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Clinical correlation of renal vasculature variation

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Abstract---Background: The coupled renal arteries typically supply the kidneys, which are retroperitoneal organs. However, there are frequent changes in the way that the renal arteries and their perihilar branches are presented. Aim: The aim of the current research is to evaluate the occurrence of various renal arteries and give a medical association between them. Materials and Methods: The research material consisted of 30 formalin-fixed cadavers. While performing a regular abdominal dissection, the kidneys and their arteries were examined, and the morphological differences in the renal arteries were observed. Result: In 54.8% of the patients, numerous renal arteries were seen to arise from the abdominal aorta, including double hilar arteries (22.7%), triple hilar arteries (11.9%), superior polar and inferior polar arteries (13.2%), and numerous hilar and polar arteries (7.2%). Conclusion: For angiographic tests, kidney transplantation, and urological or radiological operations, understanding the renal vasculature, including its regular as well as variational structure, is essential. This information also makes embolization and angioplasties possible.

Keywords---clinical, renal vasculature, retroperitoneal organs.

Introduction

Renal artery and vein polymorphisms are common in kidneys. In the current generation of kidney transplantations and other cutting-edge renal procedures, a thorough understanding of the changes in the structural arrangement of the kidney vasculature is crucial. The hilum of the kidney is where the renal artery, branching of the abdominal aorta that is often bilateral or paired, empties into the inferior vena cava (1). There is just one renal artery per kidney, and it emerges as a horizontal branch of the abdominal aorta between levels L1 and L2 (2,3). However, less than 25% of instances fit the traditional definition of the renal vasculature, which is made up of just one artery and one vein (4,5). The renal artery's varying quantity and atypical branches that emerge from it are the most frequently observed morphological abnormalities (6-8). The majority of these mutations were not identified until they were seen during a surgical operation or discovered by a forensic pathologist during an autopsy (9). Other names for variations in renal arteries include aberrant, supernumerary, additional, and accessory. The morphology and terminology of such vessels must be standardized as a result.

According to Sampaio and Passos (1992), the arteries should be referred to as numerous since they are divisional channels for the kidneys and do not have anastomoses among them. They must also be given the names ashilar, superior polar, and inferior polar based on the territory that they supply (10). Additional or auxiliary renal vessels may access the kidney in a variety of ways such as through the surface of the kidney, the hilum, or the upper or lower pole as polar arteries (11). For the purposes of our research, we used the terminology proposed by Sampaio and Passos (10), and we assumed that surgical treatment throughout renal transplantation, the repair of abdominal aortic aneurysms, urological procedures, and angiographic interventions all require knowledge of such potential variations of renal arteries (12-14).

Materials and Methods

The study material consisted of 30 cadavers that had been formalin-fixed. The kidneys and their arteries were examined during regular abdominal dissection, and the various morphologies of the renal arteries were recorded. Several abdominal viscera were retrieved and kept as specimens throughout the dissection process for educational purposes. We examined the pre-hilar branches of the major artery that flow to the kidneys and arteries emerging from the abdominal aorta. The bigger aortic branches were known as renal arteries, and the branches that emerged from renal arteries before they reached the hilum were known as pre-hilar branches. A dividing line is seen between two media most points in the frontal plane of each kidney defined the hilum boundaries.

Results

We found a number of single renal arteries, branching from the abdominal aorta, in 18/42 (42.9%) on the right side and 21/43 (47.7%) on the left side. In 24/42 (57.1%) cases on the right side and 23/44 (52.5%) cases just on the left side, various renal arteries believed to have originated from the abdominal aorta were

observable. These arteries include both hilar arteries (DHA), four hilar arteries (THA), two hilar and two Superior polar arteries (SPA), and two hilar and two Inferior polar arteries (IPA). Table 1 shows the percentage distribution of these arteries.

Table 1
Renal arteries for the right and left kidneys, in terms of percentages

Arterial characteristics	Left Kidney	Right Kidney	Total (%)
One Renal artery	21/43 (47.7%)	19/43 (43.0)	39/85 (45.3%)
Four Hilar artery	5/43 (9.6%)	7/43 (14.3%)	11/85 (11.9%)
Various Renal arteries	23/43 (57.2%)	23/43 (52.5%)	47/85 (54.8%)
Hilar and 2 SPA	8/43 (16.7%)	5/43 (9.6)	12/84 (13.2%)
Hilar and 2 IPA	4/43 (9.6%)	3/43 (4.8%)	7/85 (7.2%)
DHA	10/43 (21.5%)	11/43 (23.9%)	20.85 (22.7%)

In 15/43 (33.4%) case scenarios on the right side and 13/43 (28.6%) instances on the left side, the renal artery exhibited premature branching before it entered the kidney's hilum. These initial branches of the main renal artery either had an additional hilar appearance by reaching via one of the kidney's poles or entered the kidney through the hilum. Table 2 shows the renal artery's extra-hilar dispersion.

Table 2
Distribution in percentage of right and left kidney extra-hilar branch of the renal artery

Arterial characteristics	Left Kidney	Right Kidney	Total (%)
Extra-hilar inferior polar	2/43(2.5%0	6/43 (12.0%)	7/85 (7.2%)
Extra-hilar superior polar	9/43 (20%)	10/43 (21.5%)	18/85 (20.3%)

Discussion

Approximately 30% of renal artery alterations are referred to as extra, auxiliary, or aberrant renal arteries (1). The study and therapy of renal injuries, vascular reconstruction procedures, renal hypertension, renal artery embolization, and angioplasty are all aided by knowledge of these variances (11). Accessory renal arteries are additional arteries that run parallel to the renal arteries through the hilum, while aberrant renal arteries are those that enter through the upper or lower pole (polar arteries). These differences have an embryological foundation. The renal, suprarenal, and gonadal organs are supplied by the dorsal aorta and the lateral mesonephric arteries. Felix claimed that the group probably (6th–9th) section of the lateral mesonephric arteries is where the renal arteries originate. Supplemental renal arteries develop when many middle-group arteries are resistant (15).

Saldarriage et al. reported a bilateral accessory artery in 7.7% of patients. He also observed inferior polar arteries in 1.8% of patients and auxiliary arteries in 12% of cases (11). The many pre-hilar branching configurations that were seen included fork, double, triple, and staircase arrangements. These branches show the segmental distribution of the kidney, which increases the risk of bleeding or hemorrhaging after stroke and transplantation. These branching show the divisional organization of the kidney, which increases the risk of bleeding or hemorrhaging after stroke and transplantation (16).

In a research by Bordei P et al., out of 54 cases, twenty-four cases reached the kidney through the hilum, sixteen cases via the inferior polar arteries, and five cases via the superior polar arteries (17). The abdominal aorta is the source of additional and aberrant arteries, which also has the same origin in our study. Clinicians should be aware of these twin renal arteries since they are crucial in the development of clinical disorders including hydronephrosis and renal transplants. Following regular surgical procedures, changes in renal veins are unintentionally discovered in the microvascular system. Comparing to renal veins, which represent for 18% of cases, alterations of arteries are observed rather frequently (18). Anupama et al. found several genetic abnormalities of renal veins, some of which were leaking into the inferior vena cava. Out of thirty, ten occurrences of a right-sided enumerate renal vein and one case of a bilateral supernumerary renal vein were observed (19). According to research, renal vein variations are typically caused by developmental abnormalities of the inferior vena cava, and these abnormalities are more frequent on the right side (28%) than the left (1%) of the body (20,21).

Conclusion

Our research suggests that the vascularization of the kidney exhibits a wide range of anatomical differences. The emergence of numerous renal arteries occurs most frequently. For surgical care during kidney transplantation, abdominal aorta aneurysm repair, urological techniques, and angiographic treatments, we think that knowledge of variances is essential. Understanding these variances is crucial for setting recommendations prior to surgery and lowering the risk of artery trauma from vascular ligation and anastomosis. Arteriography should be carried out to prevent any vascular complications.

References

1. Awojobi OA, Ogunbiyi OA, Nkposong EO. Unusual relationship of multiple renal arteries. Urology. 1983 Feb 1;21(2):205-6.
2. Babinski MA, Machado FA, Costa WS. A rare variation in the high division of the sciatic nerve surrounding the superior gemellus muscle. European journal of morphology. 2003 Feb 1;41(1):41-2.
3. Beregi JP, Mauroy B, Willoteaux S, Mounier-Vehier C, Rémy-Jardin M, Francke JP. Anatomic variation in the origin of the main renal arteries: spiral CTA evaluation. European radiology. 1999 Aug;9(7):1330-4.
4. Bordei P, Şapte E, Iliescu D. Double renal arteries originating from the aorta. Surgical and Radiologic Anatomy. 2004 Dec;26(6):474-9.

5. Budhiraja V, Rastogi R, Asthana AK. Renal artery variations: embryological basis and surgical correlation. Rom J Morphol Embryol. 2010 Jan 1;51(3):533-6.
6. Çiçekcibaşi AE, Ziylan T, Salbacak A, Şeker M, Büyükmumcu M, Tuncer I. An investigation of the origin, location and variations of the renal arteries in human fetuses and their clinical relevance. Annals of Anatomy-Anatomischer Anzeiger. 2005 Sep 1;187(4):421-7.
7. Dhar P, Lal K. Main and accessory renal arteries--a morphological study. Italian Journal of Anatomy and Embryology= Archivio Italiano di Anatomia ed Embriologia. 2005 Apr 1;110(2):101-10.
8. Favaro WJ, Santos TD, Cagnon VH. Venous Communication Between the Right and Left Kidneys: A Rare Anatomic Variation. International Journal of Morphology. 2009 Mar;27(1):117-20.
9. Felix W, Keibel F, Mall FP. Manual of human embryology. Keibel and Mall. 1912;2:752.
10. Gupta A, Gupta R, Singal R. Congenital variations of renal veins: embryological background and clinical implications. J Clin Diagn Res. 2011 Nov;5(6):1140-3.
11. Jyothsna P, Rao KM, Somayaji SN, Ashwini LS. Multiple vascular anomalies involving testicular, suprarenal arteries and lumbar veins. North American journal of medical Sciences. 2012 Mar;4(3):154.
12. Krishnasamy N, Rao M, Somayaji SN, Koshy S, Rodrigues V. An unusual case of unilateral additional right renal artery and vein. International journal of anatomical variations. 2010 Jan 1;3:9-11.
13. Nathan H, Glezer I. Right and left accessory renal arteries arising from a common trunk associated with unrotated kidneys. The Journal of urology. 1984 Jul 1;132(1):7-9.
14. Olsson O, Wholey M. Vascular abnormalities in gross anomalies of kidneys. Acta Radiologica. Diagnosis. 1964 Sep;2(5):420-32.
15. Özkan U, Oguzkurt L, Tercan F, Kizilkilic O, Koç Z, Koca N. Renal artery origins and variations: angiographic evaluation of 855 consecutive patients. Diagnostic and interventional Radiology. 2006 Dec 1;12(4):183.
16. Rao TR. Aberrant renal arteries and its clinical significance: a case report. International journal of anatomical variations. 2011 Jan 1;4:37-9.
17. Rusu MC. Human bilateral doubled renal and testicular arteries with a left testicular arterial arch around the left renal vein. Rom J Morphol Embryol. 2006 Jan 1;47(2):197-200.
18. Saldarriaga B, Pérez AF, Ballesteros LE. A direct anatomical study of additional renal arteries in a Colombian mestizo population. Folia morphologica. 2008;67(2):129-34.
19. Sampaio FJ, Passos MA. Renal arteries: anatomic study for surgical and radiological practice. Surgical and Radiologic Anatomy. 1992 Jun;14(2):113-7.
20. Satyapal KS, Haffejee AA, Singh B, Ramsaroop L, Robbs JV, Kalideen JM. Additional renal arteries incidence and morphometry. Surgical and Radiologic Anatomy. 2001 Apr;23(1):33-8.
21. Shoja MM, Tubbs RS, Shakeri AB, Oakes WJ. Origins of the gonadal artery: embryologic implications. Clinical Anatomy: The Official Journal of the American Association of Clinical Anatomists and the British Association of Clinical Anatomists. 2007 May;20(4):428-32.