

Case report

Right superior aberrant renal artery - its embryological significance

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Abstract

During routine dissection of an old male cadaver, in the Department of Anatomy, Pinnamaneni Siddhartha Institute of Medical science, Chinoutpalli, Andhra Pradesh, India, presence of right superior aberrant renal artery was noted. It took origin from the lateral aspect of abdominal aorta, below the origin of superior mesenteric artery and above the right main renal artery. The right superior renal artery runs towards upper pole of the right kidney. Proper knowledge of variations of the arteries supplying the kidney is essential not only to the anatomists but also to the vascular surgeons, urologists, nephrologists and radiologists. Such vascular variations as noted in the present study have been explained in light of embryogenic development.

Key words: Right superior aberrant renal artery, abdominal aorta, superior mesenteric artery, Right main renal artery.

Introduction:

Knowledge of the anatomy of the renal blood supply is important to every urologic surgeon, and fortunately this subject lends itself to easy investigation. Anatomists were keenly interested in renal vascular patterns before the end of the 19th century, but the advent of aortography in the 1940s and 1950s spear-headed a systematic clinical approach to this topic^{1,2}.

Renal arteries are two large vessels which branch laterally from the aorta just below the superior mesenteric artery, the right is longer and often higher than left, passing posterior to the inferior vena cava, right renal vein, head of pancreas and descending part of the duodenum. The left is a little lower, it passes behind the left renal vein, body of the pancreas and splenic vein. Each renal artery divides into four or five branches. Most of these branches pass between the renal vein and ureteric pelvis; the vein being anterior, ureteric pelvis posterior. One or more branch usually passes behind the pelvis. Each renal artery supplies small inferior suprarenal branches, and also the ureter, surrounding cellular tissue and muscles, they usually enter above or below the renal hilum.

One or two accessory renal arteries frequently occur, especially on the left, usually from the aorta above or below the main artery, the former slightly more often. They usually enter above or below the renal hilum; if below, the vessel crosses anterior to the ureter and, on the right, usually also anterior to the inferior vena cava³. The most commonly observed variation is the presence of an accessory renal artery, occurring in approximately 30% of cases, arising from the aorta above or below the main renal artery.

The accessory renal artery variations have been explained in the light of embryological development from the lateral mesonephric branches of the dorsal aorta.

Case Report:

During routine dissection of an old male cadaver, in the Department of Anatomy, Pinnamaneni Siddhartha Institute of Medical science, Chinoutpalli, Andhra Pradesh, India, presence of unilateral aberrant renal artery was noted, while dissecting the structures in the posterior abdominal wall, all paired and unpaired branches of abdominal aorta were traced and observed. Noticed that the right kidney was supplied by an aberrant renal artery which was arising from lateral side of abdominal aorta at the level of superior mesenteric artery and 35mm above the right main renal artery and reaching the upper pole of right kidney where it gives one small branch before entering the substance of kidney, the right main renal artery took its origin 5mm above the inferior mesenteric artery and passed to the hilum anterior to the right ureter. The left kidney was supplied by a single artery - the left main renal artery which took its origin at the level of superior mesenteric artery where the right aberrant renal artery was also seen arising and it passed to the hilum anterior to the left ureter (Figure I) No other anomalies were observed in the posterior abdominal wall.

Discussion:

Presence of aberrant renal arteries can be explained

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in the light of embryogenic development and its molecular regulation.

Each primitive dorsal aorta gives off ventral splanchnic arteries, lateral splanchnic arteries, somatic arteries and caudal continuation.

The lateral splanchnic arteries supply, on each side, the mesonephros, metanephros, the testis or ovary and the suprarenal gland. All these structures develop, in whole or in part, from the intermediate mesenchyme of the mesonephric ridge. One testicular or ovarian artery and three suprarenal arteries persist on each side. The phrenic artery branches from the most cranial suprarenal artery and the renal artery arises from the most caudal one. Additional renal arteries are frequently present and may be looked on as branches of persistent lateral splanchnic arteries.

After the induction of angioblasts (precursors to blood vessels), *sonic hedgehog*, secreted by the notochord, induces surrounding mesenchyme to express *vascular endothelial growth factor* (VEGF).

In turn, VEGF expression induces the Notch pathway (a transmembrane receptor pathway), which specifies arterial development through expression of *ephrinB2* (ephrins are ligands that bind to Eph receptors in a pathway involving *tyrosine kinase* signaling). Misexpression of one or more transcription factors as mentioned above may lead to aberration in the arterial development.

Persistence of lateral splanchnic arteries with branches in the form of accessory renal arteries may be attributed to misexpression of any of these transcription factors and signalling molecules as mentioned above viz VEGF, TGF β , PDGF, SHH and EphB2. The bilateral accessory renal arteries are reported by some earlier anatomists.

Ugur Ozkan et al in his angiographic evaluation of origin and variation of renal arteries (163 females & 692 males), found renal arteries originated between the first and second lumbar vertebral level in most patients. Variations of renal arteries included multiple arteries in 24%, bilateral multiple arteries in 5%,

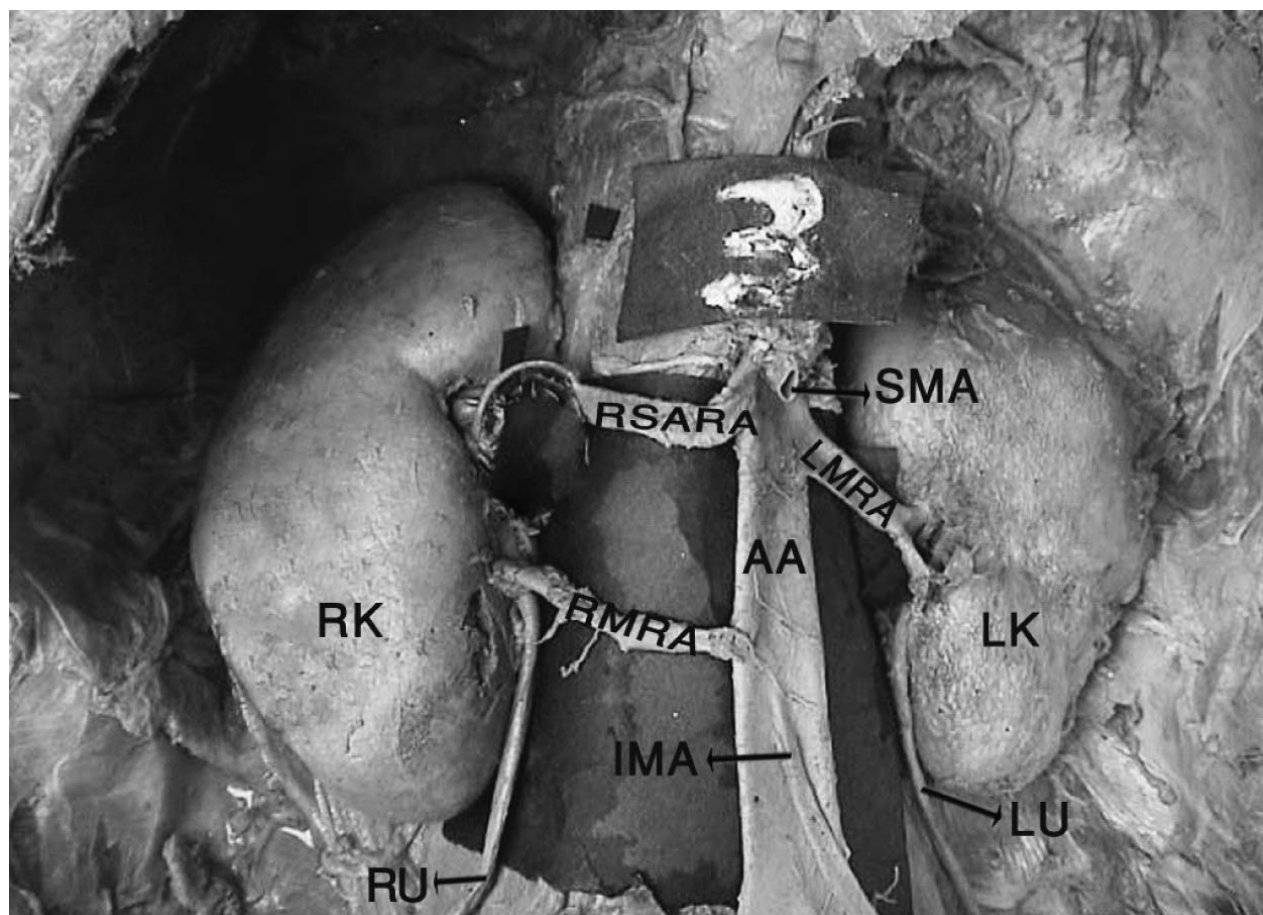


Figure 1. Showing the right kidney, left kidney and the main renal arteries and right aberrant renal artery arising from abdominal aorta. (After removal of inferior venacava, right and left renal veins)

RK: Right kidney; LK: Left kidney; RMRA: Right main renal artery; LMRA: Left main renal artery; RSARA: Right superior aberrant renal artery; SMA: Superior mesenteric artery; IMA: Inferior mesenteric artery; AA: Abdominal aorta; RU: Right ureter; LU: Left ureter.

and early division in 8% of cases. Additional renal arteries on the right side were found in 16% and on the left side in 13% of cases. Bilateral aberrant renal arteries were found in 13- 16 % of cases. This result should be kept in mind when a non-invasive diagnostic search is performed for renal artery stenosis or when renal surgery related to renal arteries is performed⁷.

Bordei P *et al.* (2004) reported 54 cases, out of which six cases were bilateral. In about 28 cases, supplementary renal artery entered the kidney through the hilum, in 16 cases it was inferior polar, in five cases it was superior polar⁸.

Incidence of multiple accessory renal arteries has been reported to be 20.2% and 19% on right and left sides, respectively by Janschek EC *et al.*(2004)⁹.

Saldarriaga B *et al.* (2008) reported 97 out of 390 (24.9%) cases, with kidneys having additional arteries; out of these 87 (22.3%) had one additional artery and 10 (2.6%) had two additional arteries. The frequency of one additional artery was 43.5% on right side and 56.3% on left side¹⁰.

Rusu reported bilateral double renal arteries; on the right side as superior hilar and inferior hilar renal arteries, and, on the left side as superior hilar and inferior polar renal arteries. All these renal arteries emerged from the abdominal aorta¹¹.

Bayramoglu *et al.* reported a variant which consisted of bilateral additional renal arteries originating from the abdominal aorta and an additional right renal vein accompanying the additional right renal artery. These anomalies were associated with unrotated kidneys with extrarenal calices and pelvis. All the additional vessels were located posterior to the ureter with a close relationship to the ureteropelvic junction on the right side¹².

This accessory renal artery is important in surgical procedures related to the posterior abdominal wall, mainly during kidney transplantations, repair of abdominal aortic aneurysm, ureter surgery and surgeries involving the vascular pedicles of kidney. It may also be of practical importance for radiologists, for correct interpretation of roentgenographic examinations in angiographic procedure.

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