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A study of renal artery variations in cadavers

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ABSTRACT

Objectives: To know the variations of renal artery in human cadavers and to report the incidence. **Methods**: The study was performed on 32 cadaveric kidneys over 4 years. The posterior abdominal wall was dissected to study the paired kidneys. **Results**: The following parameters were observed. The number of renal arteries supplying each kidney, single in 88%, double in 12%, the level of origin of renal arteries (RA), Right RA higher origin in 75%, Left RA higher origin in 15%, both right and left RA origin at same level in 10%. Branching of RA, Hilar in 67%, Prehilar in 33%. The prevalence of accessory renal arteries (ARA) in the present study is 28%.The percentage of unilateral ARA in the present study is 15.67% and of bilateral ARA is 6.2%. Percentage of origin of ARA from aorta is 15.6%, from main renal artery is 7.8%. **Conclusion**: Anatomical knowledge of the vascular variations is essential for the clinician to perform procedures such as renal transplantation, renal vascular operations more safely and efficiently.

Keywords: Renal artery, Accessory renal artery, Cadaver, Variations.

Introduction

Variations in the renal vessels have been observed frequently in routine dissection and surgical practice. Renal artery variation including their number, source of origin and course are very common, but such occurrence existing with or without other congenital anomalies such as, horse –shoe kidney or polycystic kidney is rare. The study of congenital anomalies of renal artery which comprises a diversity of abnormalities ranging from complete absence, aberrant origin, location, orientation has been of interest to urologists.[1]Man since ages has speculated the etiology of congenital malformation with the aim of diagnosing them early and preventing their occurrence if possible or planning suitable surgical approach to correct them. With the advent of simple investigations such as intravenous pyelography (IVP) to sophisticated and specific imaging techniques like arteriography, scintigraphy, the study of various abnormalities. Spear headed a systemic clinical approach to this topic.

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Most of the classic work was performed by investigations in the middle to late 1950's and early 1960's.The renal blood vessels basically may be mal-developed owing to genetic defects or to environment. However the etiology of the majority of malformations is not known. (Stephens 1982)[2] Although it is possible that urologic malformations arise from aberrations of normal development, it is likely that a genetic basis exists for urologic birth defects, as these are reports of sibling and familial uro-pathology. A wide range of anomalies result from a multiplicity of factors that interact with one another to influence renal development in a sequential and an orderly manner. Abnormal maturations or inappropriate timing of these processes at critical points in development can produce many variations in the development of the renal vessels. This critical period is between 15-94 days of gestation of human embryo.[3] The author has taken up the study of gross congenital malformations of renal vessels as10-15% of all neonatal deaths are attributed to congenital renal malformations. It is therefore crucial that surgeons, especially urologists, pediatric surgeons involved in the care of newly born infants be alert to the prenatal clues of underlying congenital abnormalities to detect them early and attend to them

immediately. Variations in renal vessels both extra renal and intrarenal are very frequent. Knowledge of these aberrant vessels is essential in the management of pathological conditions they may cause. Not all congenital anomalies of the urinary tract require surgery and it is thus important to identify kidneys with anomalies of blood vessels at risk by radiological examinations and sonography, which provide predominantly anatomic information, where as the function of the kidney and upper urinary tract can be reliably studied by scintigraphy[4]. These functional data are essentialwhen deciding on the most appropriate treatment for patients with congenital urinary tract abnormalities and thus contribute to some extent to the vast knowledge of this topic and prove fruitful to some extent. According to study of Libertino *et al*., (in 1988) variations of the main renal vessels are common, present in 25%-40% of kidneys. The most common variation is the occurrence of supernumerary renal arteries, 2 or more arteries to single kidney, up to five having been found, these usually arise from the lateral aspect of the aorta and occur perhaps slightly more often on the left than on the right and may enter the renal hilum or directly in to the parenchyma of one of the poles of the kidney, the upper pole being more common than the lower. Lower pole supernumerary arteries on the right tend to cross anterior, than posterior to the inferior vena cava. Lower pole arteries on either side mostly cross anterior to the urinary collecting system and may be an extrinsic cause for pelvi-ureteric junction obstruction. Supernumerary arteries are more common in an ectopic kidney and in some unusual cases, arise from the celiac, superior mesenteric artery or iliac arteries. According to studies of surgical practice two or more renal arteries occur most commonly in women and unilaterally on the left. The main importance of the abnormalities is as a source of potential error during surgeries in the retro peritoneum especially those on the kidney. The renal arteries are functional end arteries, so division of an aberrant lower pole artery will lead to segmental infarction of the parenchyma its supplies. Renal veins, in contrast have extensive collaterals and an aberrant vein can be divided if necessary. Aberrant vessels may not cause hydronephrosis, although a hydronephroticrenal pelvis can bulge between renal vessels making them particularly noticeable. According to studies of surgical practice there can be aberrant renal arteries and veins with anomalies more common in the left kidney. Renal arteries are end arteries and their division or obstruction can lead to renal infarction. Lower pole renal arteries are a cause of obstruction and hyronephrosis and can be defined by angiography.[5]According to Moore and Persaud, [6] (accessory renal vessels), during their ascent to their final site, the embryonic kidneys receive their blood supply and venous drainage from successively more superior vessels. Usually the inferior vessels degenerate as superior ones take over the blood supply and venous drainage. Failure of these vessels to degenerate results in accessory renal arteries and veins. The present work was under taken to document the research on accessory renal arteries.

Materials and methods

The present study was done on 32 cadavers over a period of four years in the department of anatomy, Deccan College of medical sciences. Cadavers were obtained and embalming was done. Dissection was carried out to explore the vascular supply of kidney, along the length of abdominal aorta below the origin of superior mesenteric artery till its terminal bifurcation as common iliac arteries. Accessory renal arteries (ARA) were located and studied in detail and the specimens were photographed. Cadavers were numbered, their gender and age noted.

Results

In the present study during routine dissection by the undergraduate students, 32 cadavers (64 kidneys) of 8 females, 24 males were studied for vascular variations. A thorough observation of external morphology including a study of anomalies of renal vessels was carried out.

Cadavers were numbered and differentiated according to sex.

In present study the following parameters were observed in both males and female cadavers.

a) Regarding the **number** of renal arteries supplying the kidney: 2 arteries in 8 specimens (12.5%) Fig 5,6
b) Regarding the **level of origin** of renal arteries(RA): The origin of **right** RA **higher** than the left RA in 24 specimens(75 %), **left** RA origin **higher** than the right in 5 specimens (15%), both right and left renal artery origin at the **same level** in 3 specimens(10%). Fig 1,3& 5
c) Regarding the **branching** of renal arteries: **Hilar** branching in 43 specimens (67%)Fig 6, **Prehilar** branching in 21 specimens (33%) on right side.Fig 2,5,6
d) Regarding the presence of **accessory** renal artery (ARA): ARA was found in 18 specimens (28%), 10 specimens on the right

side. Fig 1,2,3 specimens on the left side. Fig 2,4

e) Regarding the prevalence of **unilaterality** or **bilaterality** of accessory renal arteries (ARA): Unilateral in 10 specimens (15.6%) Fig 1,3,4 Bilateral in 4 specimens (6.2%). Fig 2

f) **Source of origin** of ARA: Aorta out of 18 none from the common iliac artery or the bifurcation of aorta Fig 1,2,3,4,5,6

g) Source of origin of different types of ARA: From Aorta-10, out of which 2 superior polar A, 4 inferior polar A, 4 hilar A. From Main Renal artery -5, out of which 2 Superior polar A, 1 Inferior polar A, 2 hilar artery Fig.1,2,4,5,6.

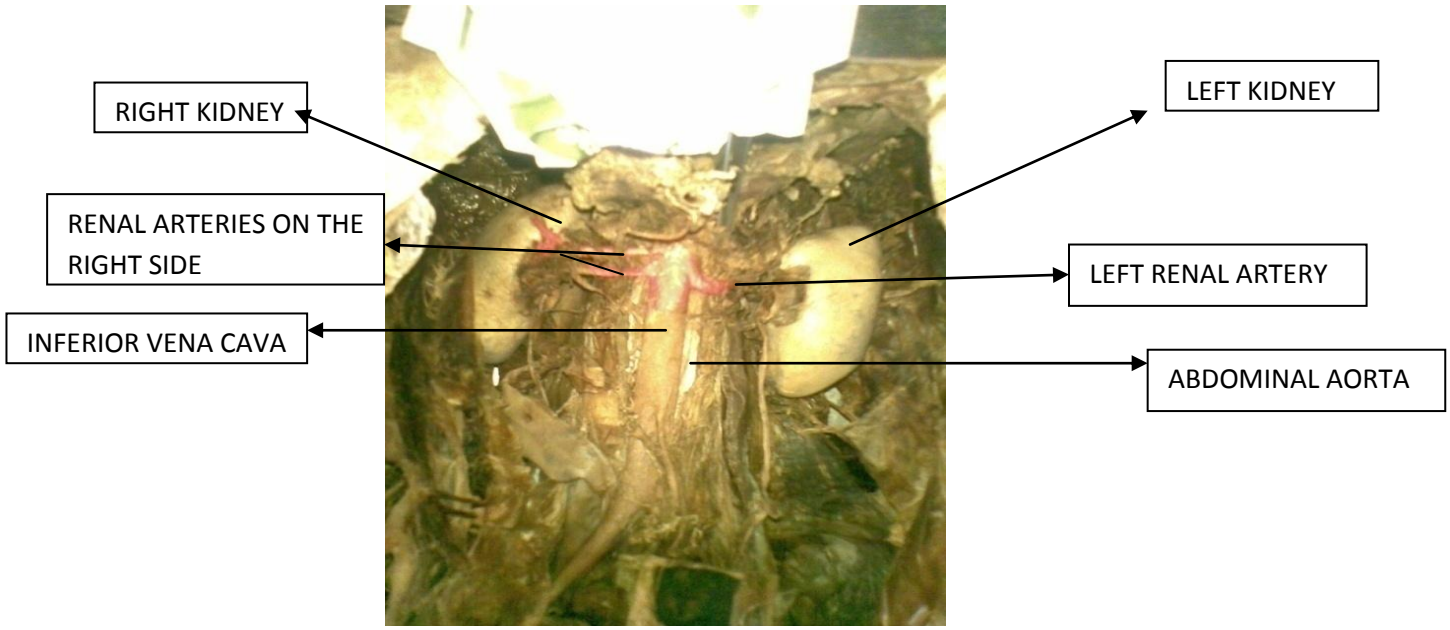

Fig 1: Origin from abdominal aorta

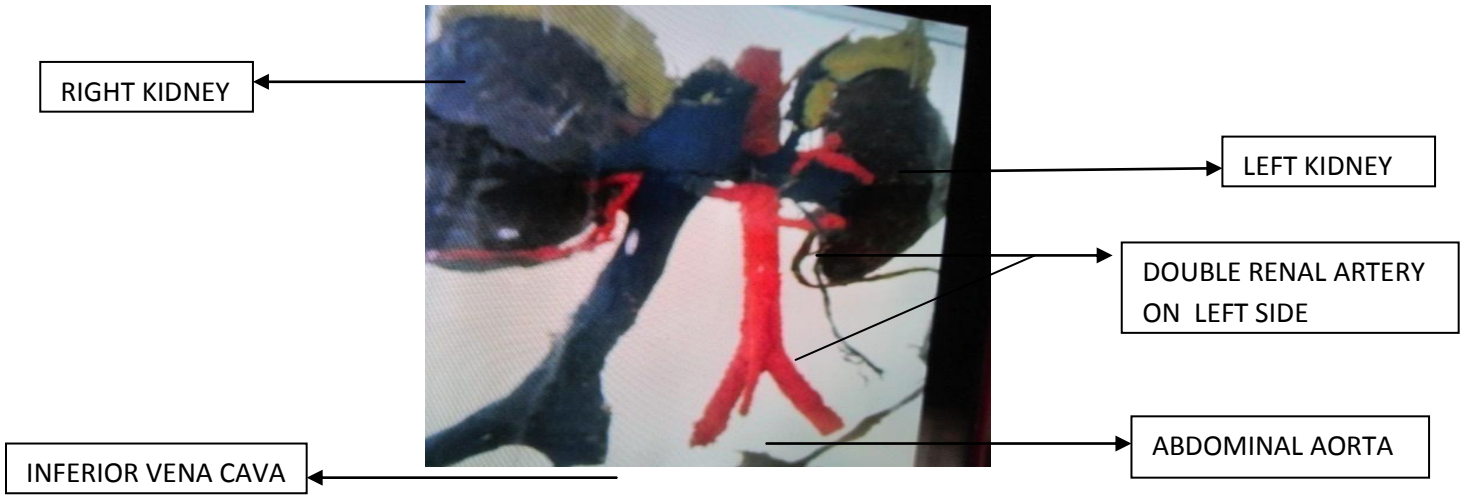

Fig 2:Double renal artery on left side

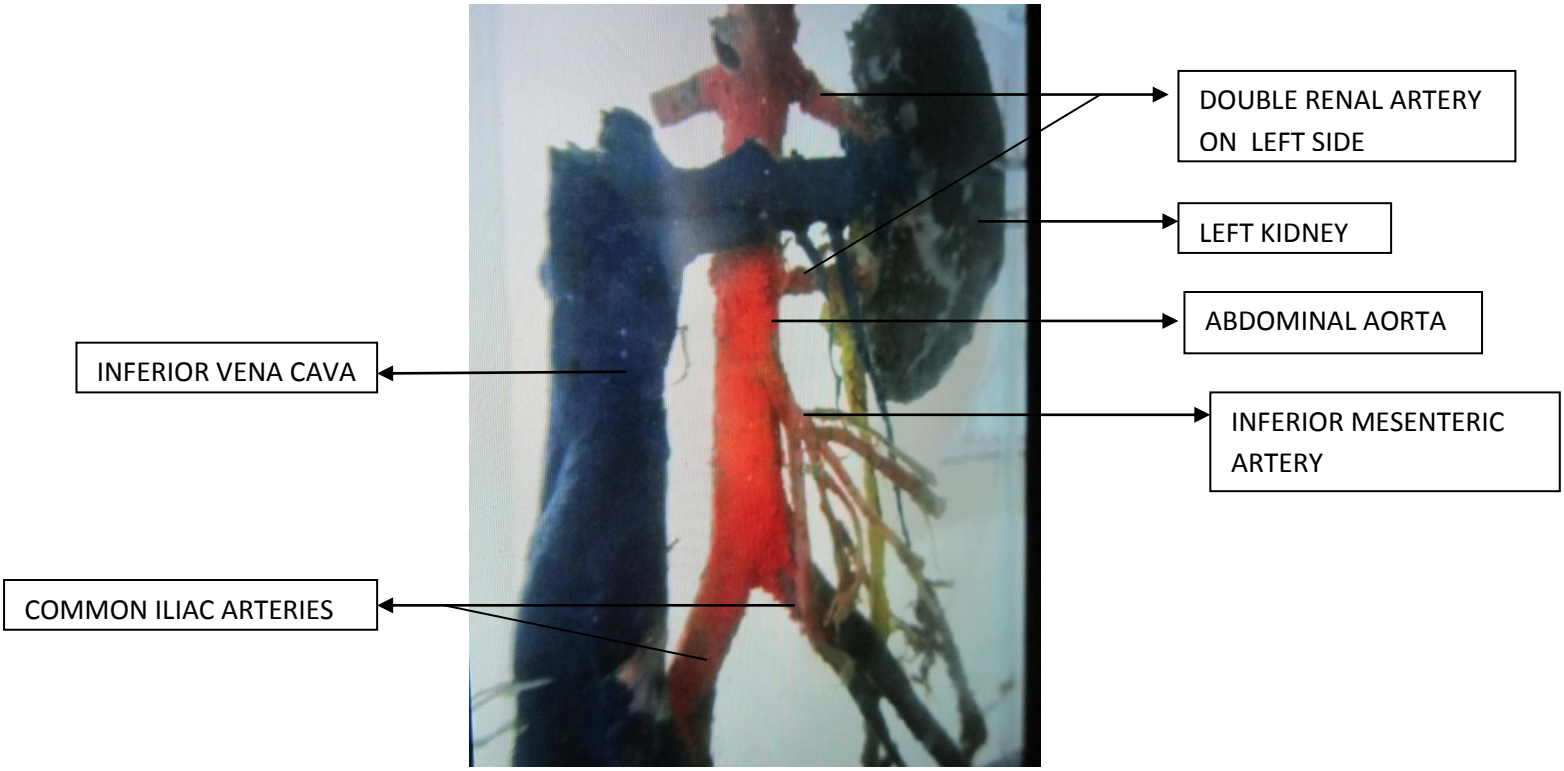

Fig 3: Double renal artery on right side

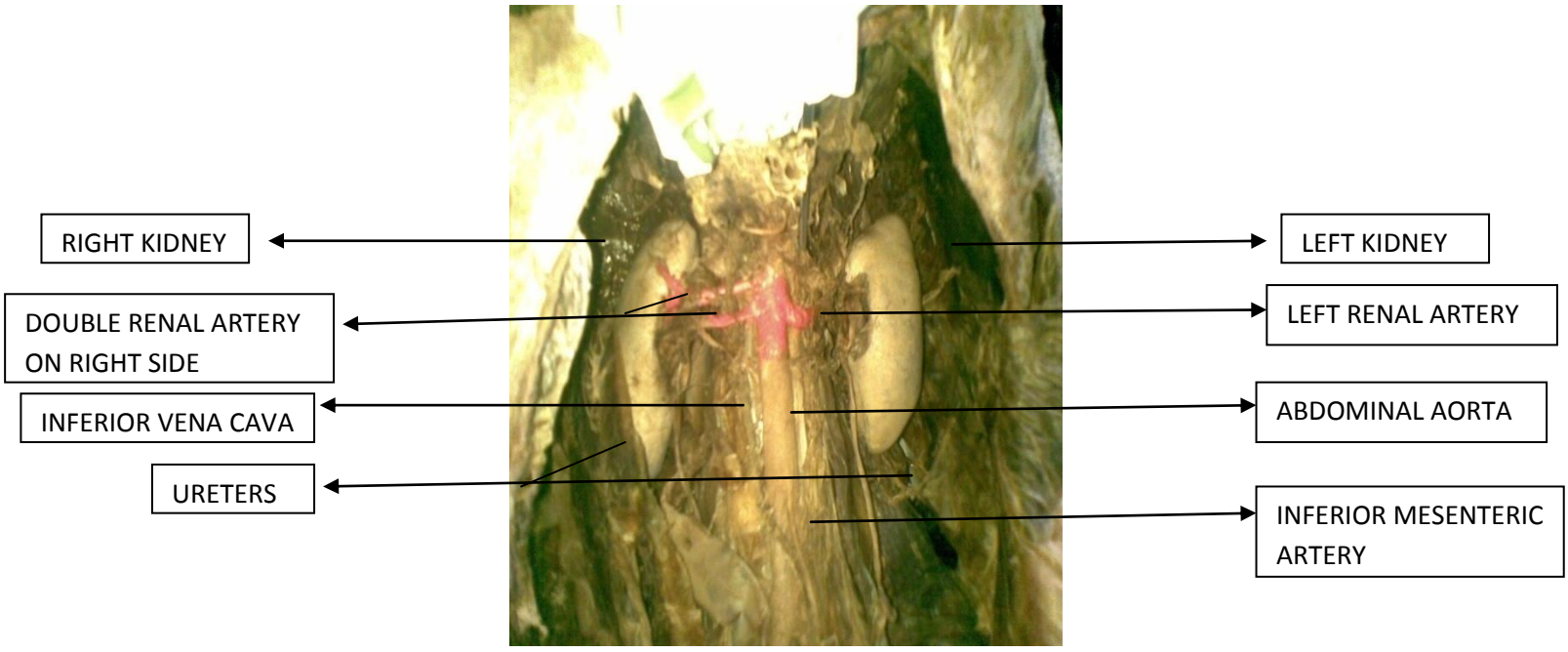

Fig 4:Left renal artery higher origin & prehilar branching

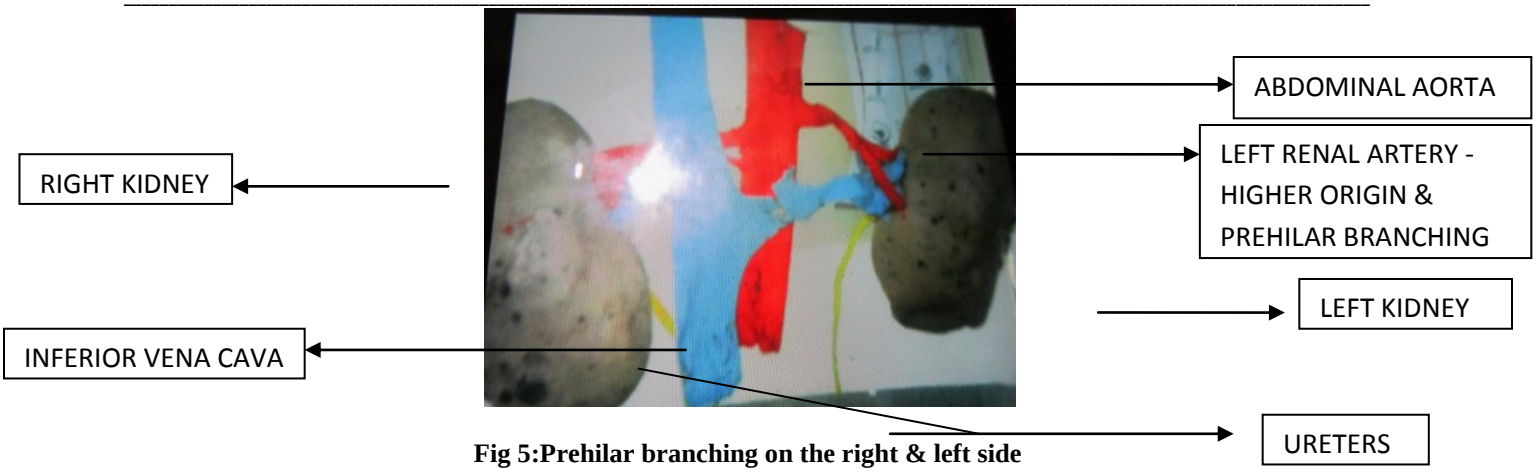

Fig 5:Prehilar branching on the right & left side

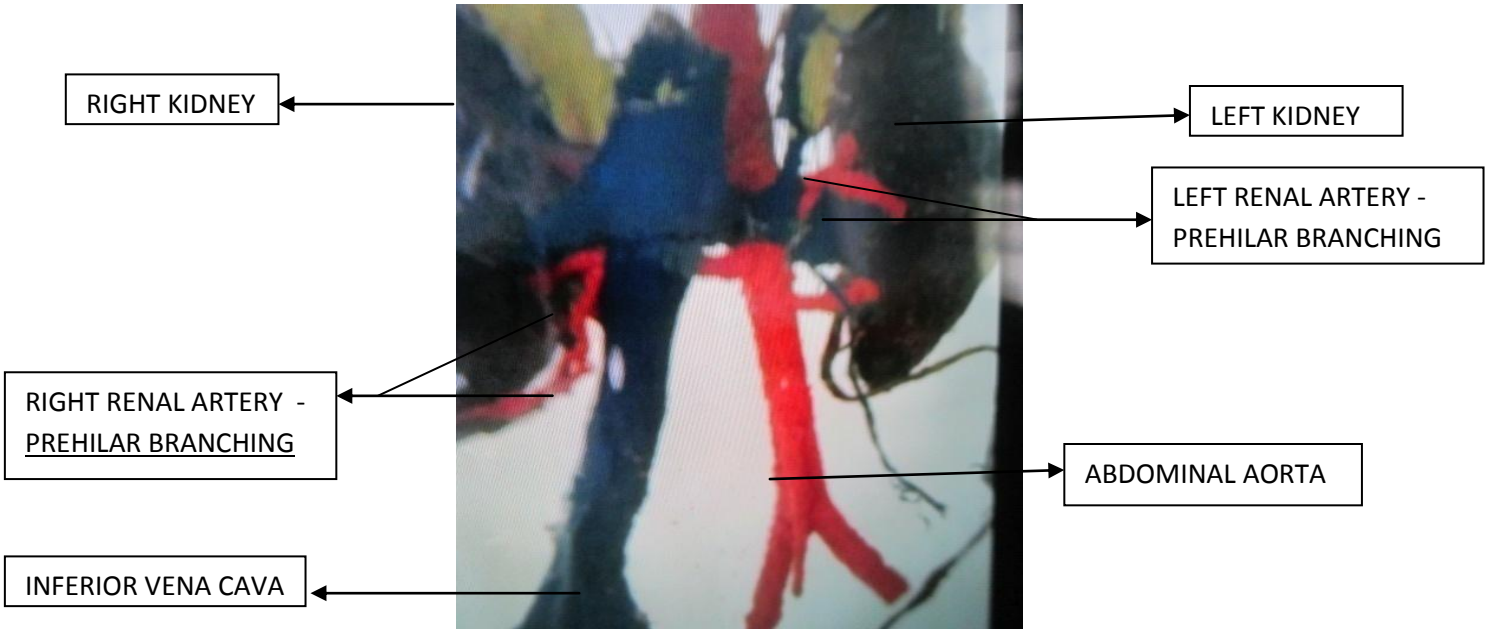

Fig 6:Hilar branching on the right side

Fig 7:Hilar branching on the right side

Discussion

In the present study of variations in blood supply to the kidneys observations were made on 32 cadavers in 64 kidneys , it has been observed that abnormalities were observed in 19 male and 5 female cadavers.Renal arteries are usually single, one renal artery supplying each kidney. The frequency of extrarenal arteries shows variability from 9% to76% and is generally between 28-30% in anatomic and cadaver studies[8]. In our study, in 88 % a single artery was found supplying the kidney, in 12% double renal artery,Which is in concurrent with study of K.Khamanarong *et al* [7] ie 82 % with single artery 17 % with double artery.The extra renal arteries are detected much less frequently than by angiography, and the arteries entering the renal parenchyma are frequently confused with adrenal or capsular arteries. So it is important to consider the results obtained by cadaver dissection method when compared to those obtained by angiographic method. On Origin of right renal artery is usually higher than that of left. In our study, in 75% of specimens the right renal artery origin was at higher level, in 15% the origin of both right and left at the same level, in 10% the origin of left was at higher level. Branching of renal arteries into anterior and posterior divisions more proximal than the renal hilar level is called early division. In present study, the division of renal artery was normal in 79% and early in 21%. This is comparable with the studies done by Kadir.and Ugur Ozkan[8]

Accessory renal arteries are common, and usually arise from aorta above or below the main renal artery and follow it to the renal hilum. They are regarded as persistent embryonic lateral splanchnic arteries, compares the prevalence of accessory renal arteries in our study (28%) with other studies. The accessory renal arteries may be unilateral or bilateral. In our study the bilateral occurrence of accessory renal artery is 6.2%, and unilateral occurrence is 15.6% which is similar with the study by Ambica Wadhwa *et.al*.(Unilateral-15%, Bilateral-5%).13.4% have polar arteries supernumerary arteries are equally frequent on the two sides is observed by Graves (1956) [10] and other have recognized that supernumerary arteries represent segmental arteries or some branch of these , emphasizing the fact that the term Äccessory arteries which has been applied to these in inappropriate, since they do not anastomose with other vessels and interruption of any one therefore produces a zone of neurosis. In our present study, out of 18 accessory renal arteries 10(15.6%) originated from aorta, whereas 5(7.8%) from the main renal artery. Compared with study done by Ronald *et al* [11] is 17% which correlates with this study. Also studies by Pick and Anson[12]found supernumery arteries in 32.25% of the kidney, which they studied. Merklin and Michels(1958)[13] in an extensive review of the literature concluded that although approximately 71% of kidneys two or more arteries of aortic origin that enter a or close to the hilus of the kidney , about 12.5% have two arteries of aortic origin with one enter the hilus and the other one pole of the kidney.With the advent of laparoscopic renal surgeries and donor nephrectomies, it becomes mandatory for the surgeon to understand the abnormality or variations in the renal vasculature. Otherwise renal transplant may be jeopardized by the presence of acessory renal vessels. Therefore, considering the increase in incidence of the accessory and multiple renal arteries, the anatomical knowledge of such may be important for the academic, surgical as well as radiological procedures and the present study is an effort to highlight the same.

Conclusion

The results of the present study clearly indicate that the renal artery shows frequent variations. Most of the variations are in the origin, branching and presence of accessory renal artery. The knowledge about these variations is of utmost importance to the urologist, surgeons dealing with kidney retrieval and transplantation, radiologists performing various endourologic procedures and innumerable interventional techniques.

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