ORIGINAL RESEARCH PAPER
Volume - 11 | Issue - 01 | January - 2022 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A STUDY OF VARIATIONS OF INTRA RENAL ARTERY IN HUMAN KIDNEY

Anatomy

Dr. Amresh Kumar Tutor, Department of Anatomy, ANMMCH, Bodh Gaya.

Dr. Vijay Kumar Singh Tutor, Department of Anatomy, NMCH, Patna.

Dr. Babita Priti* Tutor, Department of Anatomy, GMC, Purnia Bihar. *Corresponding Author

ABSTRACT

Background: The advent of more conservative methods in the renal surgery has necessitated a more precise knowledge of renal vascularization and its importance in partial and total renal transplantation surgeries. the Intrarenal arterial segmental patterns and its variations in 60 human kidneys by dissection. **Material and methods:** Totally 60 adult human kidneys were studied in the present work belonging to both sexes; Out of it 40 were procured from dissection cadavers in the Department of Anatomy, at Anugrah narayan magadh medical college and Hospital Bodh Gaya, Bihar. Before removal of the kidneys from the bodies, possibilities of additional renal arteries from the common iliac, internal iliac, lumbar, sacral, superior mesenteric, hepatic and inferior suprarenal arteries were looked upon. **Conclusion:** importance is given to the segmental artery which arises in common and divides within the renal parenchyma, as healthy renal tissue is often involved during partial nephrectomy of the affected part during ligating the specified segmental artery.

KEYWORDS

Human Kidneys, Intrarenal, Arterial segmental patterns.

INTRODUCTION

Intrarenal arterial segmental pattern of human kidneys and its variations has been undertaken because of its urosurgical importance in making a relatively bloodless surgical approach to the kidneys and to save the healthy renal tissue in partial nephrectomy. The advent of more conservative methods in the renal surgery has necessitated a more precise knowledge of renal vascularization and its importance in partial and total renal transplantation surgeries. The renal vascular segmentation was originally recognized by John Hunter[1] in 1794 and wrote "The veins in the spleen and kidney anastamose in vary large trunks while the arteries do not at all" but the idea of segmental anatomy started with the discovery of bronchopulmonary segments in 1889 by William Ewart[2] In 1901 Max Bordel[3] has advocated an incision on the posterior side of the lateral border of the kidney as this site was thought to be relatively avascular but however in practice most of the surgeons had found that this is by no means a bloodless area. In 1952 F. T. Graves[6.] came across two cases of nephrolithotomy which resulted in post operative persistent hematuria which compelled him to do total nephrectomy in order to save the life of the same patient. The loss of the normal kidney that has partially affected prompted him to investigate the arterial distribution in the kidney substance. Hence in 1954, he made an outstanding contribution to the renal surgeries by describing five segmental branches of the renal artery with little anastamosis of there neighboring branches for the establishment of an effective collateral circulation in cases of segmental infarction of the kidney. In 1955, Riches[8] said the knowledge of avascular planes is most important and therefore the renal angiography should be considered as an essential investigation prior to all the endourological surgeries and partial nephrectomy is contemplated. Even in 1950[4] Abehouse and Lerman also advocated the renal arteriography and determined the distribution of the segmental artery by noting the purplish discoloration produced by its compression. In 1960, Robert stressed the necessity of knowing the variation in the vascular segmental patterns to prevent the avoidable loss of normal healthy renal tissue which occurs in total nephrectomy while removing the infarcted renal tissue. Thus from radical total nephrectomy to conservative partial nephrectomy. In 1963, D. Sykes said that surgeons should know all the possible variations and their incidence to make through search and take spot decision at the operation table as their vascular patterns in the kidneys are not same in all the kidneys or similar in the two kidneys of the same person. many workers especially endourological surgeons from time to time confirmed the clinical importance of the intrarenal arterial segmental patterns and its variations for adventing more conservative therapy or the surgeries.

OBJECTIVES

study the intrarenal arterial segmental patterns and its variations in 60 human kidneys by dissection, To help the endourologic surgeons to carry out safer surgeries on kidneys.

Review of Literature

John Hunter (1794) [1] said that the veins in spleen and kidneys anastamose but not the arteries and the search for segmentation in kidneys was made when William Ewart[2] discovered broncho pulmonary segments in lungs. Max Bordel (1901) described a relatively avascular zone in the kidney cortex where the branches of anterior and posterior divisions of the renal artery end as functional end arteries. So he advocated an incision on the posterior side of the lateral border of the kidney to minimize bleeding.In 1950 Abehouse and Lerman also advocated the renal arteriography and determined the distribution of the segmental artery by noting the purplish discoloration produced by its compression which enables the surgeons regarding the amount of tissue to be resected. Robert More and Lyman Duff in 1951 denoted the independence of anterior and posterior major divisions supplying larger anterior about 2/3rd and smaller posterior about 1/3rd respectively. He named the five segments of the kidney as apical, upper, middle, lower and posterior. He termed the medial part of the kidney at its upper pole as the apical segment, a larger part at the lower pole as lower segment, posterior portion of the intervening these parts as 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 him are supplied by anterior division of the renal artery and posterior segment by its posterior division. Robert J Merklin and Nicholas A Michels (1958) reported various possibilities of origin of segmental renal arteries from inferior phrenic artery to apical or upper segmental, apical artery giving rise to inferior suprarenal artery, and origin of upper, middle or lower segmental arising directly from abdominal aorta. Donald F, McDonald and Johan M. Kennelly, JR. (1959) done vinylite artery casts which reflected the condition of the vessels and said right renal arterial anomalies constitute 65% compared to left. Kher, Bhargawa and Makhani (1959) studied 53 human kidneys by dissection and by corrosion method. Verma, Chaturvedi and Pathak (1961) studied casts of butyrate acetate of renal artery; of them, 83 cases showed extrahilar branches of the renal artery. They described a variation in which the anterior division of renal artery after entering the kidney was arching lateral wards like the posterior division and was giving four segmental branches from its convex side to the apical, upper, middle and lower segments. They also observed that in 16 specimens apical segmental artery was absent. Arne Ljungvist and Curt Lagergren (1962) detected that kidney depends upon the lumen of the segmental artery. Partial or complete blocking of any segmental artery in old age leads to decreased segmental perfusion and may lead to that segmental ischemia. David Sykes (1963) studied 82 kidneys. He noted three types of arterial segmental pattern (1) Typical arterial type was present in 59 casts corresponding to the description given by Graves, (2) Typical venous type present in 6 casts and (3) Dual arterial pattern in 17 casts. He was the first to describe the venous pattern of the renal arterial branching. Chatterjee S K and Dutta A K (1963) studied the segmental

pattern in 59 kidneys by injecting neoprene latese under pressure of 150 to 160 mm of mercury into renal artery and also by arteriography.

MATERIAL AND METHODS

Total number of adult human kidneys studied in the present work was 60 belonging to both sexes, Out of which 40 were procured from dissection cadavers in the Department of Anatomy, at Anugrah narayan magadh medical college and Hospital, Bodh Gaya Bihar. Study duration of two years. all the three methods, after identifying the supernumerary renal arteries from the aorta, the kidneys of each pair were separated along the renal arteries by discarding the piece of aorta. Before removal of the kidneys from the bodies, Adult human kidneys from the dissection cadavers were washed in running tap water to remove the formalin. The narrow end of the silicon gun was tightly kept in the stem of renal arteries and slowly silicon material was injected till complete resistance occurs.

RESULTS

The nomenclature of the renal segments approved at the 8th International Congress of Anatomists held in Wiesbaden, Germany in 1965 is as superior (apical of Graves), anterior superior (upper of Graves), anterior inferior (middle of Graves) and posterior segments (posterior of Graves). The classification adapted here is based mainly on the classification of the various types of renal segmental arteries made by Graves. He described four types of the apical segmental arteries according to its mode of origin and three of the anterior division of the renal artery based on its mode of termination[6]. Kher et al modified the grouping of the Graves. They grouped the other arteries also formerly omitted by Graves. They classified (1) Six types of the apical segmental arteries instead of four types described by Graves and (2) Four types of the lower segmental artery not typed by Graves. Verma et al further modified the classification. They grouped (1) Four groups of anterior division of the renal artery instead of the three groups described by Graves (2) Three types of the posterior division not typed by the previous workers, David Sykes described the venous type of branching of the renal artery.

The anterior division terminates as the upper and middle segmental arteries after giving off the lower segmental artery. The specimens were grouped as shown on table no. 1

Sl. No.	Side	Method	Specimens No.	Total
1	Right	Dissection	27	1
2	Left	Dissection	12,22,30,46	4
3	Right	Cast	-	0
4	Left	Cast	-	0
5	Right	Radiological	-	0
6	Left	Radiological	54	1
Total Percentage = 10%			**Total Specimens**	**6**

The anterior division terminates as the middle and lower segmental arteries after giving off the upper segmental artery.

Sl. No.	Side	Method	Specimens No.	Total
1	Right	Dissection	1,3,7,11,13	5
2	Left	Dissection	-	0
3	Right	Cast	-	0
4	Left	Cast	-	0
5	Right	Radiological	-	0
6	Left	Radiological	34,47	2
Total Percentage = 11.66%			**Total Specimens**	**7**

The anterior division gives off three terminal branches viz., apical, upper and middle after giving off lower segmental artery much before the hilum.

Sl. No.	Side	Method	Specimens No.	Total
1	Right	Dissection	23	1
2	Left	Dissection	4,6,38	3
3	Right	Cast	50,53	2
4	Left	Cast	52,49	2
5	Right	Radiological	-	0
6	Left	Radiological	59,60	2
Total Percentage = 16.66%			**Total Specimens**	**10**

Arises from the anterior division of the renal artery along with most of the other segmental arteries.

Sl. No.	Side	Method	Specimens No.	Total
1	Right	Dissection	5,9,15,17,21,23,29,39,41,45	10
2	Left	Dissection	2, 4, 6, 8,10,16,18,24,26,28	10
3	Right	Cast	53	1
4	Left	Cast	33,49,51,52	4
5	Right	Radiological	55,56,57	3
6	Left	Radiological	35,36,58,59,60	5
Total Percentage = 55%			**Total Specimens**	**33**

Arises from the posterior division of the renal artery.

Sl. No.	Side	Method	Specimens No.	Total
1	Right	Dissection	9, 13	2
2	Left	Dissection	-	0
3	Right	Cast	50	1
4	Left	Cast	31, 49	2
5	Right	Radiological	-	0
6	Left	Radiological	-	0
Total Percentage = 8.33%			**Total Specimens**	**5**

accessory renal artery arises directly from the aorta and it replaces one or two of the segmental branches of the anterior division of the renal artery which accounts for 6.66%. If present it is usually arises superior to the normal renal artery or it may arise in close to it.only 3 specimens i.e. 5%, in which a single accessory renal artery arises directly from the aorta and replaces the anterior or the posterior division of the renal artery.

DISCUSSION

The advent of more and more conservative methods in the field of endourological surgeries has necessitated the precise anatomical knowledge of the renal segmentations and its vascular patterns. It is also involved in knowing the renal function by noting the amount of renal perfusion by the arteries to that of amount of urine formed from the collecting system.The description of Brodel`s line in 1901 revolutionized renal surgery[3]. Since that time, a variety of complex renal reconstructive procedures have evolved for renal parenchyma preservation as an alternative to simple or radical nephrectomy. The lack of arterial anastomosis in the neighboring segments will affect only the affected segment and will neither produce ischemia nor interfere with blood supply of neighboring segments. This lack of arterial anastomosis will render the technique of resection easier, since the field of operation will be relatively bloodless following the ligation of the segmental artery supplying the area of the operation.It should be remembered that the origins of the segmental arteries are accessible. In the majority of cases, they are easily seen in the hilum and often at the points nearer the aorta. This is of practical value, since segmental resection is best carried out from the hilum towards the periphery. Accessory renal arteries to the lower aspect of the renal hilum are often found in close relation to the ureteropelvic junction or upper part of the ureter. Their presence accentuates the obstruction leading to hydronephrosis. Hence, they cannot be ignored. F.T. Graves[6] and Kher et al made only 3 types of anterior divisions, where as in the present study totally 8 types have been described which has not being described by the previous workers. The variation of type V has not been commented upon by Graves, but Verma et al noticed the said variation in 12.5% of specimens in their study; but the authors have not categorized the variation. But, this has become a specific type and was observed in 6.66% of specimens in the present work. where in the lower segmental artery is a direct branch from the aorta was noted in 28.33% of cases but along with the middle segmental artery. In this type IV pattern, one has to be aware of the gonadal artery arising in turn from the lower segmental artery, sometimes quite near the kidney. Ligation of the latter must therefore be made after the artery to the gonad has originated, as otherwise testicular atrophy will eventually develop (Graves[6]). However such variations were not seen in the present study.In 10% of the cases (Type III), the lower segmental artery is given off directly from the renal artery much before the hilum. But others findings varies like 1% of Kher et al, 3% of Verma et al and 41% of H. Fine et alThe accessory or aberrant renal arteries have been of interest to the clinicians for many years, mainly because of the possible part that the vessel may play in the causation of the hydronephrosis. Many cases have been described in literature in which, one aberrant or accessory artery is found to enter the lower pole of the kidney and to lie in such a position as to appear to obstruct the outflow of the urine at the pelvi-ureteri junction. However, opinion is also divided on the advisability of dividing the aberrant vessel, as the effects of such an intervention upon the obstruction and the possibility of resultant necrosis of part of the kidney have to be borne in min.

CONCLUSION

The advent of more and more conservative methods in the renal

surgery has necessitated a more precise knowledge of renal vascularization and its importance in partial and total renal transplantation surgeries. Therefore the valuable contribution of anatomical knowledge to operative surgery, particularly in partial or segmental resection of kidneys, will help further development of different techniques for the removal of calculi or affected part of kidneys and also helps in partial renal transplantation surgeries with end to end anstamosis of the resected part of the kidney.

REFERENCES

1) John Hunter. Vasculature of the body. Br J Surg 1794; 38: 1-8.
2) William Ewart. Bronchopulmonary segments of lung. Br J Surg 1889; 38: 1-8.
3) Bordel. Urological clinics of North America 1901;4: 19-21.
4) Abehouse and Lerman. Internal branching of the renal artery. Ind J Surg 1950; 22: 563-579.
5) Robert H More, Lyman G Duff. The renal arterial vasculature in man. Am J of Path 1951; 27: 95-108.
6) Graves F T. The anatomy of intrarenal arteries and its application to segmental resection of the kidneys. Br J Surg 1952; 42: 132-140.
7) Graves F T. The aberrant renal artery [synopsis]. Proc of soc of med 1957: 50: 368-370.
8) Riches E W. The present status of renal angiography. Br J Surg 1955; 42: 462-470.
9) Bose P. A study of the gross vascular pattern in human kidney. J of Anat Soc Ind 1955; 4: 18-25.
10) Robert J Merklin and Nicholas A Michels. The variant renal and suprarenal blood supply with data on the inferior phrenic, ureteral and gonadal arteries. J of Int col of Surg 1958; 29: 41-76.
11) Donald F, McDonald and Johan M Kennelly, JR. Interarenal distribution of multiple renal arteries. J of Uro 1959; 81:25-26.
12) Kher, Bhargawa and Makhani. Anatomy of renal vascular segments. J of Anat Soc of Ind 1959; 10: 12-14.
13) Servo V.V. Segmental arterial distribution in the human kidney. J of Urol 1959 March; 24-26.
14) Mahesh Verma, R P Chaturvedi and R K Pathak. Anatomy of renal vascular segments. J of Anat Soc of Ind 1961; 10: 12-19.
15) Mahesh Verma and R P Chaturvedi. Buteryate acetate and alkathene for renal casting. J of Anat Soc of Ind 1961; 10: 34-37.
16) Arne ljungqvist and Curt Lagergren. Normal intrarenal arterial pattern in adult and ageing human kidney. J Anat 1962; 96: 285-300.
17) David Sykes. The arterial supply of the human kidney with special reference to accessory renal arteries. Br J Surg 1963; 50: 368-370.
18) Zhao B. A new distinctive variation of renal arterial vascularization. Anat Anz 1997 Oct; 179(5):487-488.
19) Bergmen, Thompson and Affi Saadeh. Compendium of human anatomical variations. Urban & Schwarzenberg: 1998; 81-83.
20) Bretan PN, Malone MJ. Complex renal reconstruction. Urol Clin North Am 1999; 26(1): 201-2