



## Horse-shoe Shaped Kidney in Fetus and its Associated Variations: A Case Report

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### Abstract

*Horseshoe kidneys are found in 3% of the population and are probably the most common of all renal fusion anomalies. This anomaly consists of two distinct renal masses lying vertically on either side of the midline and connected at their respective lower poles by a parenchymatous or fibrous isthmus. In a male fetus, aged 32 weeks of gestation, horseshoe kidney was observed during anatomical dissection. Variations in the position of the ureter and the arterial supply were also noted. Although most cases of horseshoe kidneys are asymptomatic and discovered upon autopsy, the condition may increase the risk for ureteric obstruction, venacaval obstruction owing to abnormal placement of ureter, renal infections associated with vesicoureteral reflux, renal stones due to deviant orientation of kidneys combined with slow urine flow and increased risk of renal cancer.*

**Key words:** Horseshoe kidney, ureter, renal artery, carcinoma, vesicoureteral reflux, renal stones

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## Introduction

Horseshoe kidneys are found in 1 in 400 individuals with an increased incidence in males [1]. Transverse bridge of renal tissue, the isthmus, usually but not invariably containing functioning renal substance, connects the two renal masses. The isthmus lies between the inferior poles, usually anterior to the great vessels. The ureter curves anterior to the connection and may have a high insertion to the renal pelvis.

Horse-shoe kidneys can have an associated congenital pelvi-ureteric junction obstruction in up to 30%. Anomalous vessels crossing the ureter and the abnormal course of the ureter as it passes over renal substance may also cause obstruction. Horse-shoe kidneys have an increased incidence of stone disease, probably due to areas of inefficient drainage [2].

The blood supply to horse-shoe kidneys is variable. One vessel to each moiety is seen in 30% of horse-shoe kidneys. Multiple anomalous vessels are common and the isthmus may be supplied by a vessel directly from the aorta or from the branches of the inferior mesenteric, common iliac or external iliac arteries. In view of this variable arterial anatomy, angiography is very helpful when planning renal surgery on horse-shoe kidneys [2].

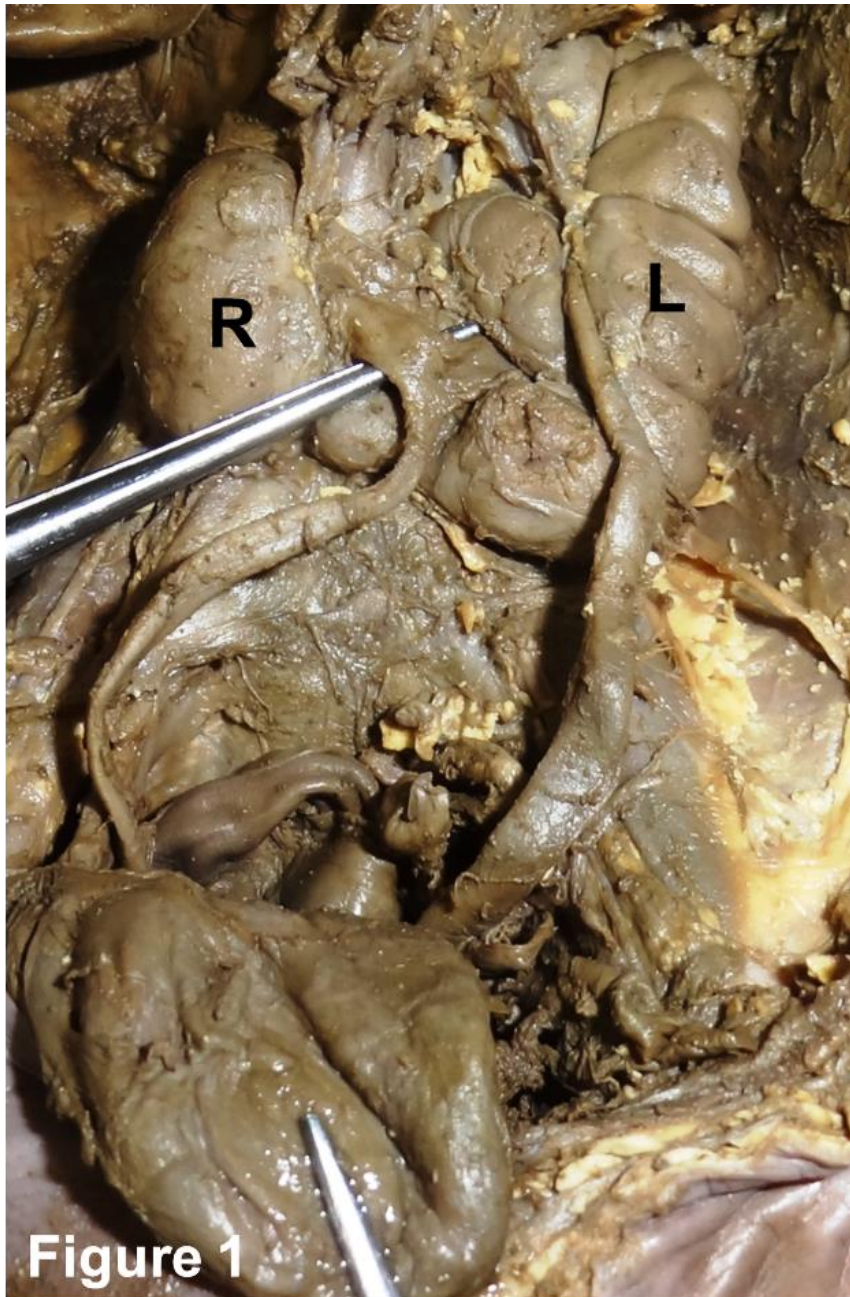
Although there are several reports on the prenatal diagnosis of horseshoe kidney [3-5] and one study reported the prenatal detection rate [6], the true incidence of horseshoe kidney in the fetus has not been well determined and it is likely that many horseshoe kidneys go undetected during fetal life.

## Case Report

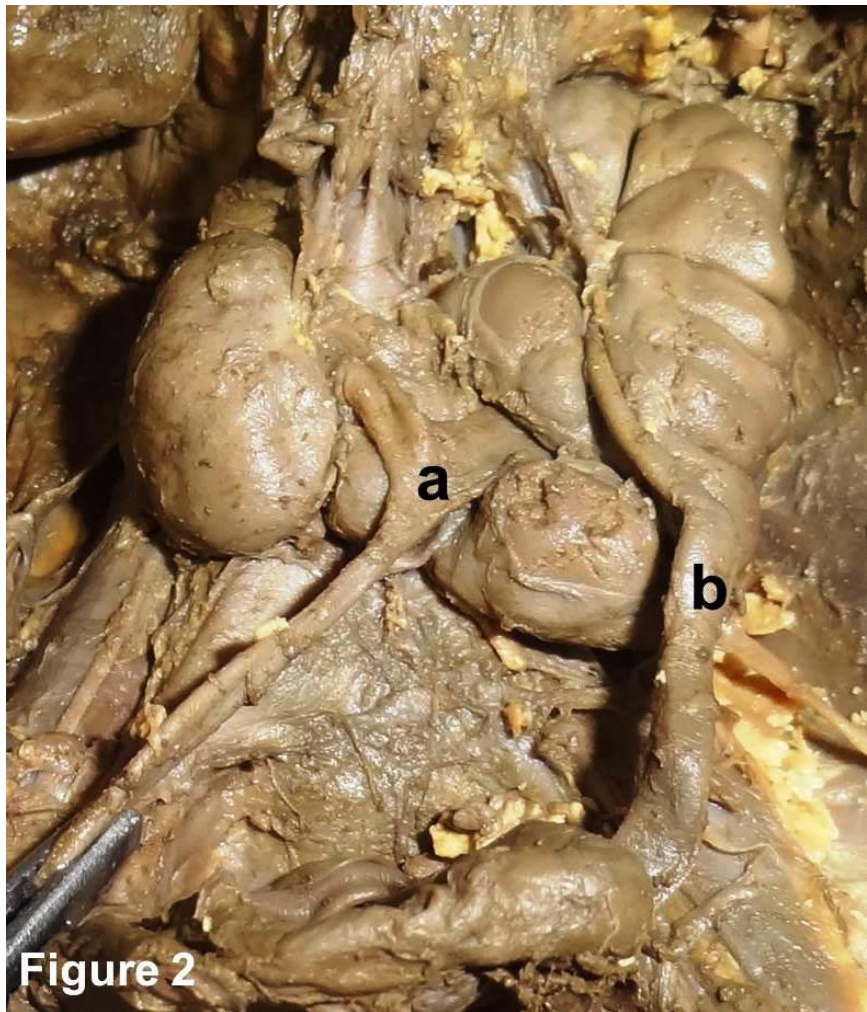
In a male fetus, aged 32 weeks of gestation, horseshoe kidney was observed during anatomical dissection. Various other morphological variations were also noted.

The kidneys failed to ascend, arrested by the inferior mesenteric artery at L4 level. The right kidney was typically bean shaped; while the left was highly lobulated and much longer. The lower end of both the kidneys was fused in the midline, connected by an isthmus (Figure1). A common ureter was seen to be arising from both the kidneys in the region of the isthmus. This ureter descended and further continued as the right ureter draining into the urinary bladder. An additional ureter was also observed to be draining the left kidney which continued as the left ureter (Figure 2). The hilum was ill-defined in both the kidneys showing the exit of the renal

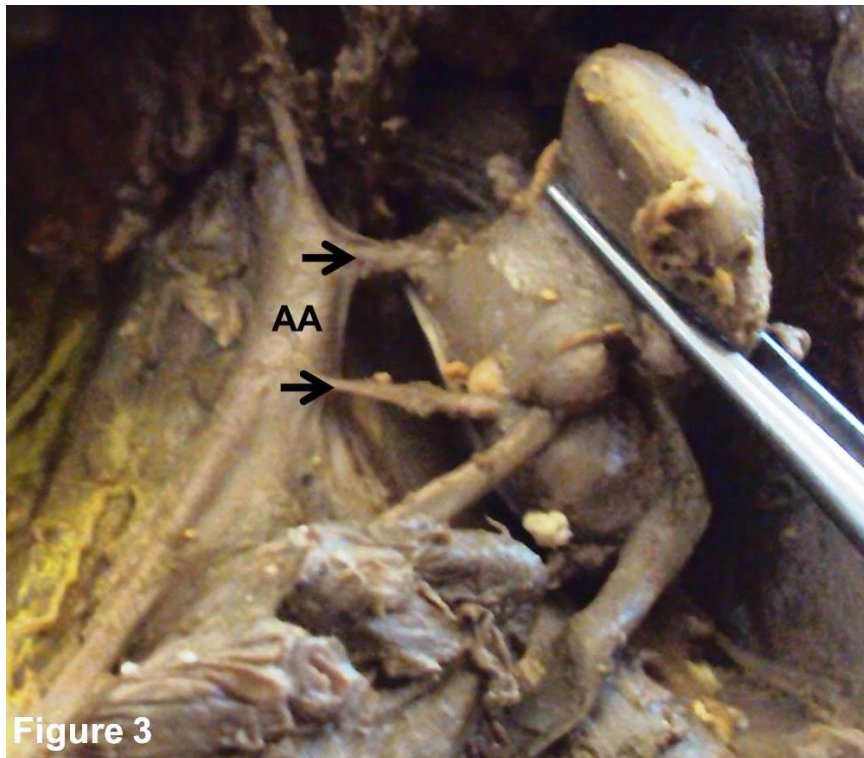
veins and an additional ureter on the left side. Variation in the arterial supply to the kidneys was also observed. No separate arteries were seen to supply the right and the left kidneys. The isthmus, however, received two separate branches arising ventrally from the abdominal aorta (Figure 3).



**Figure 1.** Horse shoe shaped kidney in fetus- The right kidney was typically bean shaped; while the left was highly lobulated and much longer. The lower end of both the kidneys was fused in the midline, connected by a parenchymatous isthmus.



**Figure 2.** Showing a common ureter arising from both the kidneys and further continuing as the right ureter (a) and a separate left ureter additionally draining the left kidney (b).



**Figure 3.** Showing the isthmus receiving two separate branches arising ventrally (indicated by arrows) from the abdominal aorta (AA).

### Discussion

The horseshoe kidney consists of two distinct functioning kidneys connected at the lower poles by an isthmus of functioning renal parenchyma or fibrous tissue that crosses the midline of the body anterior to the aorta. Two theories of embryogenesis have been proposed. The classic theory involves mechanical fusion of two kidneys during organogenesis. The inferior poles of kidneys touch and fuse in the lower midline during the migration through the narrow fork of umbilical arteries [7]. An alternative theory proposes that there is abnormal migration of posterior nephrogenic cells, which then coalesce to form the parenchymal isthmus [8,9]. Teratogenic events involving the abnormal migration of posterior nephrogenic cells may be responsible for the increased incidence of related congenital anomalies and neoplasms associated with the isthmus of the horseshoe kidney [9].

The first description of a horseshoe kidney as a pathology of the kidney was provided by Morgagni in 1820 [10]. Hydronephrosis is a common complication of horseshoe kidney. Surgical treatment of the functionally reduced or even non-functional part of the kidney can therefore become inevitable [11].

Most of the malignant tumors arising in horseshoe kidneys are renal cell carcinomas, but transitional cell carcinomas, squamous cell carcinomas, Wilm's tumors, lymphomas, carcinoid tumors and sarcomas have also been reported [1,12].

Only 123 cases of renal malignant tumors in horseshoe kidneys have been reported on the international literature up to 1998, and about 50% of these cancers were renal cell carcinomas. In tumor-bearing horseshoe kidneys, preoperative knowledge of the localization, extent and vascular supply of the neoplasm is indispensable [13].

The blood supply to the horseshoe kidney can be quite variable. In 30% of the cases, it consists of one renal artery for each kidney [2], but the blood supply may be atypical, with duplicate or even triplicate renal arteries supplying one or both kidneys [14]. The isthmus and adjacent parenchymal masses may receive a branch from each main renal artery, or they may have their own arterial supply originating from the aorta either above or below the level of the isthmus [14]. This area may also be supplied by branches from the inferior mesenteric artery, the common or external iliac arteries, or the sacral arteries [15].

Tae-Hoon Kim in his case report affirmed that the isthmus was receiving two arterial supplies that originated from the aorta at the level of the isthmus, and there was an additional arterial supply from the left common iliac artery [16].

In the present case, no arteries were seen supplying the right and left kidneys. The isthmus was supplied by two branches arising ventrally from the abdominal aorta.

An aberrant vascular supply is one of the major anatomic features in horseshoe kidneys; thus, the vascular supply cannot be easily predicted on the surgical field. Therefore, angiography is indispensable for guiding the radiologic and surgical interventions.

Recent researches have shown that horse-shoe kidneys can also be used in kidney transplantations. Horseshoe kidneys, being the most common renal fusion anomaly, can provide a useful solution to the ever-increasing gap between demand and supply. The successful transplantation of a horseshoe kidney into a single recipient has been reported [17].

Although most cases of horseshoe kidneys are asymptomatic and discovered upon autopsy, the condition may increase the risk for ureteric obstruction, venacaval obstruction, owing to abnormal placement of ureter; renal infections associated with vesicoureteral reflux; renal stones

due to deviant orientation of kidneys combined with slow urine flow and ureteric obstruction; increased risk of renal cancer, especially Wilms' tumor, transitional cell carcinoma, carcinoid tumor etc [2,18].

The common ureter draining both kidneys should also be taken care of during surgical intervention.

The sole arterial supply to the isthmus of kidney in actual surgical scenario may call for extra cautious handling of structures of the posterior abdominal wall.

Considering the varied clinical significance, the present case report will be important for adding to existing knowledge.

**Conflict of interest:** None

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