

Study on Renal Artery Segmental Branching Pattern in South Indian Population

Dr. Girish V. Patil¹, Dr. Shishirkumar²

¹Associate Professor, Department of Anatomy, DM- Wayanad Institute of Medical Sciences, Meppadi, Wayanad. Kerala, India

²Assistant Professor, Department of Anatomy, DM- Wayanad Institute of Medical Sciences, Meppadi, Wayanad. Kerala, India

Abstract: Study on arterial segments of the human kidney has been undertaken because of its surgical importance in making a relatively bloodless surgical approach to the kidney and to save the healthy renal tissue in partial nephrectomy and nephrolithotomy. The advent of more conservative methods in the renal surgeries has necessitated a more precise knowledge of renal vascularisation and that has consequently assumed new importance. Total 100 adult human kidneys were studied in the present work which were collected and studied. 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. The presence of the arterial segments within the substance of kidney does not change, but, there is a lot of variation in the course and exact point of origin from the renal artery or aorta of these segmental vessels outside the substance of the kidney.

Keywords: Arterial segments, Calculi, Kidney, Nephrectomy, Nephrolithotomy

1. Introduction

Study on arterial segments of the human kidney has been undertaken because of its surgical importance in making a relatively bloodless surgical approach to the kidney and to save the healthy renal tissue in partial nephrectomy and nephrolithotomy. The advent of more conservative methods in the renal surgeries has necessitated a more precise knowledge of renal vascularisation and that has consequently assumed new importance.

In 1952, F.T. Graves [1] made an outstanding contribution to renal surgery by describing the five segmental branches of the renal artery with very little anastomosis of their neighbouring branches for the establishment of an effective collateral circulation in cases of segmental infarctions of the kidney.

In 1955, Riches said [2] "The renal angiography should be an essential investigation for all cases of partial nephrectomy. The knowledge of avascular planes is most important. The renal angiography should be considered an essential investigation in all cases where partial nephrectomy is contemplated. Hence the knowledge of renal arteries and there segmental pattern is most important".

The renal artery arises from the lateral, anterolateral or posterolateral aspect of the abdominal aorta immediately below the origin of superior mesenteric artery at the level of first lumbar vertebra. The right and left renal arteries may arise at the same or at different levels. The right artery is often higher. The left renal artery usually runs horizontally or even slightly upwards. The renal artery divides into anterior and posterior divisions anywhere between the aorta and the renal hilum or even inside the sinus.

The primary branches of renal artery are usually two and called anterior and posterior divisions. The secondary branches are the segmental arteries. The branching of the renal artery is variable. The five segments of the kidney

were named as: Apical, Upper, Middle, Lower and Posterior.

2. Materials and Methods

Total 100 adult human kidneys were studied in the present works which were collected from the department of Anatomy DM- Wayanad Institute of Medical Sciences, Wayanad Kerala. The formalin preserved human kidneys were washed in running water to remove formalin. The capsule of each kidney was removed. The parenchymatous tissue was removed piece-meal with forceps under water, tracing the segmental arteries. The segmental branches were later painted with enamel oil paints using the following colors. The dissected specimens were preserved in 7% formalin.

Vessel	Colour
Aorta, Renal artery and its anterior division	Red
Apical segmental artery	Yellow
Upper segmental artery	Blue
Middle segmental artery	Black
Lower segmental artery	Green
Posterior division and posterior segmental artery	White

3. Results



Figure 1: Anterior division segmental branching pattern

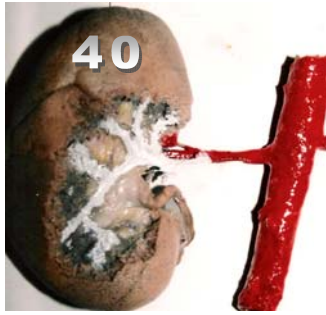


Figure 2: Posterior division branching pattern



Figure 3: showing accessory renal vessels

Table 1: showing the pattern of anterior division of the renal artery

Specimen studied	Type I, terminates as the upper and middle segmental arteries after giving off the lower segmental artery (3 segments).	Type II, terminates in the middle and lower segmental arteries after giving off the upper segmental artery (3 segments).	Type III, gives origin to the apical segmental artery and then to 3 terminal branches, upper, middle and lower segmental arteries (4 segments).	Type IV does not give off the apical segmental artery but gives off 3 terminal branches, the upper middle and lower (3 segments).	Type V, runs downwards with an outward convexity from which the apical, middle and lower segmental arteries arise (4 segments).	Type VI, the anterior division terminates into middle and lower segmental artery (2 segments).
Right	14%	16%	8%	6%	2%	4%
Left	16%	18%	10%	-	4%	2%
Total	30%	34%	18%	6%	6%	6%

Table 2: showing the pattern of apical segmental artery

Specimen side	Type I, from the anterior division of the renal artery.	Type II, from the upper segmental artery.	Type III, from the junction of the anterior and posterior divisions of the renal artery.	Type IV, from the renal artery.	Type V, from the aorta.	Type VI, from the posterior division of the renal artery.
Right	14%	20%	-	6%	4%	6%
Left	26%	16%	-	6%	-	2%
Total	40%	36%	-	12%	4%	8%

Table 5: Showing the pattern of posterior division of the renal artery

Specimen side	Type I, The normal pattern of the posterior division	Type II, Here, the conventional pattern of arching is not present, but the posterior division has bifurcated or trifurcated at the hilum posterior to ureteric pelvis.	Type III: The posterior division is relatively larger due to the additional replacement of segmental arteries of anterior division.
Right	38%	8%	6%
Left	38%	8%	2%
Total	76%	16%	8%

Table 3: Showing the pattern of lower segmental artery

Specimen side	Type I, from the anterior division of the renal artery.	Type II, from the posterior division of the renal artery.	Type III, arises from the renal artery.	Type IV, arises either above or below the renal artery from the aorta
Right	40%	-	2%	8%
Left	32%	-	6%	12%
Total	72%	-	8%	20%

Table 6: Types of accessory renal arteries replacing segmental arteries

Specimen side	Superior accessory renal artery replacing the apical segmental artery.	Inferior accessory renal artery replacing the lower segmental artery.	Replaces the anterior or the posterior division of the renal artery.
Right	4%	8%	-
Left	-	12%	4%
Total	4%	20%	4%

Table 4: Showing the pattern of middle segmental artery

Specimen side	Type I arises from the anterior division of the renal artery.	Type II arises from the upper segmental artery.	Type III arises from the lower 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	18%	4%	28%	-	-	-
Left	18%	6%	24%	2%	-	-
Total	36%	10%	52%	2%	-	-

4. Discussion

Renal surgery had its inception a century ago. The courageous and enthusiastic contributions made by surgeons in several countries informed and stimulated their colleagues and led to rapid progress in renal surgery. Partial nephrectomy is a technique which, until relatively recently, had not been highly favored. The actual technique of partial nephrectomy varies according to clinical preference, but all methods incorporate four basic principles:

1. Early control of the main renal vasculature.
2. Minimal renal ischaemic time.
3. Meticulous haemostasis.
4. Complete closure of the collecting system.

Sam D Graham [3] states that, as long as the four principles are observed, the incidence of complications will be minimal. Partial nephrectomy is undoubtedly the procedure of choice. Somewhat less firm indications are a localized disease segment, usually either upper or lower pole; when removed, the affected portion would provide a good chance of cure. As Sam D Graham [3] states, total nephrectomy should be performed only when absolutely necessary; that in local diseases of the kidney, the operative intervention should, whenever possible, be limited to the diseased part (partial nephrectomy).

The new techniques employed in renal surgery mainly depend upon the segmental resection, namely wedge-type resections, if upper or lower segments are affected by the disease. But for the mid-portion lesions, the enucleation technique, although obviously limited to tumours, may be employed in other conditions with minimal loss of renal functions.

With the increased interest in renal vasculature lesions, especially associated with hypertension, Pontasse and others [4] had a good result with the use of partial nephrectomies for segmental vascular diseases. Isolated congenital or atherosclerotic arterial stenosis, arteriovenous malformations and inter-renal arterial aneurysms are all amendable to partial nephrectomy.

The most commonly seen complication encountered after partial nephrectomy is bleeding. Life was threatened by post-operative complications such as severe bleeding prior to the advent of the conservative segmental resections. Later, the profound knowledge of variations of the mode of origin of the segmental arteries reduced the mortality rate. The attention to haemostasis and the use of cold ischaemia have reduced the complication rate considerably.

The lack of arterial anastomosis in the neighbouring segments will affect only the affected segment and will neither produce ischaemia nor interfere with blood supply of neighbouring 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. The ligation and division of accessory vessels without resection of the

ischemic tissue was condemned by Zoram L. Babaric [5]. These vessels can be preserved in most of the cases.

5. Conclusion

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. The presence of the arterial segments within the substance of kidney does not change, but, there is a lot of variation in the course and exact point of origin from the renal artery or aorta of these segmental vessels outside the substance of the kidney. After the advent of the renal segments, the urological complications following partial nephrectomy have considerably reduced. Nephrectomy or total removal of a kidney will no longer be performed, if a lesser procedure can offer a better prospect. Every fragment of healthy, functional renal tissue should be preserved, provided that it has an arterial supply, a venous drainage, and a urinary exit, and expertise is available to preserve the healthy fragment.

References

- [1] Graves F.T. "The anatomy of intrarenal arteries and its application to segmental resection of the kidneys". *Br J Surg* 1952; 42:132-140.
- [2] Riches E.W. "The present status of renal angiography". *Br J Surg* 1955; 42:462-470.
- [3] Sam D Graham. "Conservative renal surgery an anatomical basis". *Br J of Surg*, 1960; 43:1-8.
- [4] Pontasse. "Partial nephrectomy in the treatment of renal calculi". *Ann Roy Coll Surg (Eng)*, 1952; 11:32-46.
- [5] Zoram L. Babaric. "The nephroplastic procedure in the treatment of hydronephrosis". *Br J of Urol*, 1957; 29:277-286.

Author Profile



Dr. Girish V Patil has completed his MBBS from KIMS Hubli and has completed his M.D in Anatomy from VIMS Bellary. He has also finished his DNB Anatomy. He is presently working as an Associate Professor in the Department Of Anatomy, DM-WIMS Meppadi, Kerala, India



Dr. Shishirkumar has completed his MBBS from KLE'S JNMC Belgaum and has completed his M.D in Anatomy from K.S.Hegde Medical Academy, Deralakatte, Mangalore. He is presently working as an Assistant Professor in the Department Of Anatomy, DM-WIMS Meppadi, Kerala, India