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BILATERAL ANOMALOUS RENOVASCULAR ARCHITECTURE

Anatomy

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ABSTRACT

Comprehensive knowledge of renal vascular anatomy and its variations is important for various clinical approaches in kidney disorders. In our study, we aim to present one such variation that was encountered during routine abdominal dissection. A constellation of variations was observed in the branching pattern of renal arteries. Both the renal arteries had normal origins from the abdominal aorta. The left renal artery was 0.7cm long which divided into anterior and posterior branches that further ramified into several pre-hilar branches. Similarly, the right renal artery trifurcated at a distance of 4cms from the abdominal aorta into inferior suprarenal artery, anterior division and posterior division. The anterior division further subdivided into superior polar artery, inferior polar artery and an intermediate artery whereas the posterior division gave off a pre-hilar and a hilar branch. The study was conducted since bilateral pre-hilar branching of renal artery is uncommon. Acquaintance with these variations of renal artery is necessary for diagnostic and surgical approaches carried out during renal transplantation, interventional urological and radiological procedures, renal artery embolization, vascular reconstruction, angioplasty to name a few.

KEYWORDS

Renal artery, vascular anomalies, abdominal aorta.

INTRODUCTION

The renal artery is the principal artery supplying the kidneys. It originates as a lateral branch of the abdominal aorta at the level of the L1 vertebral body, just below the origin of the superior mesenteric artery. Upon reaching the renal hilum, it divides into anterior and posterior branches, which further subdivides into segmental arteries. Five segmental arteries are usually seen: apical, superior (anterior), inferior, middle (anterior) and posterior segments. Segmental arteries moreover divide into lobar, then interlobar, arcuate, interlobular, and lastly afferent and efferent arterioles. This is the most common pattern encountered, and there can be significant variations. Each kidney has a single renal artery in approximately 70% of individuals [1].

MATERIALS AND METHOD

The present study was carried out during routine abdominal dissection of a 60-year-old formalin-fixed male cadaver destined for use in teaching at the department of Anatomy, Lady Hardinge Medical College, New Delhi. The kidneys and their vasculatures were explored and studied for their number, origin, course and branching pattern. Measurements were taken using vernier calliper.

Case Study

Bilateral anomalies of renal arteries were found during the dissection. Both the renal arteries originated from the ventral surface of abdominal aorta 1 cm below the origin of superior mesenteric artery.

The left renal artery measured 0.7cm in length and 1cm breadth. It divided into anterior and posterior divisions. The anterior division (4.5cm x 0.5cm) first ran downwards, then upwards over the psoas major muscle and then bifurcated into 2cms long upper hilar branch and 3.3cm long lower hilar branch in front of left renal vein. The upper hilar branch entered the hilum closer to its anterior border whereas its lower hilar branch entered the hilum at its lower limit (Fig.1).

The larger posterior division of left renal artery (5cm x 0.8cm) was situated posterior to the left renal vein. It extended upwards giving off three terminal branches: one pre-hilar branch of length 0.7cm in the anterior plane and two hilar branches of length 1.5cm and 2.3cm in the posterior plane (Fig.1).

The right renal artery of length 4cms and width 1cm followed its normal course in the posterior abdominal wall then it trifurcated into right inferior suprarenal artery, thin anterior and a thick posterior division.

The anterior division of dimension 0.4cm x 0.4cm produced two extra-hilar branches: the superior (3cm) polar branch and the inferior branch. The superior polar branch ran obliquely towards the superior pole and terminated by entering the anterior surface of the upper pole of the right kidney. The inferior branch further subdivided immediately into an intermediate branch (2.5cm) reaching the anterior surface, 1cm lateral to the hilum and a 9cms long inferior polar branch descending along the anterior surface of the infra-hilar part of right kidney. This inferior polar artery terminated by piercing the inferior pole of the right kidney (Fig.1).

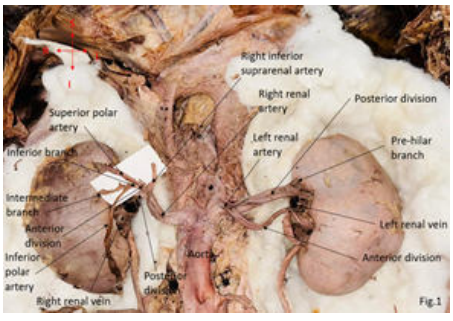

Figure 1: Anterior view of kidneys with its vasculature.

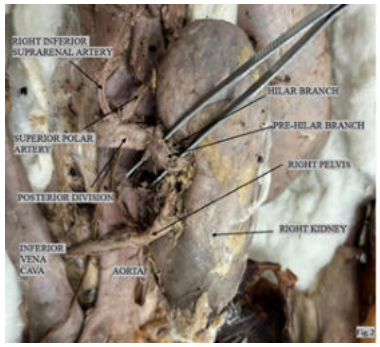

Figure 2: Posterior view of reflected right kidney with its vasculature.

The 1cm thick posterior division of right renal artery coursed behind the right renal vein for 2.3cms. It then bifurcated into two segmental arteries. The upper hilar segmental artery measured 0.5cm long whereas the lower pre-hilar segmental artery was 1.2cms long. These arteries entered the kidney at the upper margin and middle of posterior margin of the hilum respectively (Fig.2).

The formation, course and termination of both the renal vein and ureter were found to be normal.

DISCUSSION

There have been multiple reports on the accessory renal arteries but there is paucity of literature on bilateral early branching of the renal artery. The anomalies found in the renal arteries can be explained according to the 'Ladder Theory' proposed by Felix (1912). As stated by this theory, the caudal 6th to 9th pairs of lateral splanchnic arteries formed a vascular network called 'rete arteriosum urogenitale'. This network gives rise to arteries supplying the retroperitoneal viscera. These caudal mesonephric arteries should degenerate when kidney ascends from the initial pre-natal pelvic position to post-natal lumbar position, and the cranial pairs of mesonephric arteries intended to form the permanent renal artery should persists. Any deviation from this pattern, due to unusual blood flow through anastomotic channels occurring from failure of obliteration of these channels, results in anomalous arteries [2].

According to studies done by Cinar C et al (2016) and Wrobel G et al (2019), any branching of renal artery within 1.5cms from the aorta in the left kidney or in the retrocaval segment in the right kidney or more proximally than the renal hilum was named pre-hilar(early) branching [3,4]. The present study with bilateral pre-hilar branching of renal artery is similar to study done by Hyun-Bong Lee et al (2019) who reported of the 2nd accessory renal artery on the right side and left main renal artery showing early division along with three inferior polar arteries [5]. In the present study, there is one inferior polar artery on the right. Similar to the present study, Aremu et al. (2021) reported early branching of renal artery in 18% cases out of which 1% cases were bilateral [6]. Similarly, Gumus et al (2012) in their study noted early division of renal artery in 27% cases, of which 6% displayed bilateral early branching [7].

Nayak et al (2014) and Kamanda (2021) reported unilateral pre-hilar branching, in their study [8, 9]. Likewise, Hassan et al (2017) noted unilateral pre-hilar branching, in 1 out of 63 cadavers [10]. Other reports on pre-hilar branching of renal artery were given by Cinar and Turkvatan who reported 33 of 504 cases (6.5%), Garcia et al (2023) in 2 out of 16 (12.5%), Gumus et al in 219 out of 820 (27%), Majos et al (2017) 185 in 496 (37.3%), Lama (2019) in 2 out of 18 (16.66%) [3, 11,7, 12, 13].

The present study also reports one superior polar artery and one inferior polar artery on the right side. Polar arteries are those arteries entering the kidney through the poles. They arise either from the abdominal aorta or common iliac arteries but rarely from other branches of the aorta. Cinar and Turkvatan reported 33 cases of accessory polar arteries arising from the abdominal aorta, more on the left and the superior polar being more common [3]. Naveen described both superior and inferior polar arteries on the left side [14]. Stojadinovic observed inferior polar arteries on both sides and superior polar on the left [15]. Wrobel and Kamanda reported left inferior polar arteries [4, 9] whereas Hyun Bong Lee has reported bilateral presence of inferior polar arteries budding from abdominal aorta [5]. In contrary to previous studies, we found the polar arteries to be arising from the right renal artery.

CONCLUSION

In-depth knowledge of renal vascularity is of utmost importance for surgeons for good surgical interventions and clinical approaches. Familiarity with the variations can improve the approaches on management of renal vascular disorders and procedures such as renal donor nephrectomy and renal artery reconstructive surgeries. The detailed understanding may also help radiologists in better radiological interpretations. This study adds to our existing knowledge on possible variations of renal vascular system.

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