

## Case Report

# SPLIT KIDNEY: A CASE REPORT

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## ABSTRACT

**Background:** The kidneys are retroperitoneal organs with a unique embryological formation. They are formed by two distinct embryological bases, one for the collecting system and one for the parenchymatous tissue. The kidneys are often target to anatomical variations regarding its vessels, its collecting system, its position on the abdominal cavity and others. Most of those variations happen due to different stimuli during its embryonic development. Such is the case of the distinct fetal period lobulation, which happens uncommonly. Many of these abnormalities may produce clinical symptoms, moreover, variations can cause confusion among clinicians regarding diagnostic aspects or surgeons during partial nephrectomy, kidney transplants and other surgical procedures involving the retroperitoneal area or the kidney itself.

**Case Report:** During regular dissection of a male cadaver, after dissection of the retroperitoneal region, it was observed an abnormal conformation of the right kidney: it was completely divided by a fibrous septum into two lobes. The fibrous septum was composed of the same tissue of the kidney's fibrous capsule. A coronal section of the kidney showed that there was also a variation regarding the calyces: they joined independently in order to form the renal pelvis.

**Conclusions:** We believe that knowledge regarding variations of the kidney is of great significance to the clinician and the surgeon, and many of them can produce discomforting symptoms.

**KEY WORDS:** Anatomic Variation, Kidney, Retroperitoneal, Embryology.

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## Access this Article online

### Quick Response code



DOI: 10.16965/ijar.2016.455

**Web site:** International Journal of Anatomy and Research  
ISSN 2321-4287  
[www.ijmhr.org/ijar.htm](http://www.ijmhr.org/ijar.htm)

Received: 31 Oct 2016  
Peer Review: 01 Nov 2016  
Revised: None

Accepted: 01 Dec 2016  
Published (O): 31 Dec 2016  
Published (P): 31 Dec 2016

## INTRODUCTION

The kidneys are retroperitoneal organs that produce and excrete urine. In this fashion, they are in charge of eliminating most of the toxic residues of our body. Situated at each side of T11-L3, the kidneys are surrounded by fat tissue and loose connective tissue. The right kidney is usually situated more inferiorly than the left, due to the large size of the liver [1,2]. The kidneys are enveloped by a fibrous tunic, and fissures may be found in infants, remnants of a

lobulated kidney in fetal period [1,2].

Variations and anomalies regarding this organ are well established and described in the literature by many authors [1-4]. Anomalies and variations are more commonly found on the vessels of the kidney, although the renal arteries are less susceptible to variations than the veins [1,3-5].

Knowledge of such variations is crucial to identify diseases and is the key to a successful surgical procedure, such as partial nephrectomy.

Furthermore, interpretation of ultrasound and other imaging exams requires awareness of the many different types of variation [2,6].

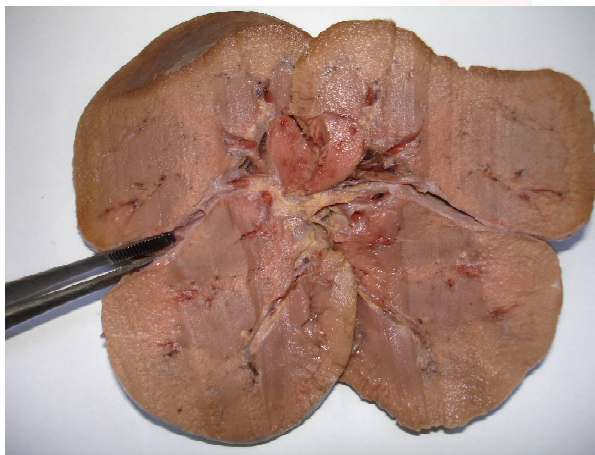
We report a case of an uncommon variation regarding complete division of the right kidney in two distinct lobes and review the embryological aspects of the kidneys, while performing a review of the literature and addressing its surgical and clinical significance.

## CASE REPORT

**Fig. 1:** The septate kidney. An anterior view of the right kidney shows its complete septation into two distinct lobes.



**Fig. 2:** Coronal section of the right kidney. We can see that the calyces arise from each lobe independently in order to form the renal pelvis. The fibrous septa can also be seen.



A male cadaver fixed with a 10% formalin solution was dissected during regular anatomy lessons of the Fluminense Federal University's anatomy laboratory. While dissecting the retroperitoneal portion of the abdominal cavity, we observed an unusual display of the right

kidney. After removing the pararenal adipose tissue, we saw that the right kidney was completely segmented from its anterior to its posterior faces (Figure 1). We also observed that the fibrous capsule that envelops the kidney was also reflected, thus, causing complete division of the right kidney into two distinct lobes. A coronal incision was made from its lateral margin to the medial margin, and we also noticed that independent calyces joined in order to form the renal pelvis (Figure 2). The vasculature showed extrarenal vessels to each independent pole.

## DISCUSSION

The kidneys are developed together with other organs of the urogenital apparatus through 3 pairs of structures that develop in a craniocaudal disposition from the intermediate mesoderm: the pronephros, the mesonephros and the metanephros. The definitive kidneys are derived from the metanephros [2,6,7].

During the fourth week of development, a small duct (mesonephric duct or Wolffian duct) is generated through epithelialization of the intermediate mesoderm. Those ducts form a small conglomerate of cells which regresses to give rise to the mesonephros. Then, mesonephric tubules begin to develop within mesonephric buds adjacent to the mesonephric duct on either side of the vertebral column, in a craniocaudal direction, as they differentiate, the cranial tubules regress, and this structure only occupies the region between L1-L3, and start functioning as an abbreviated version of the definitive kidney until the tenth week, ceasing their role, regressing in females and they are thought to give rise to the efferent ductules in males [6,7].

The metanephros is composed by two different portions: excretory and collector, which have different embryological origins. Two ureteric buds arise from the caudal portion of the mesonephric duct (day 28), then, they penetrate the metanephric mesenchyme and begin to bifurcate and replicate, branching itself. After the sixteenth week, they form around fourteen to sixteen lobes, giving the metanephros a lobulated aspect [6,7]. This process continues and the ureteric bud expands to form the renal

pelvis, then it bifurcates four times to form the major calyces, and around the seventh week the minor calyces are formed through the same mechanism. In 32 weeks, this process forms three million of collecting ducts [6,7]. In fishes and amphibians, the kidney is formed by the mesonephric bodies, while in reptiles, birds and mammals they suffer atrophy and disappear [2]. The normal kidney is formed from fusion of multiple lobes known as renunculi or reniculi which develop during the second trimester. Those renunculi are constituted by a large central medullary pyramid containing the collecting tubules surrounded by cortex containing the glomeruli [6].

The kidneys are developed in the pelvis, and then migrate to the upper portion of the abdomen. As they arise, their blood supply from the external and internal iliac vessels regresses and the abdominal portion of the aorta takes main role in its supply. Furthermore, the kidney hilum is faced ventrally, and as they ascend, this hilum rotates medially in an angle of 90° degrees. They attain their adult position by the ninth week [7,8]. Understanding the embryological aspects of the kidney is essential to comprehend its normal and pathologic variations [7].

According to Goss (1973) mammals such as the bear and the ox display a kidney with many distinct lobes, although this feature in humans is only present during the fetal period of development [2]. Moore and Dalley (2001) report an incidence of 7% of this condition in adults [9].

As previously stated, the kidney is formed by a junction of many renunculi. The lobulated aspect of the kidney is normal in neonates, and the organ possesses many grooves. As the kidney develops, this lobulated aspect regresses and takes the regular aspect [7]. A failure in the junction mechanism of two larger lobes would explain our variation, as the capsule also invaginates to form two distinct lobes, similar to the variation of the lungs, whereas the azygos vein arches over the hilum and together with the pleura a new lobe is formed on the right lung, the azygos vein lobe [10]. Moreover, Rodriguez (2014) described that persistent fetal lobulation may be related to defects in renal maturation [11]. A review of the literature shows many varia-

tions of the kidney: they may be longer or narrower [3]; one kidney may be smaller or absent, while the other is proportionally hypertrophied [1,3]; a supernumerary kidney may be found [1,2]; it may present the horseshoe kidney configuration [2,3]; it may present the form of a ring when both poles of both kidneys are joined [1,2]; the kidneys can suffer malrotation [8]; ectopic kidneys have been described located more cranially [2]; on the iliac fossa [2]; over the sacroiliac joint [2]; over the sacral promontory [2]; on the pelvis [2,3,12]; between the rectum and the bladder or even laterally to the uterus [2]. Furthermore, the kidney may "float", which would be caused by the complete involvement of the kidney by the peritoneum, and finally, the kidney may be mobile, a condition more known in malnourished males [2,3]. Nevertheless, variations of the calyces, pelvis and ureter are also common and extensively described in the literature [3,13].

Abeshouse (1944) reported a similar case to ours, where the left kidney was completely divided into two lobes with a distance of 3 cm from each other, due to the presence of a septum [14].

Most of these variations are presented together with anomalies of supernumerary vessels and congenital defects of the ureter, thus, some may or may not cause a great number of symptoms such as hydronephrosis, infections and nephrolithiasis, and may lead to hypertension, although, further studies are needed to prove this hypothesis [5,8,15]. Persistent fetal lobulation may be associated with syndromes such as Bardet-Biedl Syndrome or may be confused in exams by renal scars, schwannomas, hemangiomas, and angiomyolipomas [11,16-19].

## CONCLUSION

In conclusion, knowledge of the many kidney variations and its associated structures are of great importance to the surgeon and physician, as renal transplants, partial nephrectomies, lithotripsies and other procedures are common. Furthermore, in order to understand the clinical aspects of many diseases and to avoid misdiagnosis, knowledge regarding the kidney development and possible failures should be further studied.



## Conflicts of Interests: None

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### How to cite this article:

Souza CFC, Pires LAS, Teixeira AR, Araujo RC, Babinski, MA. SPLIT KIDNEY: A CASE REPORT. Int J Anat Res 2016; 4(4):3263-3266.  
**DOI:** 10.16965/ijar.2016.455