in this study. Present study aims at knowing the variations in origin of Suprarenal Artery from Inferior Phrenic Artery and Coeliac Trunk which is very useful for surgeons, oncologists and interventional

radiologists. Vascular anamolies of coeliac trunk and its branches should be kept in mind while planning surgeries on abdominal part of oesophagus, stomach, duodenum, liver, gall bladder, pancreas and spleen.

Aims and objectives of the study was the origin of Suprarenal Arteries from Coeliac Trunk with its incidence, variant course, clinical significance and a note on its development.

METHODS

The study was done on 48 formalin fixed cadavers (33 males, 15 females) aged between 30 to 80 years in the department of anatomy, Bangalore Medical College and Research Institute between September 2014-October 2019. The study was conducted in a government medical college where cadavers were procured from the Victoria and Vanivilas hospitals where patients had died due to various reasons and donated to the college for medical education.

All the cadavers in the department irrespective of age and sex were included in the study and specimens in which the branches were damaged and untraceable were excluded from the study.

Inclusion criteria

- Cadavers where structures around the coeliac trunk and its branches were clearly dissected and traced towards their supply were included.

Exclusion criteria

- Patients with growth involving stomach, Liver, Gall bladder, Biliary tree, Pancreas and Lower Esophagus for the possibility of vascular distortion due to the disease.
- Patients with previous Surgeries in and around Coeliac trunk, Adrenal gland and Renal Surgery.

During routine dissection hours for undergraduate's, abdomen was dissected as per the instructions in Cunningham's manual 3 followed by fine dissection. The peritoneal cavity was entered, Lesser omentum removed, lesser sac entered, and proximal part of abdominal aorta was skeletonized. Retroperitoneal organs were dissected, and adrenal glands were identified. Vessels supplying the adrenal glands were dissected and traced towards their origin. Branches of abdominal aorta were traced to look for SSA, MSA and ISA. Coeliac trunk was identified and skeletonized, its branches were noted and traced. Inferior phrenic artery was identified and traced both proximally and distally looking for SSA, MSA and ISA.

The specimens were numbered from one to forty-eight and labelled. The observations were noted, required photographs were taken and labelled. Incidence of variant origin of Suprarenal Artery from Coeliac trunk was calculated. Variations in the arterial pattern were noted and tabulated.

RESULTS

Forty-eight coeliac trunks from cadavers were studied in which 33 were males and 15 were females. It was observed that out of 48 coeliac trunks studied, IPA which normally gives SSA branch was traced in 21 cases and the remaining 27 cases IPA arose from AA.

Among these 27 cases of IPA from AA, 26 cadavers had SSA arising from IPA and supplying the adrenal gland and 1 did not supply Suprarenal gland. MSA from these 26 cases were coming from Abdominal Aorta and ISA from renal artery.

In Twenty-one Coeliac trunks which gave IPA 8 did not give SSA branch and not supplying adrenals. SSA in these 8 cadavers came from Abdominal Aorta directly few centimeters above the MSA branches. The remaining thirteen IPA from Coeliac Trunk gave SSA branches, and MSA were not coming from these CT. Among these 13 SSA, 7 were bilateral and 6 were unilateral where 4 SSA was arising from Left Inferior Phrenic Artery and 2 SSA from right inferior phrenic artery.

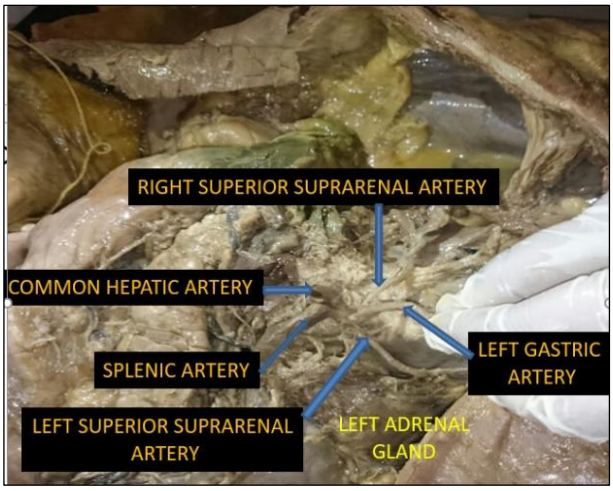

Figure 1: SSA arising from CT.

In one variant case which was a female cadaver it was observed that SSA directly arose from coeliac trunk. Figure 1 shows bilateral SSA coming from CT with Left SSA supplying upper half of adrenal gland. Coeliac trunk came from Abdominal Aorta at the level of T12-L1 Junction coursed 2.5 Cms long giving 1st division bilateral SSA simultaneously followed by Left Gastric Artery, Splenic Artery and Common Hepatic Artery (Figure 2).

IPA here came from AA and did not give SSA. MSA was not present and ISA was from AA. Absence of MSA and wide branching pattern of SSA showed it substituted for MSA supplying a major part of adrenal gland.

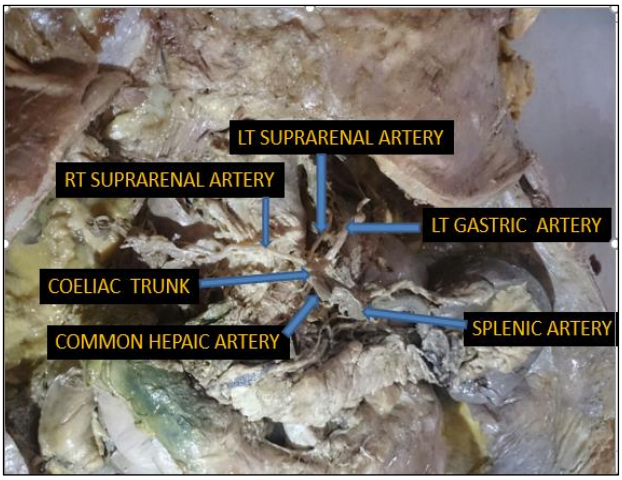

Figure 2: 1st division of CT as Bilateral origin of Superior Suprarenal Artery diverging and dividing profusely to substitute MSA.

Table 1: The arterial flow of SSA studied along with their number and percentage distribution.

Arterial flow pattern	Number (N=48)		%
AA -> IPA -> SSA	26		54.16%
AA -> CT -> IPA -> NO SSA	8		16.66%
AA -> CT -> IPA -> SSA	13	BL 7 UL 6	27.08%
AA -> CT -> SSA	1		2.08%

AA: Abdominal Aorta, CT: Coeliac Trunk, IPA: Inferior Phrenic Artery, SSA: Superior Suprarenal Artery, BL: Bilateral, UL: Unilateral

From the above table it can be inferred that the incidence of SSA from CT directly is 2.08% and overall incidence of SSA from CT (directly and through IPA) to be 29.1%.

Table 2: The sex distribution of SSA variation.

Supra renal artery from coeliac trunk (14)		
Sex	Yes (14)	No (35)
Male (33)	5(35.7%)	28
Female (15)	9(64.28%)	6

The table shows that 64.28% females are showing variations while males are showing 35.7% depicting, and females are more prone to this anamolous origin.

DISCUSSION

Vasculature of Adrenal gland is rich and complex, showing high variability in their origin and position. Present study concentrated on the origin of Suprarenal Artery from Coeliac Trunk.

It was noted that in 27.08% of cases SSA came from IPA of variant origin from Coeliac trunk. Sushma et al, observations show that all SSA were arising from IPA in her study and IPA were originating from Abdominal Aorta except in 2 cases which were from Renal Artery.[4] In occlusive vascular diseases IPA gives collaterals to intestinal circulation including renal perfusion and may be the reason for bleeding in pathologies such as hepatocellular carcinoma, bleeding caused by gastroesophageal problems, hepatic or diaphragmatic bleeding due to trauma or surgeries.[5,6]

Knowledge of this kind of anatomical variation where Suprarenal Artery is arising from Inferior Phrenic Artery which itself is originating from the Coeliac Trunk is important specially in cases of hepatic surgeries mobilizing the left lobe of the liver, lymphatic dissection in cases of carcinoma stomach, carcinoma oesophagus, Carcinoma Pancreas and Cholangiocarcinoma. Awareness of the vascularization of highly variant Adrenal gland is crucial in angiographic studies to differentiate between functioning and non-functioning adrenal lesions. Knowing of anatomical vascular variation and anticipating its presence is very important in bariatric surgery, anti-reflux surgery and also in repairing hiatal hernia.

Munmun sarkar et al, has presented a case report where Left IPA arising from Coeliac Trunk gave SSA which even replaced MSA on the same side.[7] When compared to this study 7 were from bilateral IPA, 4 were from Left IPA and 2 were from Right IPA.

Studies done by Merklin and Michel, Gagnon have shown the origin of SSA directly from Aorta, Coeliac Trunk and Superior polar artery.[8,9] In 2010 Rajesh B Astik et al, reported a case of origin of Left SSA and Left MSA from Coeliac Trunk.[10] Incidence was not done then and done now which shows to be 2.08%.

Manso et al, observed the origin of MSA from Coeliac Trunk in 3.3% of cases.[11] MSA will be absent in some cases.[12] One of the cases in this study showed bilateral origin of SSA from Coeliac Trunk, supplying middle part of Adrenal gland and absence of MSA which has not be been documented hitherto. In this study the incidence of origin of SSA directly from Coeliac Trunk is 2.08%.

The Coeliacomesentric system develops from 6 sets of paired right and left - subphrenic, ventricular (upper, middle, lower), intestinal (upper, lower) as suggested by Murakami et al, which later gets modified during fetal development. Anamolies of branches from Coeliac Trunk is a result of retaining some parts of longitudinal channels that normally disappear or disappearance of parts that normally persist.[13]

CONCLUSION

The incidence of Superior Suprarenal Artery from Coeliac Trunk directly is 2.08% and overall incidence of Superior Suprarenal Artery from Coeliac Trunk (directly and through Inferior Phrenic Artery) is 29.1%.

Improved technology and vast knowledge of biology of diseases necessitates complex surgeries and minimally invasive surgeries to be done to improve the quality of life. Updated knowledge of vascular anamolies is highly important for Surgeons, Interventional radiologists and anatomists to reduce the morbidity and mortality. This study showed the variations in vascular supply to adrenal glands from coeliac trunk guiding the surgeons, radiologists and anatomists to avoid complications.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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