



VARIATIONS IN BRANCHING PATTERN OF RENAL VESSELS.

Anatomy

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ABSTRACT

The kidneys are paired reddish brown structure present on posterior abdominal wall on either side of vertebral column. The renal artery arises laterally from abdominal aorta just below the origin of superior mesenteric artery at the level of second lumbar vertebra. The right renal artery is little longer and left renal artery is slightly higher in its origin. The right renal vein is shorter than left renal vein. We found variations in renal vessels i.e. in both the arteries and veins in 3 cases. In 1st case on left side double renal veins are present. In 2nd case on right side double renal arteries are present. In 3rd case on right side inferior phrenic artery take origin from right renal artery. Knowing the anatomy, variations and pattern of the renal vessels are important prior to surgical interventions and procedures in the abdomen as they act as road map.

KEYWORDS

Kidneys, Renal Artery, Renal vein, Vessels.

Introduction

The kidneys are paired reddish brown structure present on posterior abdominal wall on either side of vertebral column (Richard S Snell). The renal artery arises laterally from abdominal aorta just below the origin of superior mesenteric artery at the level of second lumbar vertebra. The right renal artery is little longer as abdominal aorta lies on left side and left renal artery is slightly higher in its origins (NBS Parmala). The renal veins are present anterior to renal arteries and drain into inferior vena cava. The right renal vein is shorter than left renal vein described by Bolla SR.

In 70% individuals each kidney is supplied by a single renal artery and in 30% of individuals accessory renal arteries are present. However the classical description of the renal vasculature, formed only by one artery and one vein, occurs in less than 25% of cases. Variations in pattern of renal arteries have been reported more frequently than any other large vessels in the body. Feller I et al. described that knowledge of these variations has great importance when a surgical approach is made to abdominal aorta which has basic anatomical relationship with the neighbouring structures.

Vanita Gupta mentioned development of kidney starts in the pelvic cavity and they are supplied by the branches of internal iliac or common iliac arteries. During further development kidneys ascend to lumbar region, their arterial supply also shifts from common iliac artery to the abdominal aorta. Accessory renal arteries are common (30% of individual) and commonly they arise from abdominal aorta either below or above the main renal artery reach the hilum. Rarely they arise from celiac trunk, superior mesenteric arteries or common iliac arteries. by Standring S Gray's Anatomy. B He and JM Hamdrop explained that proper knowledge of anatomical variations of renal vessels and their embryologic development will help the surgeons to anticipate and manage these potential risks successfully to prevent the complication.

Materials And Method

The material taken for the present study was formalin fixed fifteen cadavers of both the sexes. The material collected from routine abdominal dissection of embalmed cadavers done for medical undergraduate students over a period of five years in the Department of Anatomy, B.P.S Medical College for women, Khanpur Kalan,

Sonipat. During the dissection kidneys along with their vessels were dissected carefully and the morphological variations of vessels were noted.

Results

The total 30 number of specimens from fifteen cadavers were dissected and observed carefully. Age of cadavers ranged from 30- 50 years. We found variations in renal vessels i.e. both the arteries and veins in 3 specimens. The following results were found.

Specimen 1

On Right Side:

Renal Artery-

Origin of right renal artery was normal. It arises laterally from the abdominal aorta at the level of intervertebral disc of L1 and L2 vertebra. After taking origin it divides into four branches. The 1st one was superior polar artery and it supplied the superior/upper pole of right kidney after entering into it.

The remaining three were hilar branches or arteries and supplied the centre and lower pole of right kidney after entering into it.

Renal Vein

- It receives the two tributaries from the right kidney and drained into the inferior vena cava.

On Left Side:

Renal Artery

- After taking origin from lateral side of abdominal aorta at the level of L1-L2 vertebra, it ran towards the hilum of left kidney. Here it passed between the main left renal vein which lies above and accessory renal vein which lies below to it i.e. it got sandwiched between the two left renal veins. Before entering into the hilum it gave one polar branch to supply superior pole of left kidney.

Renal vein-

Two renal veins (upper and lower) were emerging from the hilum of the kidney. Upper one was main renal vein as it has normal relations with the neighbouring structures. Lower vein was accessory renal vein. After emerging from hilum of kidney accessory renal vein unite with main renal vein and finally drained into the inferior vena cava at

the level of L2 vertebra.

Specimen 2 On Right Side Renal Artery

There were present double renal arteries i.e. superior and inferior. Both the arteries were arising from the abdominal aorta. Superior renal artery was considered main renal artery as it arose immediately below, approximate 0.5 cm the superior mesenteric artery at the level of L1-L2 vertebra. Inferior renal artery was considered accessory renal artery as it got originated from below the normal level i.e. 1.25 cm below the superior mesenteric artery. After taking origin superior renal artery ran downward towards the hilum, entered into it and divided into two hilar branches. Inferior renal artery ran upward and towards the upper pole of kidney and divided into three branches i.e. 1st one was superior polar and remaining two were hilar branches. Both superior and inferior renal arteries crossed each other and forming X-pattern.

Renal Vein

It follows the normal course.

On Left Side

Both the renal artery and vein follows the normal pattern.

Specimen 3 On Right Side Renal Artery

After arising from lateral part of abdominal aorta just below the superior mesenteric artery it ran towards the hilum and divide into four branches:-

- 1 Inferior phrenic artery supplied the diaphragm.
- 2 Inferior suprarenal artery supplied right suprarenal gland.
- 3 Superior polar artery (two in number) supplied upper pole of right kidney.
- 4 Hilar branch entered into the hilum.

Renal Vein

It follows the normal course.

On left Side

Both renal artery and vein follows the normal course.

Discussion

The variations of renal vessels in origins, course, branches have been studied in detail in present study. It was found that in one specimen the right renal artery is double and both were arising from abdominal aorta. Level of origins of both the arteries were different. Superior one was arising approximate 0.5cm just below the superior mesenteric artery at the level of L1-L2 vertebra and inferior artery approximate 1.5cm below the superior mesenteric artery at the level of L2 vertebra. The distance between the origins from the aorta of double renal arteries was approximate 1cm. This is comparable with the study conducted by Satyapal et al. that the distance between the double renal arteries was highly variable with an average ranging between 1-2mm to 4-6cm. Bordei et al observed double renal arteries and triple renal arteries in their study. Neelesh Kanaskar et al reported double renal arteries. Janschek EC et al. in reported incidence of multiple arteries 20.2% and 19% on right and left sides, respectively. There was discrepancy regarding the side in which additional arteries were presented, Vilhova I et al. reported a higher frequency on the left side, while Khamanarang et al. and Nayak S reported this variation to be more frequent on the right side. In same specimen the origin of left renal artery is normal between L1 and L2. These variations in renal arteries are due to different positions of kidney during development.

In 2nd specimen double renal veins were present. Both were emerging from hilum at different level but they drain commonly into the inferior vena cava as accessory renal vein unite with the main renal vein before draining into inferior vena cava. Mandal et al., Dhar and Persaud described double renal veins but they drained separately into the inferior vena cava. Senecail and Nonent reported two rare anomalies of left renal vein, a circumaortic venous ring and a retroaortic bifid left renal vein.

In 3rd specimen on right side the inferior phrenic artery arises from a renal artery. This variation was similar with previous studies done by Pia O, Pulakunta, Loukas, mentioned same observation that inferior phrenic artery arises from the renal artery.

Variations of renal vessels are very important for surgeons due to increased in frequency of renal diseases and renal transplantation as it enhance the quality of patient life. Verma P et al. mentioned that variations in anatomy of left renal artery is most critical as it is referred site for resecting donor kidney.

Soni S and Wadhwa A explained accessory renal arteries are important as they are end arteries and damage of these end arteries causes ischemia of that part of kidney which is supplied by it.

CONCLUSION

Knowing the anatomy, variations and pattern of the renal vessels are important prior to surgical interventions and procedures in the abdomen as they act as road map. A failure in identifying these variations can cause serious complications like haemorrhage, necrosis of kidney etc. Presence of multiple vessel is important cause of patient unfit for many surgical procedures.



Figure 1: Showing left renal artery present between left renal vein and accessory renal vein. A-Aorta, LRV – Left renal vein, LRA – Left renal artery, ARV – accessory renal vein, LK – Left kidney, IMA – Inferior mesenteric artery, LU – Left ureter

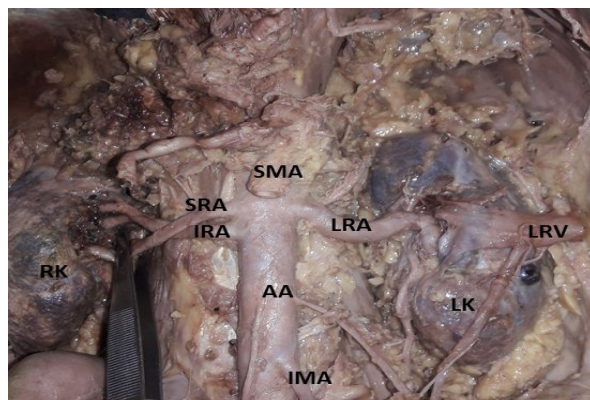


Figure 2: Showing double renal arteries supplying right kidney. SMA – Superior mesenteric artery, SRA- Superior renal artery, IRA- Inferior renal artery, LRA- Left renal artery, AA- Abdominal aorta, LRV- Left renal vein, LK- Left kidney, RK- Right kidney, IMA- Inferior mesenteric artery.

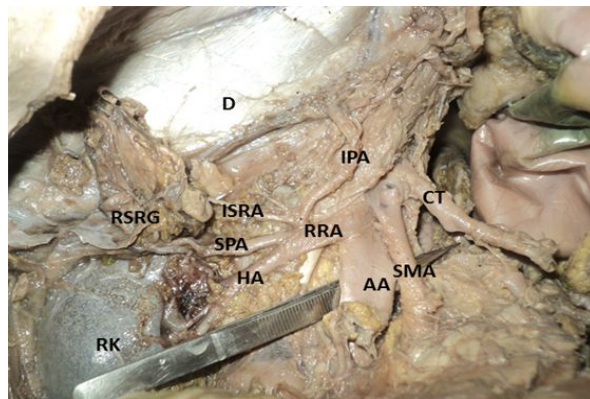


Figure 3: Showing variation of origin of Inferior Phrenic artery from the right renal artery. (D- Diaphragm, RSRG- right suprarenal gland, ISRA- Inferior suprarenal artery, SPA- Superior polar artery, HA- Hilar artery, RK- Right kidney, RRA- Right renal artery, AA- Abdominal aorta, SMA- Superior mesenteric artery, CT- Coeliac trunk, IPA- Inferior phrenic artery.)

REFERENCES:

- 1 Richard S.Snell. Clinical anatomy by regions. 8th edition. Chapter 5- The abdominal cavity.
- 2 N B S Parmala DOI:10.7860/JCDR/2013/5424.3151.
- 3 Bolla SR , Kumar S , Gorantla VR , Reddy S , Pamidi N , Jetty R. An unusual case of bilateral duplication of renal vessels:It's clinical implications.
- 4 Feller I, Woodburne RT. Surgical anatomy of the abdominal aorta. *Ann Surg* 1961; 154: 239-52.
- 5 Vanita gupta et al. Bilateral variations in renal vasculature. *IJAV*, 2010; 3: 53-55.
- 6 Susan Standring. Gray's Anatomy-Anatomical Basis of clinical practise. 40th Ed, Elsevier Churchill Livingstone, Toronto: Elsevier Ltd. 2005:1231.
- 7 B He, JM Hamdorf. Clinical importance of anatomical variations of renal vasculature during laproscopic donar nephrectomy. *OAAnatomy* 2013 Oct 18;1(3):25.
- 8 Satyapal KS, Haffjee AA, Singh B, Ramsaroop L, Robbs JV, Kalideen JM. Additional renal arteries; Incidence and morphology. *Surg Radio/ Anat.* 2001; 23: 33-48.
- 9 Bordei P, Sapte E, Iliescu D. Double renal arteries originating from the aorta, *Surg Radiol Anat*, 2004, 26(6):474-479.
- 10 Naleesh kanaskar, Vaishali Paranjape, Jyoti Kulkarni Sapna Shevade; Double accessory right renal arteries; *Journal of Dental and medical sciences* Volume 1, Issue 5 (Sep-Oct. 2012), PP 17-20.
- 11 Janschek Ec, Rothe Au, Hölzenbein Tj, Langer F, Brugger Pc, Pokorny H, Domenig Cm, Rasouloekenschaub S, Mühlbacher F, Anatomic basis of right renal vein extension for cadaveric kidney transplantation, *Urology*, 2004, 63(4):660-664.
- 12 Vilhova I, Kryvko Yy, Maciejewski R, The radioanatomical research of plural renal arteries, *Folia Morphol (Warsz)*, 2001, 60(4):337-341.
- 13 Khamanarong K, Prachaney P, Utraravichien A, Tong-Un T, Sripaoraya K, Anatomy of renal arterial supply, *Clin Anat*, 2004, 17(4):334-336.
- 14 Nayak S, Common celiaco-mesenterico-phrenic trunk and renal vascular variations, *Saudi Med J*, 2006, 27(12):1894-1896
- 15 Mandal S, Mandal P, Basu R. Bilateral accessory renal arteries, additional right renal vein and retroaortic left renal vein – A case report. *International Journal of Health Sciences and Research*. 2013;3:88-93. [10]
- 16 Dhar P. An additional renal vein. *Clinical Anat*. 2002;15:64-66. [9]
- 17 Moore KL, Persaud TVN. *The Developing Human: Clinically Oriented Embryology*. 9th edition. Philadelphia. WB Saunders. 2002:293. Subhra
- 18 Senecail B, Bobeuf J., Forlodou P., Nonent M.; two rare anomalies of left renal vein, *Surg. Radiol. Anat.*, 2003 Nov.-Dec.; 25(5-6): 465067, Epub 2003 Sept. 17.
- 19 Piao DX, Ohtsuka A, Murakami T. Typology of abdominal arteries, with special reference to inferior phrenic arteries and their oesophageal branches. *Acta Med Okayama* 1998;52: 189-96.
- 20 Pulakunta T, Potu BK, Gorantla VR, et al. The origin of inferior phrenic artery: a study in 32 south Indian cadavers with a review of the literature. *J Vasc Bras* 2007; 6:3 porto Alegre.
- 21 Loukas M, Hullett J, Wagner T. Clinical anatomy of the inferior phrenic artery. *Clin Anat* 2005;18: 357-65.
- 22 Verma P, Arora AK, Sharma P, Mahajan A. Variations in branching pattern of renal artery and arrangement of hilar structures in the left kidney; clinical correlation, a case report. *Ital J Anat Embryol* 2012; 117: 118-22.
- 23 Soni S, Wadhwa A. Multiple variations in the paired arteries of abdominal aorta- Clinical implications. *Journal of Clinical and Diagnostic Research*. 2010 June,(4). 2622-2625.