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**Research Article**

# Accessory Renal Arteries: A Cadaveric Study

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## Abstract

**Objectives:** The precise knowledge of renal vascular pattern is significant in conduct of various renal surgeries, interventional radiology, and urologic procedures. Variations in renal vascularization have assumed greater importance in conservative surgeries; hence the presence of accessory arteries cannot be overlooked during segmental resection, partial nephrectomy and renal transplants. The aim of the study was to establish the incidence and characteristics of accessory arteries in human kidneys.

**Methods:** The study was carried out on fifty adult cadaver kidneys. They were stored in 10% formalin and treated with 5% KOH solution for 72 hours prior to dissection. Dissection of the kidneys was done keeping in mind the orientation of poles, borders and surfaces. The branching pattern of renal artery was studied. Accessory arteries were observed in terms of their origin, number, side,location and formation of independent segments.

**Results:** Accessory arteries were seen in eleven kidneys (22%). All were arising from the abdominal aorta. These were more common on the left side and at the lower pole. Two accessory arteries were seen in one kidney (9.09%). Accessory arteries were seen more on anterior surface and formed independent arterial segments in seven kidneys (63.63%).

**Conclusion:** The recognition of accessory arteries is anatomically significant and of paramount importance in surgical and radiological practice.

**Keywords:** Renal vasculature, accessory arteries, conservative surgeries, renal transplants

## 1. Introduction

Unusual vascular patterns are the most often encountered variations among renal morphological variations. Most of these variations remain undiscovered unless surgical procedures or radiological interventions are undertaken. The knowledge of accessory arteries is of great importance for surgeons performing segmental resection as indicated in trauma, urolithiasis, renal tuberculosis and localized neoplasms. The average occurrence of accessory arteries is approximately30%.[1]

Very often the decision to perform a segmental resection of the kidney shall have to be taken by the surgeon either before operation by angiography or on the operation table after exploration of the kidney. But certainly it is of importance to be acquainted with different types of cases that are unsuitable for segmental resections and this will put the surgeon on guard to exercise greater caution in the surgery. Anson and Kurth[2] opined that 'Experience shows that supernumerary arteries and veins represent the rule in renal structure, not the exception'. The problem arises as to whether or not an accessory artery has to be ligated and divided without causing damage to the kidney. The answer to this question can only be based on a clear understanding of the distribution of these arteries within the kidney.

Alternative nomenclatures have been used to describe the accessory artery as supernumerary, multiple, aberrant, additional etc. According to Graves[3] any artery arising from the aorta in addition to the main renal artery should be named 'accessory' and the renal arteries arising from sources other than the aorta should be called 'aberrant'.

## 2. Material and Methods

The study was carried out on fifty kidneys from formalin preserved adult cadavers. The duration of study was one year. Normal kidneys were merited as specimens. Diseased or polycystic kidneys were excluded. Controls and statistical analyses were not applicable in this study. These were treated with 5% KOH solution for 72 hours prior to dissection. This made the renal tissue soft and facilitated the tracing of arteries through the substance of kidney. Dissection of the kidneys was done meticulously keeping in mind the orientation of poles, borders and surfaces. The branches of renal arteries were traced through the kidney substance and accordingly the renal segments were demarcated. Presence of any accessory arteries was observed, noting its origin, site, number and whether it was forming a segmental artery or additional supply to the kidney. The kidneys were preserved in 10% formalin solution after the dissection.

## 3. Results

Following observations were made:

- Accessory arteries were seen in 11 kidneys (22%)
- All accessory arteries were arising from the abdominal Aorta.
- One accessory artery was seen in 10 kidneys (90.9%)

Two accessory arteries were seen in 1 kidney (9.09%)

- Accessory renal arteries were more commonly found in seven kidneys on the left side (63.63%) than four kidneys on the right (36.36%)

- Accessory renal arteries were more common at the lower pole as seen in seven kidneys (63.63%) than at the upper pole as seen in three kidneys (27.27%) and at both upper and lower poles it was seen in one kidney (9.09%)
- Accessory renal arteries supplying the segments on the anterior surface were seen in ten kidneys (90.9%) and on posterior surface in one kidney (9.09%).
- Accessory renal arteries formed independent arterial segments in seven kidneys (63.63%) and formed additional arterial supply to a segment in four kidneys (36.36%).

**Fig 1: showing accessory artery at upper pole of kidney, AA-accessory artery**

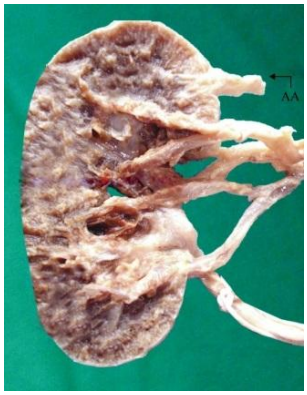



**Fig 2: schematic representation of Fig 1**

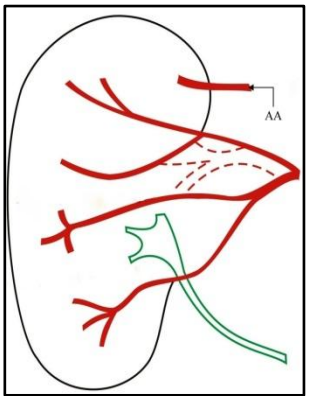



**Fig 3: showing accessory artery at lower pole of kidney, AA-accessory artery**


**Fig 4: schematic representation of Fig 3**

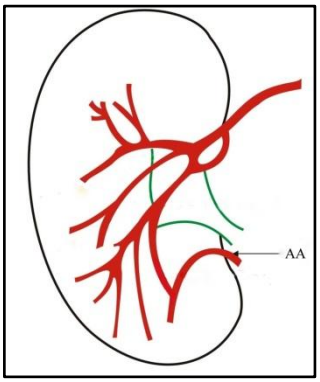
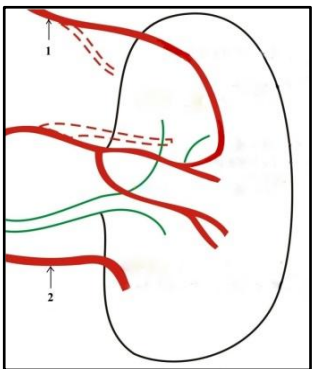



**Fig 5: showing accessory artery at upper and lower poles of kidney, AA-accessory artery**


**Fig 6: schematic representation of Fig 5**




## 4. Discussion

The commonly held view is that the permanent kidney or metanephros develops within the pelvis and between the sixth and ninth week of intrauterine life and ascends to a lumbar level just below the suprarenal glands following a path on either side of the dorsal aorta. The differential growth of the lumbar and sacral regions of the embryo may play a role in the ascent of the kidney. The ascending kidney is progressively revascularised by a series of arterial sprouts from the dorsal aorta, and the arteries at lower levels gradually regress. Occasionally one or more of the transient renal arteries at lower levels fail to regress resulting in the presence of accessory renal arteries. Thus accessory arteries are normal segmental arteries with more proximal origin than usual[4]. The additional renal arteries in the adult would be expected to arise on embryological grounds from the median sacral, the external or common iliac arteries or the lower part of abdominal aorta[5]. Some studies have shown the origin of accessory renal arteries from aorta and the renal artery.[6,7] In this study all the accessory arteries were arising from the abdominal aorta.

Most workers have found accessory arteries in 15-35% of the kidneys in their studies[8-13]. However Budhiraja[14] reported 11.66% and Elvira Talovic[6] reported 46.15%. Some authors have reported accessory arteries in as low as 2%[15]and as high as 73%[16]. Present study showed accessory arteries in 11 kidneys (22%)**,** which corresponded with results of the previous authors.

Multiple renal arteries are common in lower vertebrates[12]. Studies have shown multiple renal arteries in human kidneys.[17-21] This study showed maximum number of two accessory arteries in one kidney (9.09%). These results are important for harvesting donor for renal transplant. Transplantation of kidney with one renal artery is technically easier than with multiple renal arteries. Also postsurgical rates of complication and kidney loss are lower.

There have been variations regarding the side on which the additional renal arteries were seen. Some authors have reported a higher frequency on the left,[9,13,22,23] where as others have found it to be more frequent on the right side.[7,10,14] In the present study, accessory renal arteries were observed more on the left (63.63% )than on the right side (36.36%).

The frequency of accessory arteries at the lower pole was found to be more than at the upper pole by some workers[3,5,24]. Accessory arteries were also seen both at the poles and at the hilum.[10,25] The findings of the present studies were consistent with the previous studies. Accessory arteries were not seen at the hilum. Segmental resection of the upper and lower pole is of practical value; hence the presence of accessory arteries at these sites cannot be over looked. Also accessory arteries occurring at lower pole only were considered in relation to lower polar artery causing hydronephrosis.[8]

The accessory arteries forming independent segments have been reported by Sykes[5]. Present study showed accessory arteries forming independent segments in seven kidneys (63.63%) and forming additional supply to a segment in four kidneys (36.36 %).

Data is established literature mentions that segmental renal arteries are end arteries. Hence it follows that from clinical point of view, occlusion of a segmental artery causes necrosis of the dependent segments due to the absence of functional anastomotic channel. This fact has been the theoretical basis for selective embolisation of segmental artery and segmentectomy. However, it is known that surgeons do face frequent difficulties with hemostasis during segmental renal resections which are not always explainable by a conventional segmental distribution of blood supply, blurred limits of segments or by imperfections in surgical techniques. This may be explained by additional supply by an accessory artery.

## 5. Conclusion

Knowledge of the variations in the renal arteries is important for urologists, radiologists and surgeons in general. It is of great importance in performing operations like segmental resections, partial nephrectomy, and renal transplantation. These variations can be confirmed preoperatively by selective angiography. Its awareness may also provide safety guidelines for endovascular procedures like therapeutic embolization and angioplasties and helps in the management of renal vascular hypertension.

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