

STUDY ON VARIATIONS OF ANTERIOR INFERIOR SEGMENTAL BRANCH OF RENAL ARTERY

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ABSTRACT

Background: The kidneys are paired solid organs that lie in the retro peritoneum along the borders of psoas muscle. Each kidney is positioned obliquely and awareness of the relationship of the kidneys to the surrounding organs is paramount. Each kidney is supplied by a renal artery, which is a branch of the abdominal aorta, the branching pattern of renal artery shows very much variations, the knowledge of individual segmental artery variation are very helpful for clinical practices of renal surgeries.

Materials and Methods: Fifty pairs of kidneys with intact abdominal aorta and renal artery were collected from the dead bodies obtained from the mortuary of Forensic department, JSS Medical College and Mysore Medical College and studied in JSS Medical College. For study of segmental variation Corrosion cast technique method was used.

Results: In present study type I anterior inferior segmental artery were found in 47%, type II in 16%, type III in 24%, type IV 10%, type V in 0% and type VI 1% of cases.

Conclusion: The variation of the anterior inferior segmental artery has not been given importance in previous works and they have been typed (6 types) in the present work. The knowledge of anterior inferior segmental artery variations are helpful in renal surgeries in particular with anterior inferior segmental artery distribution area.

KEYWORDS: Renal Surgery, Renal transplantation, Anterior inferior segmental artery, Kidney.

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INTRODUCTION

A survey of literature reveals that the knowledge about the arterial segments of the kidney is very recent. The earlier records have been only about accessory renal arteries. The earliest record about aberrant renal arteries seem to be that of Eustachius[1] made in 1552 on copper plates, which were published 162 years later in 1714 by Lancisi[2], the anomaly mentioned as "Lucus Nature's play". It was F.T. Graves[3] who pointed

out recently in 1954 about this publication. In 1794, John Hunter [4] stated the veins in the spleen and kidneys anastomose, but not the arteries. Benjamin, Abehouse and Samuel in the year 1950 stated that temporary compression of a branch of the renal artery causes segmental purplish discoloration, enabling the surgeon to determine the amount of tissue to be removed and to minimize bleeding [5]. F.T.Graves is the first to recognize the 5 renovascular segments

in the human kidney. He studied by making polyster resin casts of the renal artery and its branches and by angiography of post mortem kidneys using 50% and 70% solutions of diodone. He noted the presence of segmental pattern of renal artery branches, the absence of segmental pattern of the renal vein, the absence of Brodel's line the relatively avascular radial planes in between the segmental arteries favourable for relatively bloodless renal surgery, and the absence of intersegmental anastomosis. He named the 5 segments of the kidney as apical, upper, middle, lower and posterior. He termed the medial part of the kidney at its upper pole apical segment, a larger part at the lower pole the lower segment, the posterior portion of the intervening part the posterior segment, the anterior portion between apical and lower segments being divided into upper and middle segments. The apical, upper, middle and lower segments of Graves are supplied by the anterior division of the renal artery and the posterior segment is supplied by its posterior division. According to his description the anterior division of the renal artery has 3 patterns of branching, the posterior division being constant, - the lower segmental artery, arising first, the upper and middle segmental arteries having a common origin, the upper segmental artery given off first and middle arising from the lower segmental artery, and the upper, middle and lower segmental branches springing at the same point. He has described 4 types of apical segmental artery variations regarding its mode of origin, - from the upper segmental artery or from the anterior division of the renal artery, from the junction of the anterior and posterior divisions of the renal artery, from renal artery or from the aorta and from the posterior division of the renal artery[3].

David Sykes (1963) after a study of 82 kidneys described 3 types of segmental arterial pattern, -typical arterial type present in 59 casts corresponding to the description type given by Graves, typical venous type present in 6 casts, and dual arterial pattern in 17 casts. He was the first to describe the venous pattern of the renal arterial branching. The nomenclature of the renal segments approved at the 8th International Congress of Anatomists held in

Wiesbaden, Germany, in 1965, is as follows, superior (apical of Graves), anterior superior (upper), anterior (middle), inferior (lower), posterior segments (posterior), supplied by segmental arteries of the same terms[6].

In 1987 Mark J Horacek studied the renal vascular system of the monkey using neoprene latex 842A and found the course of the renal artery in the monkey (*Macaca fascicularis* and *Macaca mulatta*) and its relationship to other structures is similar to that observed in man. The renal arteries arise from the lateral aspect of the aorta below the superior mesenteric artery at approximately the same level, although either may arise more cranially than its counterpart on the contralateral side[7].

In 1992 J.Gil Garcia studied arterial pattern and fractional dimension of the dog kidney using Araldite CY233 plastic resin and fractal program[8]. In 1993 F.J.B. Sampaio studied the arterial blood vessels of 26 kidneys of people of both sexes at the first period of mature age. Using Doppler renal investigation of superior segmental and anterior inferior segmental arteries in color duplex scan mode and multislice computed tomographic angiography, intravital investigation of 20 kidneys were performed. Corrosion casts of the renal vasculature of 6 kidneys, obtained at autopsy, were studied using scanning electron microscopy. It was shown that in kidneys with a single renal artery, anterior inferior and superior segments have a similar level of blood supply when quantitative parameters of hemodynamics of these renal segments were compared, no significant differences were detected; in fact, no differences were found in the angioarchitectonics of anterior inferior and superior segments[9].

In present study 6 types of origin of the anterior inferior segmental artery have been noticed.

Type I: arises from the anterior division of the renal artery.

Type II: arises from the anterior superior segmental artery.

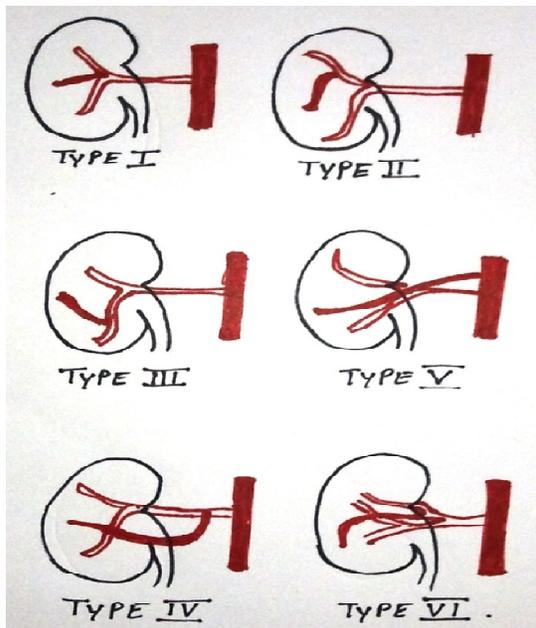
Type III: arises from the inferior segmental artery.

Type IV: arises from the renal artery.

Type V: arises from the aorta as on accessory renal artery either above or below the renal artery)

Type VI: arises from the posterior division of the renal artery.

Fig 1: Anterior inferior segmental artery.



MATERIALS AND METHODS

Fifty pairs of kidneys with intact abdominal aorta and renal artery were collected from the dead bodies obtained from the mortuary of Forensic department, JSS Medical College and Mysore Medical College and studied in JSS Medical College.

Corrosion cast technique - A vertical incision was made on the anterior wall of abdominal aorta in order to expose the opening of renal arteries and any accessory renal arteries. Using 10cc syringe water was flushed slowly through the renal artery until the blood and clots present inside were thoroughly removed. Silicon rubber is injected into the renal arteries using 10cc syringe by applying mild pressure. After a sufficient amount of silicon rubber is injected the syringe is removed and a tourniquet is applied. The silicon injected inside solidifies within 2 to 3 hours. The kidneys were finally kept in concentrated hydrochloric acid for 2 days for corrosion of the soft tissues leaving behind the silicon casts of the arterial trees. After complete corrosion, the silicon cast was kept in a gentle stream of tap water till the debris was washed away. The silicon casts were examined. The different segments were identified and photographed.

RESULTS

In present study type I anterior inferior segmental artery were found in 47%, type II in 16%, type III in 24%, type IV 10%, type V in 0% and type VI 1% of cases.

In 47 specimens the normal anterior inferior segmental artery is observed (type-I)

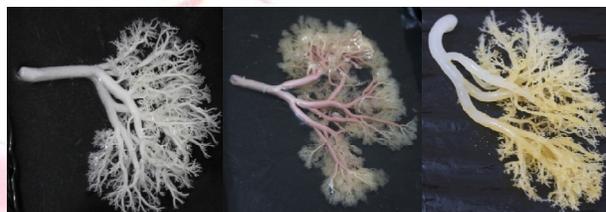
In 51 specimens the artery is seen arising from the aorta, renal artery, posterior division, anterior superior segmental and inferior segmental arteries.

Type I is more predominant in left kidney both in males and females.

Type V is absent.

Type VI is present in 1% of cases [Table 1].

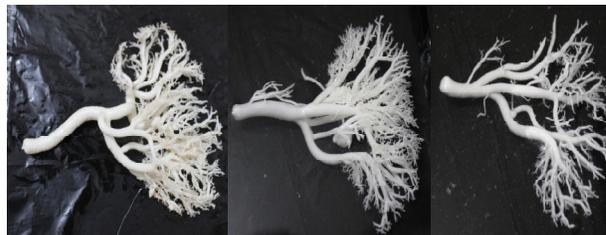
Type I: Anterior inferior segmental artery.



Type II: Anterior inferior segmental artery.



Type III: Anterior inferior segmental artery.



Type IV: Anterior inferior segmental artery.



Type VI: Anterior inferior segmental artery.



Table 1: The Anterior Inferior Segmental Artery.

Sex	Kidneys studied	Type I, arises from the anterior division of the renal artery	Type II, arises from the anterior superior segmental artery	Type III, arises from the inferior segmental artery	Type IV, arises from the renal artery	Type V, arises from the aorta	Type VI, arises from the posterior division of the renal artery
	Right	9(18%)	6(12%)	8(16%)	1(2%)	0(0%)	0(0%)
MALE	50	-48%	-14%	-26%	-8%	0%	-2%
	Left	15(30%)	1(2%)	5(10%)	3(6%)	0(0%)	1(2%)
	Right	11(22%)	4(8%)	6(12%)	4(8%)	0(0%)	0(0%)
FEMALE	50	-46%	-18%	-22%	-12%	0%	0%
	Left	12(24%)	5(10%)	5(10%)	2(4%)	0(0%)	0(0%)
TOTAL	100	47 (47%)	16(16%)	24(24%)	10 (10%)	0 (0%)	1 (1%)

DISCUSSION

The variation of the anterior inferior segmental artery have not been classified by previous workers 6 types have been recognized in the present work in the order of origin from proximal to distal sources. The finding our present study as follows compared with previous works [Table 2].

(1) Most commonly arises directly from the anterior division of the renal artery (type I) in 74% of specimens in the works of Verma et al and 47% in present study. Fine H et al study not shown Type I.

(2) Takes origin from the inferior segmental artery (type III) in 65% of cases in the works of Fine. H et al and 24% in present study. Verma et al study reported 4% case as Type III pattern.

(3) Arise from the superior segmental artery (type II) in 16% of cases in the works of Fine. H et al and in present study. Verma et al study reported 8% of cases as type II.

(4) Rarely arises from the posterior division (type V) or the aorta (type IV) is in about 1% of specimens. Verma et al study reported type VI in 1% of cases.

Table 2: The Anterior Inferior Segmental Artery.

Workers	Verma et al[11]	Fine. H et al[10]	Present study
Years	1961	1966	2012
Kidneys studied	98	107	100
Type I	74%	-	47%
Type II	8%	16%	16%
Type III	4%	65%	24%
Type IV	-	-	10%
Type V	-	-	0%
Type VI	1%	-	1%

CONCLUSION

Anterior inferior segmental artery commonly arises from the anterior division of renal artery, our study confirmed that in 47% of specimens taking origin from the anterior division of renal artery. The variation of the anterior inferior segmental artery not reported much in previous

studies but in our study given importance to this artery and classified as 6 types. The knowledge of anterior inferior segmental artery variations are helpful in renal surgeries in particular with anterior inferior segmental artery distribution area.

Conflicts of Interests: None

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