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MORPHOLOGICAL STUDY

Accessory renal vessels at the upper and lower pole of the kidney: a cadaveric study with clinical implications

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Abstract: The renal artery is known to exhibit variations in its number and position. The present study was performed on 50 cadaveric kidneys to observe the topographical anatomy of the accessory renal arteries (ARA) entering the upper or lower poles of the kidney. Out of 50 kidney cadaveric specimens (irrespective of sex) studied, 2 kidneys (4 %) showed the presence of ARA. The presence of ARA was observed on the left and right kidneys, respectively. In one left kidney, we observed in addition to the usual renal artery, an ARA near the lower pole of the kidney which divided into anterior and posterior branches. Another right kidney specimen exhibited the presence of single and double ARA at the upper and the lower poles, respectively. The presence of ARA, both at the upper and lower poles is a rare entity. No medical history of the cadavers was available to corroborate the clinical findings. Additional renal vessels may signify a developmental defect. Anatomical knowledge of the variations in the renal vascular supply may be important for abdominal imaging studies and surgical operations involving renal transplantations. The present study discusses in detail the anatomical features and clinical implications of ARA located at both the upper and lower poles of the kidney *(Fig. 2, Ref. 15)*.
Full Text (Free, PDF) *www.bmj.sk.*
Key words: kidney, renal, artery, accessory, supernumerary, anatomy, variations.

The kidneys are supplied by the renal arteries. Usually, on each side, there is one renal artery originating from the abdominal aorta. Vascular anomalies related to the renal artery or vein are not uncommon. Additional renal vessels are known as the accessory renal artery (ARA) or supernumerary renal artery (SRA). These vessels are sometimes termed as aberrant renal vessels and their incidence varies between 9–76 % (1, 2, 3). The incidence of the ARA may vary according to the race (1). A meta-analysis has showed its median incidence of the ARA to be 30 % (2). An incidence of 30 % certainly warrants proper understanding of its anatomy and clinical implications.

Standard textbooks of anatomy mention the presence of ARA but there are no reports of ARA to the upper and lower pole of the kidney. Entry of the renal vessel into the kidney other than the site of hilum is considered to be a rare finding (4). Presence of ARA on the upper and lower pole may be linked to a developmental defect.

We as anatomists believe that the anatomical knowledge of the presence of ARA may be important for radiological procedures involving the kidneys. Presence of additional renal vessels may result in erroneous interpretation of angiograms and pyelograms. Prior anatomical knowledge of the variations of the renal vessels may also be helpful for surgeons for preoperative investigations as there are reports of surgical complications which include massive haemorrhage (5). Interestingly, recent reports have also stressed the fact that the patients with galactosemia need to be thoroughly investigated for the presence of any renal vascular anomalies (6). In the present study, we highlight the presence of a rare variation of the ARA at both the upper and lower poles of the kidney and highlight its clinical implications.

Methods

We observed 50 cadaveric dissected kidneys (n=50) for the presence of any ARA on the upper or the lower pole of the kidney. No emphasis was given to any other anomaly except for the presence of ARA. Anomalous ARA were located and studied in detail. The kidneys were weighed, appropriate measurements were taken and the specimens were photographed (Figs 1, 2).

Results

Out of 50 specimens studied, we observed the anomalous ARA in 2 kidneys (n=4 %). Of these one left kidney exhibited an ARA at the lower pole while another right kidney exhibited an ARA both at the upper and lower poles.

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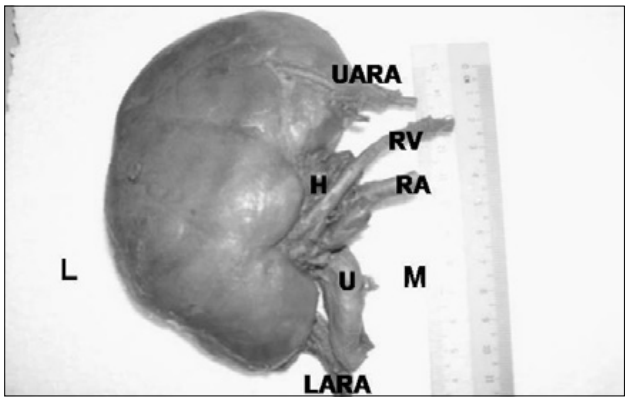

Fig. 1. Dissected specimen of the right kidney (anterior view) showing. UARA – upper accessory renal artery, LARA – lower accessory renal artery, U – ureter, H – hilum, RA – renal artery, RV – renal vein, M – medial side, L – lateral side.

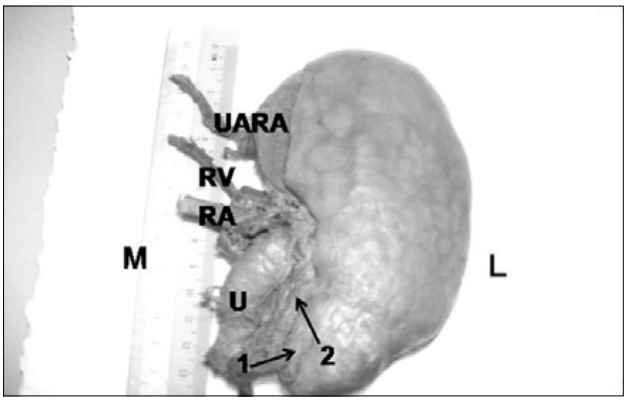

Fig. 2. Dissected specimen of the right kidney (posterior view) showing. UARA – upper accessory renal artery, U – ureter, RA – renal artery, RV - renal vein, M - medial side, L - lateral side. Lower accessory renal artery dividing into an upper branch (2) entering the hilum and lower branch (1) entering lower part of the renal tissue.

Left kidney specimen (Fig. 1)

No medical history of the cadaver was available. The left kidney weighed 87.16 grams and measured 8.5 cm and 6 cm as its maximum vertical length and transverse width, respectively. The renal artery supplying the left kidney divided into the upper and lower branches. The upper branch (anterior) again subdivided to enter the kidney above the hilum while the lower branch (posterior) entered the lower part of the hilum. Another vessel termed as the ARA entered the lower pole at a distance of 4.1 cm from the lower part of the hilum. This anomalous ARA originated from the renal artery.

Right kidney, posterior view (Fig. 2)

No medical history of the cadaver was available. The right kidney weighed 184.5 grams and measured 13 cm and 8 cm as its maximum vertical length and transverse width, respectively. The renal artery entered the hilum as usual. The upper pole was supplied by ARA which entered the medial border at a distance of 3.4 cm from the midpoint of the upper pole. Two ARAs were observed to enter the lower pole in the same specimen. The 2 lower ARAs entered the lower medial border at a distance of 1.6 cm and 3.9 cm from the midpoint of the lower pole, respectively. The ARA in the lower pole exhibited different entry points. The upper one entered the hilum while the lower one entered the renal tissue.

Discussion

As per classical anatomy textbook description, the renal arteries originate from the abdominal aorta and near the hilum divide into 4–5 branches (7). In 70% of cases the renal artery is single (7). Textbook of anatomy also documents the fact that 1–2 accessory renal arteries may be observed frequently on the left side entering the kidney above or below the hilum (7). The abnormal or aberrant arteries to the lower pole can be considered as segmental vessels with unusual origin because of the persistence of foetal vessels (8).

The arteries entering the upper or lower pole of the kidney are termed as "polar arteries." Polar arteries have been highlighted in past research studies (1, 9). The polar vessels have been considered as segmental arteries supplying a particular segment of the kidney (10). It is important that a surgeon has prior knowledge of all such ARA supplying the upper and lower poles because inadvertent injury or failure to restore circulation during renal surgeries and transplant operation might even result in necrosis (4).

In the present study, we observed two specimens to exhibit the ARA near the upper and lower pole. The presence of the two ARA in the lower pole may be considered as a rare developmental defect. It has been considered that during the development of the lower pole of the kidney it might have been supplied by a branch of an artery which might have persisted (4). Embryologically, a capillary network, known as "rete arteriosum urogenitale", has been described to give rise to all definitive renal arteries (11). The segmental lateral splanchnic arteries branch from the aorta and form the proximal portion of this network (12). These arteries usually regress but their persistence or enlargement may give rise to variations in the renal arteries (12).

Other factors like genetic background, oxygenation and haemodynamic changes may also account for the presence of ARA. Recent reports have associated galactosemia with renal vascular anomalies (6). In the present case, we did not have the medical history of the cadaver to corroborate any such clinical fact.

Precise knowledge of the renal artery and its branches is important for any vascular reconstruction, endoscopic surgeries, treatment of abdominal aortic aneurysm, treatment of renal artery stenosis and clinical evaluation of renovascular hypertension (11, 13, 14). Any pathological disease confined to the upper or lower pole would need special care in case of additional vessels supplying these regions. A past cadaveric research study had highlighted the ARA supplying the upper pole and stressed the anatomical knowledge needed for laparoscopic surgeries and renal transplant (15). Surgeons performing renal transplant need

to have prior anatomical knowledge in order to perform a successful ligation. It has been described that interference or failure to restore circulation in polar vessels after surgery may cause unnecessary ischaemia or necrosis of the renal tissue (4).

It has been described by past research workers that the transplant of any kidney with multiple vessels leads to various drawbacks like prolonged warm ischaemia time, greater chances of tubular necrosis and graft rejection, prolonged hospitalization and other vascular complications like arterial thrombosis (4).

The presence of the multiple arteries have been reported to be more common in males (28 % in males, 5.1 % in females) with an incidence of 31.1 % in Africans, 5.4 % in Indians (14) but there are no reports on the incidence from the South Eastern Asian region. The incidence of ARA may be important anthropologically. Our results show a 4 % incidence of ARA in the South Eastern Asian population. We do admit that the study was confined to a small sample size but it is the first report on the ARA from the South Eastern Asian region.

In the present study, the ARA passed anterior to the ureter near the lower pole and this might even lead to compression of the ureter. The radiographic image of the ARA may result in erroneous interpretation of angiograms and X-ray findings.

Conclusion

The present study highlighted the presence of ARA on the upper and lower poles. The presence of such anomalies may be important from the academic, anthropological, surgical and radiological point of view.

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