



# BILATERAL RENAL ARTERY VARIATIONS – EMBRYOLOGICAL SIGNIFICANCE AND CLINICAL IMPLICATIONS

Sujatha Manupati<sup>1</sup>, Subhadra Devi Velichety<sup>1</sup>, LalithaKumari M.K.<sup>2</sup>,  
Sofia Peddity<sup>3</sup>

<sup>1</sup>Department of Anatomy, Sri Venkateswara Medical College, Tirupati. Andhra Pradesh, India, <sup>2</sup>Department of Anatomy, Krishna Teja Dental College & Research Centre, Tirupati. Andhra Pradesh, India, <sup>3</sup>Department of Anatomy, S.V. Medical College, Tirupati. Andhra Pradesh, India.

## ABSTRACT

**Background:** With increased incidence of kidney transplantation and related surgical procedures anatomical knowledge of renal artery variations is gaining importance. Normally a single renal artery supplies each kidney. Accessory renal vessels are the commonly seen renovascular variations.

**Materials and Methods:** During routine dissection for 1st year undergraduate medical students in the Department of Anatomy S.V. Medical College, Tirupati, renal artery variations were observed in 24 formalin fixed cadavers (16 male & 8 female). The renal artery variations were identified and photographs were taken.

**Results:** In the present study renal artery variations were observed in 03 cadavers (12.5%). Bilateral accessory renal vessels were observed in two cadavers (8.4%) and bilateral single renal artery with pre-hilar branching and double ureter is seen in one cadaver (4.1%).

**Conclusion:** knowledge on renal artery variations are necessary during renal transplantations, urological procedures and for angiographic interventions.

**Key Words:** Renal transplantation, Bilateral variations, Embryological significance.

## INTRODUCTION

Kidneys are the vital organs in the human body. They receive blood supply through renal arteries arising from the lateral sides of abdominal aorta below the origin of superior mesenteric artery. Near the hilum of kidney each renal artery divides into anterior and posterior branches, which in turn divide into number of segmental branches supplying different segments of kidney. Accessory renal vessels constitute the most common, clinically important vascular variant seen in one-third of population. Development of kidney is very complex, as it develops from the pronephros, mesonephros and metanephros. The pronephros and mesonephros regress but the arterial network to those segments may remain and lead to supernumerary renal arteries. In 70% of cases there is a single renal artery supplying each kidney and multiple renal arteries are unilateral in 30% of patients and bilateral in 10%

of patients [1]. One or two accessory renal vessels are commonly seen, and are more common on left side. The knowledge of these variations in the renal arteries is important for urologists, radiologists and surgeons.

## MATERIALS AND METHODS

A total of 24 formalin fixed cadavers used for routine 1<sup>st</sup> year medical students dissection in the Department of Anatomy, S.V. Medical college, Tirupati were observed for renal artery variations during the period of three years (2010 to 2013). Among the 24 cadavers 16 were male and 08 were female. During dissection of the abdomen Kidneys and surrounding structures were observed carefully for renal artery variations. The observed variations were carefully photographed and the findings were recorded.

Corresponding Author:

Sujatha Manupati, Department of Anatomy, Sri Venkateswara Medical College, Tirupati. Andhra Pradesh. India.

Email: manupatisujatha@gmail.com

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## RESULTS

In the present study out of 24 cadavers 03 cadavers presented renal artery variations. Bilateral accessory renal arteries were observed in three male cadavers (12.5%). In one cadaver the two renal arteries were arising directly from the abdominal aorta on both sides (Fig.1). In another case triple renal arteries on right side and double renal arteries on left side were noted with right testicular artery arising from the inferior renal artery on right side (Fig.2). In another cadaver one single renal artery was present on each side which further divided in to two branches and supplying the kidneys with bilateral double ureters (Fig.3).

## DISCUSSION:

Knowledge of renal vascular variations is an essential prerequisite for diagnostic, endovascular and operative procedures in the abdomen. Any artery arising from abdominal aorta in addition to the main renal artery should be named as 'accessory' and those arising from a source other than the aorta should be called 'aberrant' (2). Most of the abnormalities in the renal arteries are due to the various positions occupied by kidneys during their developmental ascent from pelvis to lumbar region (3).

The metanephros is the functional kidney and to begin with it is located in the sacral region and it gradually ascends to upper lumbar region during 6<sup>th</sup> to 9<sup>th</sup> week of development. During its ascent its blood supply shifts from branches of internal iliac to common iliac artery and finally to the abdominal aorta. Origin of renal arteries from different sources and their frequent variations can be explained by the development of 20-30 segmental mesonephric arteries in the fetal life (4). Failure of degeneration of these primitive lower vessels in ectopic caudal kidney results in origin of more than one accessory and polar renal artery.

Renal arteries are end arteries. If an accessory artery is ligated or damaged, the part of kidney supplied by that artery will be ischemic. Thus the embryology of renal vessels and its development is essential to understand variations and anomalies in renal arteries.

Accessory renal vessels originate just above or below to the main renal artery. The accessory renal vessels may be 2-4 in number. Variation in the number of accessory vessels is due to the persistence of lateral splanchnic arteries (5). Normally, double renal arteries may coexist with other neurovascular variations, such as double renal vein, double ureter and persistence of foetal renal lobulations on the same or opposite side (6). But in the present study we observe accessory renal arteries with double ureter in one cadaver (fig.3) with abnormal origin

of testicular artery from inferior right renal artery which is different from that reported in literature.

Bilateral prehilum multiple branching of renal arteries, three right renal arteries with origin of right testicular artery from the inferior right renal artery and bilateral variant testicular arteries arising from the accessory renal arteries were reported in literature (7,8,9). A 20% incidence of accessory renal arteries with a 15% unilateral and 5% bilateral was reported in literature (10). In the present study were reported 12.5% (3/24 cases) incidence of accessory renal arteries that were bilateral.

Hussein Muktyaz et al (11) based on their observations in 56 cases reported 39.2 % (22 cases) incidence of renal arterial variations of which unilateral variations were observed in 10 cases (17.8%) and bilateral in 12 cases (21.4%). According to Irena Vilhova et al (12) the renal artery anomalies can be classified as follows

1. Triple renal arteries arising from the Aorta with different diameters entering the kidney through the hilum.
2. Double renal arteries originating from the Aorta with similar diameter entering through the hilum of the kidney.
3. Accessory renal arteries arising from the Aorta with the diameter of segmental arteries supplying one segment only, entering the kidney through the upper pole or lower pole or the hilum.
4. Perforating renal arteries arising from the Aorta or one of its major branches, diameter being subsegmental supplying one segment and entering the kidney outside the hilum.

In our study in one case double renal arteries (Fig.1) arising from the Aorta with 1 cm distance from each other with similar diameter entering through the hilum and upper pole of the kidney was observed corresponding to the 2<sup>nd</sup> variety described in literature (12). In other case (Fig.2) we observed a single renal artery arising as trunk which was further dividing in to two branches corresponding to 4<sup>th</sup> variant reported (12). One case in the present study (Fig.3) with bilateral double ureters represents 3<sup>rd</sup> variety reported in literature (12). Hemanth Kommuru et al (13), studied 182 kidneys. Among them 34 kidneys presented one additional artery and 18 kidneys showed two additional arteries. Extra artery was unilateral in 6 cadavers and bilateral in 20 cadavers. They also mentioned that in one of the cases the accessory renal artery was a branch of superior mesenteric artery. According to him bilateral accessory renal arteries are seen more in male cadavers and in our study also we observed in males only.

Saritha et al., (14), studied 25 cadavers and observed unilateral variations in one cadaver and bilateral in two cadavers. Neelesh Kanaskar et al (15), reported a case ad-

ditional renal arteries on the right side. Virendhrabudhira-  
 raja et al (16), studied 50 formalin fixed cadavers and  
 reported prehilal branching in 11 cases, duplication of  
 renal arteries in 8 cases (5 right & 3left) and superior  
 polar arteries in 7 cases. Krunal Chauhan et al (17), stud-  
 ied 40 formalin fixed cadavers and observed renal artery  
 anomalies in 20 cadavers (unilateral variations in 14 ca-  
 daver and bilateral in 6 cadavers).

## CONCLUSION

Accessory renal arteries are end arteries. A good knowl-  
 edge of the Anatomy and anomalies of renal vessels fa-  
 cilitates a safe approach to the kidney in trauma manage-  
 ment and prevents damage of kidney in the surgeries.  
 These variations are of utmost importance to the urolog-  
 ists, surgeons dealing with kidney transplantation and  
 also for radiologists.

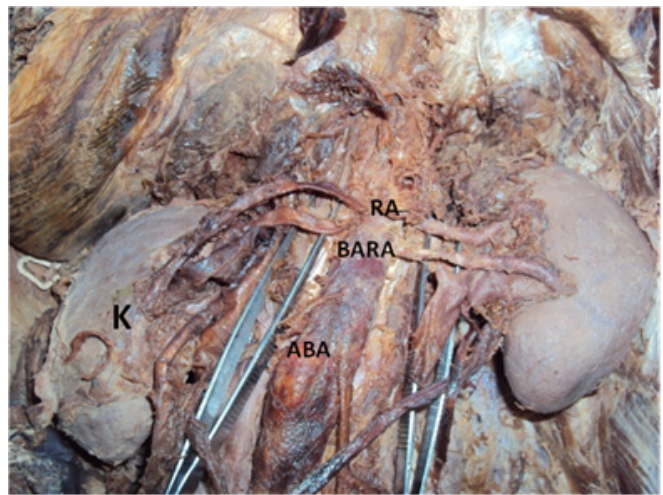
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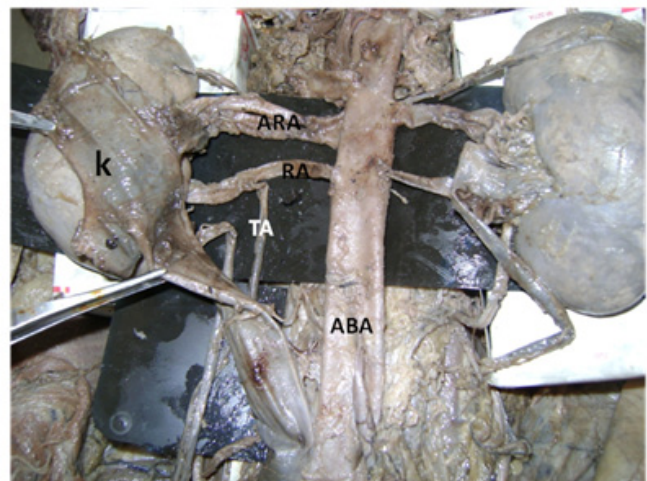
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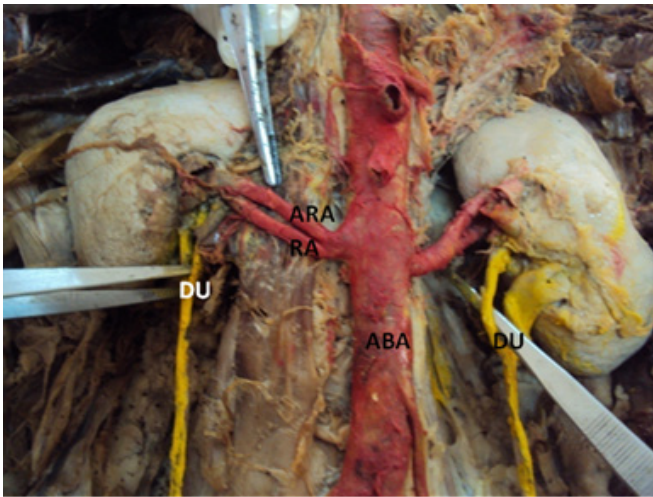
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**Figure 1:** Showing bilateral accessory renal vessels. K: Kid-  
 ney, ABA: Abdominal Aorta, BARA: Bilateral Accessory Renal  
 Artery. RA: Renal Artery.



**Figure 2:** Showing bilateral accessory renal vessels. K: Kid-  
 ney, ABA: Abdominal Aorta, RA: Renal Artery, ARA: Accessory  
 Renal Artery, TA: Testicular Artery.



**Figure 3:** Showing Bilateral Double Ureter and Accessory renal vessels. ABA: Abdominal Aorta, RA: Renal Artery, ARA: Accessory Renal Artery, DU: Double ureter.