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Vertebral Level Of Origin Of Branches Of Abdominal Aorta.

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ABSTRACT

The abdominal aorta and its branches is the chief arterial supply of viscera and body wall of the abdomenThe abdominal aorta and its braches is subjected to lot of variations morphologically in its course, extent, levels of origin of branches of various arteries arising from abdominal aorta. This study focus on the vertebral level of origin of branches of abdominal aorta in 50 adult cadaveric specimen. The results were tabulated and compared with the previous studies.

Keywords: vertebral, abdomen, aorta.

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INTRODUCTION

The abdominal aorta is the continuation of the thoracic aorta and is the chief artery supplying oxygenated blood to the abdominal wall and organs(Prakash et al 2011). This arterial trunk extends from the lower border of the 12th thoracic verterbra at the aortic opening of the diaphragm to the level of the 4th lumbar verterbra to the left of the midline(Datta A.K 8th edit).

The branches of abdominal aorta can be classified into anterior or ventral, lateral and dorsal branches. The three ventral branches are celiac trunk which supplies the foregut derivatives, superior mesenteric artery which supplies the midgut derivatives and the inferior mesenteric artery which supplies the hindgut derivatives. The paired lateral branches includes the inferior phrenic artery, middle suprarenal artery, renal and gonadal artery. The dorsal branches include four pairs of lumbar arteries and median sacral artery(Ranganathan.T.S 6th edit).

Abdominal aorta and its branches shows wide variations which has been documented in the literature since decades(Mane UddhavWamanrao 2016).These variation has gained practical importance during surgical and interventional procedures. According to Pennington.N 2004, variation in the morphology and branching pattern is of interest as it plays an important role in pathological conditions like atherosclerosis, aneurysms etc.

The knowledge of the anatomical variation regarding the abdominal aorta is essential in surgical procedures like laproscopic surgeries, liver and kidney transplantation and oncological resections in the abdominal region and interventional procedures like arterial chemoembolisation for treatment of liver carcinoma and surgical treatment of aortic aneurysms(Prakash et al 2013)

The cadaveric study is important even in the present era of advanced radio diagnostic techniques. Hence this study was performed on the cadavers present in the Department of Anatomy and from the Forensic medicine department focusing on the vertebral level of origin of branches of the abdominal aorta and its variations.

AIM AND OBJECTIVES

1. To find out the vertebral level of origin of

    - Coeliac artery
    - Superior mesenteric artery
    - Inferior mesenteric artery
    - right and left Renal artery
    - right and left Gonadal artery
    - bifurcation of Abdominal Aorta

2. To compare the results with the previous studies.

MATERIALS AND METHODS

This study was done in 50 unclaimed human adult cadavers irrespective of age and sex. The study was conducted in the Department of Anatomy, Stanley Medical College, Chennai. The specimens were obtained from the adult cadavers present in the Department of Anatomy and from the forensic department, Stanley Medical College, Chennai. The specimens were numbered in a serial order from 1-50 and the measurement were recorded and tabulated. Only aorta with normal morphology was studied and diseases pertaining to aorta such as aortic aneurysm and aortic dissection were excluded from the study. 50 embalmed adult abdominal aorta specimens obtained from the dissection method. The aorta is removed in toto along with all its visceral bracnches is washed in running water. The specimens were completely immersed in 10% formalin solution and were preserved for 10 days. Various instruments such as digital verniercaliper, thread, measuring scale, nails and hammer and dissection instruments were used in the study.

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Fig 1: Instruments used in the study.

The guidelines of the Cunningham's manual of practical Anatomy 15th edition were followed. The vertebral level of origin of coeliac trunk, superior mesenteric artery, inferior mesenteric artery, renal arteries, gonadal arteries and the aortic bifurcation were noted and recorded. The origin of each artery were identified, then a two-inch nail was hammered into the vertebral coloumn through the centre of the origin of each branch. The nail were inserted in an horizontal plane through each vertebral origin. After the abdominal aorta was stripped off, the vertebral origin of each artery and the inter-arterial distance between each branches were measured and recorded by verniercaliper, thread and scale(**Mane UddhavWamanrao 2016**)

OBSERVATION

VENTRAL BRANCHES

i) COELIAC AXIS

- In 18 out of 50 specimen, the coeliac axis arise at the level of T12-L1 intervertebral disc.
- In 14 out of 50specimens, the coeliac axis arise at the level oflower border of T12 thoracic vertebra.
- In 13 out of 50specimens, the coeliac axis arise at the level of upper border of L1 lumbar vertebra.
- In 5 out of 50 specimen, the coeliac axis arise at the level of body of L1 lumbar vertebra

ii) SUPERIOR MESENTERIC ARTERY

- In 18 out of 50 specimens, the superior mesenteric artery arise at the level of upper border of L1 lumbar vertebra.
- In 24 out of 50 specimens, the superior mesenteric artery arise at the level ofbody of L1 lumbar vertebra.
- In 8 out of 50 specimen, the superior mesenteric artery arise at the level of lower border of L1 lumbar vertebra.

iii) INFERIOR MESENTERIC ARTERY:

- In 25 out of 50 specimens, the inferior mesenteric artery arise at the level of lower border of L3 lumbar vertebra.
- In 16 out of 50 specimens, the inferior mesenteric artery arise at the level of body of L3 lumbar vertebra.
- In 9 out of 50 specimens, the inferior mesenteric artery ariseat the level of L3-L4 intervertebral disc.

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iv) RENAL ARTERIES

- The renal artery arise from upper border of L2 lumbar vertebra in 30 specimen on the right side and 31 specimen on the left side.
- The renal artery arise from the lower border of L1 lumbar vertebra in 18 specimens on the right side and 17 specimens on the left side.
- The renal artery arise from the body of the L1 lumbar in 2 specimen on both sides.

v) GONADAL ARTERIES:

- In 49 out of 50 specimen, gonadal arteries arise from the lower border of L2 lumbar vertebra on both side.
- In one specimen, the gonadal arteries on both sides arise from the upper border of L2 lumbar vertebra.

vi) AORTIC BIFURCATION

- In 37 out of 50 specimen, aorta bifurcates at the level of body of L4 lumbar vertebra.
- In 8 out of 50 specimen, aorta bifurcates at the level of upper border of L4 lumbar vertebra.
- In 4 out of 50 specimens, aorta bifurcates at the level of lower border of L4 lumbar vertebra.
- In one specimen, aorta bifurcates in the intervertebral disc between L4-L5 vertebra.

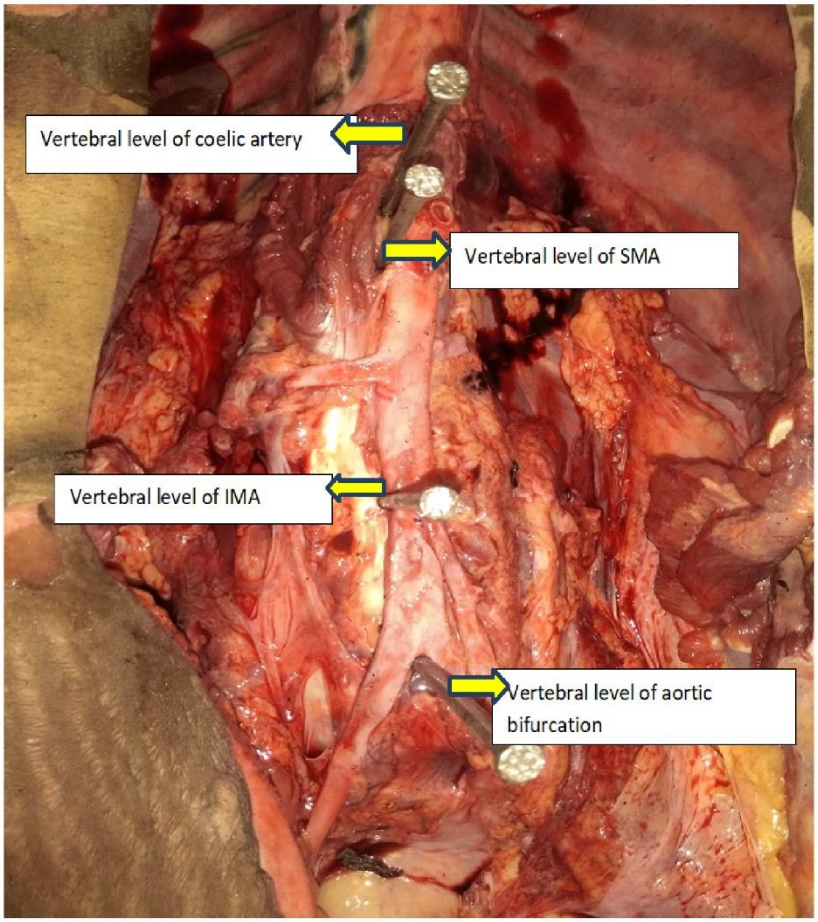

Fig 2: Dissection of abdominal cavity to expose the abdominal aorta and vertebral level by nailing the level of origin

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Specimen	CA	SMA	IMA	RRA	LRA	RGA	LGA	AB
1	T12-L1	UL1	LL3	UL2	UL2	LL2	LL2	UL4
2	LT-12	UL1	BL3	LL1	LL1	LL2	LL2	UL4
3	LT-12	UL1	BL3	UL2	UL2	LL2	LL2	BL4
4	LT-12	BL1	LL3	UL2	UL2	LL2	LL2	BL4
5	UL-1	BL1	LL3	UL2	UL2	UL2	UL2	BL4
6	T12-L1	UL1	LL3	LL1	LL1	LL2	LL2	L4-L5
7	T12-L1	BL1	LL3	UL2	UL2	LL2	LL2	BL4
8	UL1	UL1	BL3	UL2	UL2	LL2	LL2	BL4
9	LT-12	BL1	BL3	LL1	LL1	LL2	LL2	BL4
10	T12-L1	BL1	BL3	UL2	UL2	LL2	LL2	BL4
11	T12-L1	UL1	LL3	UL2	UL2	LL2	LL2	UL4
12	T12-L1	UL1	LL3	UL2	UL2	LL2	LL2	BL4
13	UL-1	BL1	BL3	LL1	LL1	LL2	LL2	BL4
14	UL-1	BL1	L3-L4	UL2	UL2	LL2	LL2	BL4
15	LT-12	BL1	BL3	UL2	UL2	LL2	LL2	BL4
16	T12-L1	UL1	LL3	BL1	BL1	LL1	LL2	LL4
17	T12-L1	BL1	L3-L4	UL2	UL2	LL2	LL2	UL4
18	UL-1	LL1	LL3	UL2	UL2	LL2	LL2	BL4
19	LT-12	LL1	BL3	LL1	LL1	LL2	LL2	BL4
20	LT-12	BL1	BL3	UL2	UL2	LL2	LL2	BL4
21	T12-L1	BL1	LL3	UL2	UL2	LL2	LL2	BL4
22	UL-1	BL1	L3-L4	LL1	LL1	LL2	LL2	BL4
23	LT-12	LL1	BL3	LL1	LL1	LL2	LL2	UL4
24	LT-12	LL1	BL3	LL1	LL1	LL2	LL2	LL4
25	T12-L1	UL1	L3-L4	LL1	LL1	LL2	LL2	BL4
26	T12-L1	BL1	LL3	UL2	UL2	LL2	LL2	BL4
27	BL-1	LL1	L3-L4	LL1	UL2	LL2	LL2	BL4
28	UL-1	LL1	LL3	UL2	UL2	LL2	LL2	BL4
29	LT-12	BL1	LL3	UL2	UL2	LL2	LL2	UL4
30	T12-L1	UL1	BL3	LL1	LL1	LL2	LL2	BL4
31	T12-L1	BL1	LL3	UL2	UL2	LL2	LL2	BL4
32	UL-1	BL1	L3-L4	LL1	LL1	LL2	LL2	BL4
33	LT-12	LL1	LL3	UL2	UL2	LL2	LL2	BL4
34	BL-1	BL1	BL3	UL2	UL2	LL2	LL2	LL4
35	LT-12	UL1	L3-L4	UL2	UL2	LL2	LL2	BL4
36	T12-L1	UL1	LL3	LL1	LL1	LL2	LL2	BL4
37	UL-1	BL1	LL3	UL2	UL2	LL2	LL2	BL4
38	UL-1	BL1	LL3	BL1	BL1	LL2	LL2	BL4
39	BL-1	LL1	L3-L4	UL2	UL2	LL2	LL2	BL4
40	LT-12	UL1	BL3	UL2	UL2	LL2	LL2	UL4
41	T12-L1	UL1	LL3	UL2	UL2	LL2	LL2	BL4
42	UL-1	BL1	BL3	LL1	LL1	LL2	LL2	BL4
43	BL-1	UL1	LL3	UL2	UL2	LL2	LL2	LL4
44	LT-12	UL1	LL3	LL1	LL1	LL2	LL2	UL4
45	T12-L1	BL1	LL3	UL2	UL2	LL2	LL2	BL4
46	T12-L1	BL1	LL3	LL1	LL1	LL2	LL2	BL4
47	UL-1	UL1	BL3	UL2	UL2	LL2	LL2	BL4
48	BL-1	UL1	L3-L4	UL2	UL2	LL2	LL2	BL4
49	T12-L1	BL1	LL3	LL1	LL1	LL2	LL2	BL4
50	UL-1	BL1	LL3	LL1	LL1	LL2	LL2	BL4

Table 1: Vertebral Origin Of Various Branches Of Abdominal Aorta

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(T12- 12thThoracic vertebra, BLI - Body of 1st lumbar vertebra , LL1-Lower border of 1st Lumbar vertebra T12-L1 intervertebral disc between 12th thoracic and 1st lumbar vertebra; L1-1st Lumbar vertebra L2-2nd lumbar vertebra, L3-3rd lumbar vertebra; BL3- Body of 3rd lumbar vertebra; LL3-lower border of 3rd lumbar vertebra; L4-4th lumbar vertebra; BL4- Body of 4th lumbar vertebra; LL4 – lower border of 4th lumbar vertebra.)

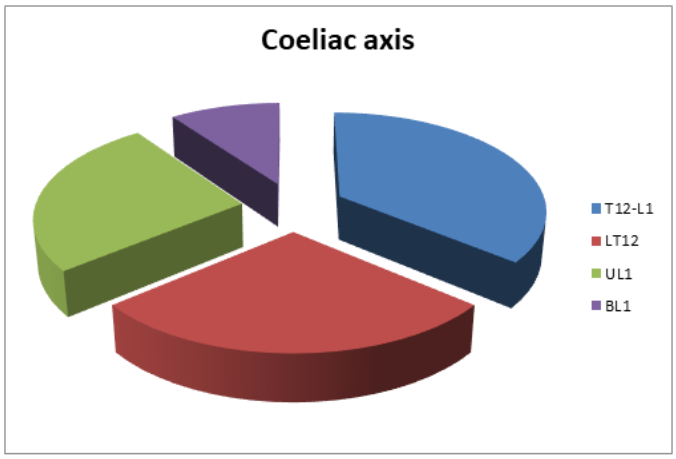
DISCUSSION

COELIAC AXIS

Out of 50 specimens, the coeliac artery arises from the intervertebral disc at the level of T12-L1 in 18 specimens, at the lower border of T12 thoracic vertebra in 14 specimens, from the upper border of L1 lumbar vertebra in 13 specimens, from the body of L 1 lumbar vertebra in 5 specimens(table 2, piechart 1)

Vertebral level	No of specimens
Intervertebral disc (T12-L1)	18
Lower border of T12	14
Upper border of L1	13
Body of L1	5

Table 2: Showing vertebral level of origin of coeliac artery.



Pie chart no 1- showing vertebral origin of coeliac axis.

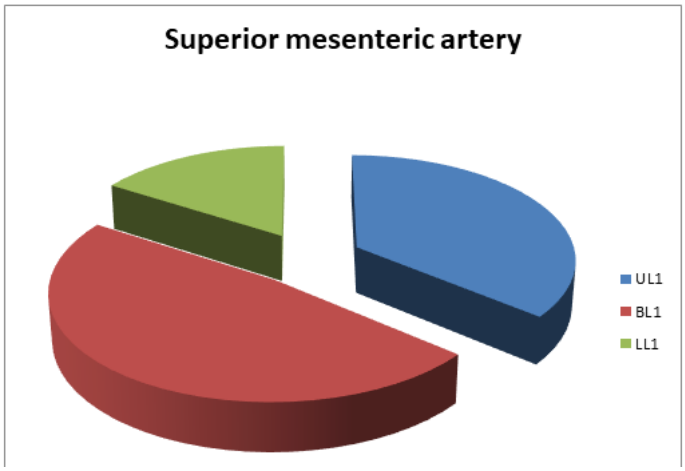
SUPERIOR MESENTERIC ARTERY

In majority of specimens, the superior mesenteric artery arises from body of L1 lumbar vertebra in 24 out of 50 specimens. It also arises from upper and lower border of L1 lumbar vertebra in 26 specimens(table 3, piechart 2)

Vertebral origin	No.of specimens
UL1	18
BL1	24
LL1	8

Table 3: Showing Vertebral Origin Of Superior Mesenteric Artery.

ISSN: 0975-8585



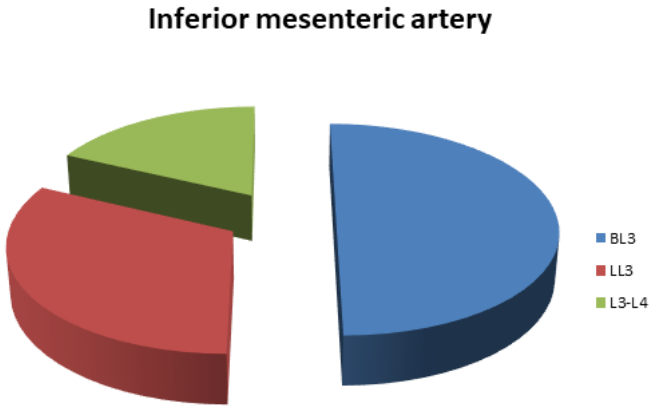
Pie chart 2: showing vertebral origin of superior mesenteric artery.

INFERIOR MESENTERIC ARTERY

In majority of specimens, inferior mesenteric artery arises from lower border of L3 lumbar vertebra (25 out of 50 soecimens). It also arises from body of L3 and intervertebral disc between L3-L4 vertebra in 25 out of 50 specimens(table 4, piechart 3)

Vertebral origin	No.of specimens
BL3	25
LL3	16
L3-L4	9

Table 4: Showing vertebral origin of inferior mesenteric artery.



Pie chart 3- showing vertebral origin of inferior mesenteric artery.

VERTEBRAL ORIGIN OF LATETRAL VISCERAL BRANCHES

The majority of renal arteries on both sides arises from upper border of L2 lumbar vertebra (in 30specimens on the right side and 31 specimens on the left side)and rest of the specimens arises from lower border and body of L1 lumbar vertebra.

The majority of gonadal artery arise from the lower border of L2 lumbar vertebra on both sides.

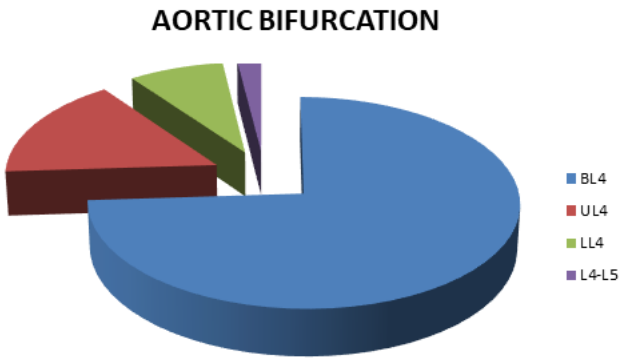
ISSN: 0975-8585

AORTIC BIFURCATION

In 37 specimens , aorta bifurcates at the level of L4 lumbar vertebra. In 8 specimens, aorta bifurcates at the upper border of L4 vertebra and in 4 specimens, aorta bifurcates in lower border of L4 lumbar vertebra. In one specimen, aorta bifurcates in the intervertebral disc between L4-L5 vertebra(table 6, piechart 4)

Vertebral origin	No.of specimens
BL4	37
UL4	8
LL4	4
L4-L5	1

Table 6: Showing Vertebral Level Of Bifurcation Of Aorta.



Pie chart 4-showing vertebral level of aortic bifurcation.

ARTERY	VERTEBRAL LEVEL OF BRANCHES OF ABDOMINAL AORTA														
	T12	T12-L1	UL1	BL1	LL1	L1-L2	UL2	LL2	UL3	BL3	LL3	L3-L4	UL4	BL4	LL4
CA	28%	36%	26%	-	-	-	-	-	-	-	-	-	-	-	-
SMA	-	-	36%	48%	16%	-	-	-	-	-	-	-	-	-	--
IMA	-	-	-	-	-	-	-	-	-	32%	50%	18%	-	-	-
RRA	-	-	-	4%	36%	-	60%	-	-	-	-	-	-	-	-
LRA	-	-	-	4%	34%	-	62%	-	-	-	-	-	-	-	-
RGA	-	-	-	-	--	-	2%	96%	-	-	-	-	-	-	-
LGA	-	-	-	-	--	-	2%	98%	-	-	-	-	-	-	-
AB	-	-	-	-	-	-	-	-	-	-	-	-	16%	74%	8%

Table 7: Percentage of vertebral origin of branches of abdominal aorta

S.no	Authors	CA	SMA	IMA	RRA	LRA	RGA	LGA	AB
1.	Satchidhanandam(1987	L1	BL1	BL3	-	-	-	-	BL4
2.	Neil pennington(2005)	BT12	UL1	LL3	LL1	LL1	-	-	LL4
3.	Songur et al(2010)	T12-L1	L1-L2	L3	L2	L2	-	-	LL4
4.	Prakash et al (2011)	T12	L1	L3	L1	L1	-	-	LL4
5.	Present study	T12-L1	BL1	LL3	UL2	UL2	LL2	LL2	BL4

Table 8: The results of the various authors with our present study are compared.

CONCLUSION

The vertebral level of origin of major branches of abdominal aorta is subjected to lot of variations in their origin and branching pattern. This study will show light on the vertebral origin of branches of abdominal aorta and the results should be borne in mind during surgical and interventional procedures. The knowledge of

course of abdominal aorta and its branches are important with regards to intervention, diagnosis and management.. Any arterial variations can have both morphological and radiological significance and its implications is of paramount importance to surgeons, radiologist and cardiologist and physicians.

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