

Horseshoe Kidney with Surplus Renal Vessels: a Case Report in Thai Cadaver

Wandee Apinhasmit, D.D.S., Ph.D., Dolly Methathrathip, D.D.S.

Department of Anatomy, Faculty of Dentistry, Chulalongkorn University, Bangkok 10300, Thailand.

ABSTRACT

A horseshoe kidney (HK) was discovered in an 84-year-old Thai male cadaver during routine dissection. Inferior poles of the kidneys fused to form a parenchymatous isthmus and constituted a HK. The HK located anterior to the abdominal aorta and the inferior vena cava at a level lower than the normal kidney. Both renal hila directed anteriorly and ureters which drained from each pelvis descended anterior to the isthmus to enter the urinary bladder. Eight renal arteries and five renal veins were observed. In this case the bulky isthmus, anatomical abnormalities, and a variable blood supply were found in association with the HK. It is important to be aware of this anomalous existence in clinical practice, especially during kidney surgeries, kidney transplants, or surgical and endovascular procedures on the aorta.

Keywords: Horseshoe kidney, abdominal aorta, anomaly, surplus renal vessel

Siriraj Med J 2012;64:57-59

E-journal: <http://www.sirirajmedj.com>

INTRODUCTION

Horseshoe kidney (HK) is a common congenital fusion anomaly with an incidence of 0.16-0.33%. It occurs twice as often in males as in females.¹⁻⁴ The fusion is usually found between inferior poles of kidneys to form an isthmus of the horseshoe shape.⁴ The HK is generally low in the abdomen with its isthmus located at the aortic bifurcation and is always anterior to great vessels.⁵ Even though the HK produces no symptoms, it is frequently concomitant with other vascular or genitourinary anomalies.^{1,2,4,6} Therefore, it is important to be aware of these anomalies in clinical practice. Moreover, the HK can be transplanted en bloc or after division of the renal isthmus.⁷ This report has described the anatomical variations on the HK and discussed its anatomical and embryological significance.

CASE REPORT

A case of HK was encountered in an 84-year-old Thai male cadaver during a routine dissection in the Gross Anatomy Laboratory of the Faculty of Dentistry, Chulalongkorn University (Fig 1). The dimensions of this HK have been shown in Table 1.

The HK appeared as a slightly open upward horseshoe-shaped structure in which, the right side of the HK was slightly smaller than the left (Table 1). Inferior poles of the HK were at the level of the fourth lumbar vertebral disc, whereas right and left superior poles were at the level of the second lumbar vertebra and at the first lumbar vertebral disc, respectively. The superior pole of the right kidney was 45.1 mm lateral to the inferior vena cava while that of the left kidney was 36.4 mm lateral to the left wall of aorta. Their long axes oriented inferomedially. The parenchymatous isthmus joined inferior poles of the HK and oriented obliquely to the left. The isthmus located anterior to the abdominal aorta and the inferior vena cava and between the third and fourth lumbar vertebral disc level. It was 23.8 mm inferior to the origin of the inferior mesenteric artery and 19.4 mm superior to the aortic bifurcation.

Both renal hila had an oval shape and opened anteriorly. The right hilus was smaller than the left one (Table 1). There were four major calyces in each pelvis. Two ureters originated from each pelvis, ran downwards obliquely on the anterior surface of the HK, and crossed common iliac arteries to reach the urinary bladder as normal.

The HK was supplied by eight arteries and five veins (Fig 1). The right renal artery arose directly from the right side of the abdominal aorta below the origin of the superior mesenteric artery. It ran downwards posterior to the inferior vena cava and divided into three branches to supply apical, upper, middle and lower segments of the HK. The left renal artery originated from the left side

Correspondence to: Wandee Apinhasmit

E-mail: Wandee.A@chula.ac.th

Received 28 November 2011

Revised 7 February 2012

Accepted 9 February 2012

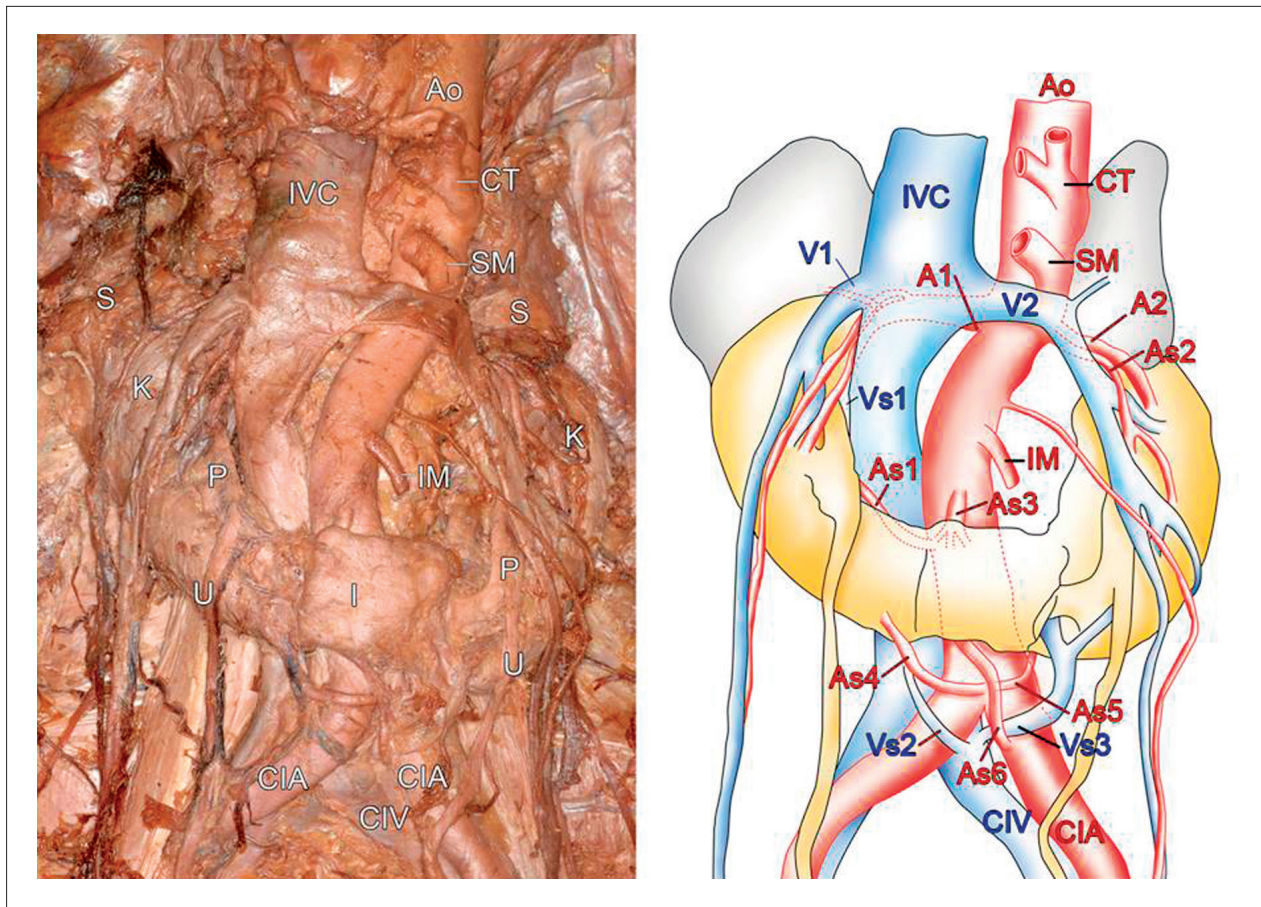


Fig 1. Photograph (left) and schema (right) showing the horseshoe kidney from the anterior aspect of the abdominal cavity. It is supplied by the right renal artery (A1), the left renal artery (A2) and six surplus renal arteries (As1-6). The venous blood drains to the right renal vein (V1), left renal vein (V2), and three surplus renal veins (Vs1-3).

Ao, aorta; CIA, common iliac artery; CIV, common iliac vein; CT, celiac trunk; K, original kidney; I, renal isthmus; IM, inferior mesenteric artery; IVC, inferior vena cava; P, renal pelvis; S, suprarenal gland; SM, superior mesenteric artery; U, ureter.

of the aorta inferior to the origin of the superior mesenteric artery. It divided into two branches, an anterior branch distributed to apical and upper segments, and a posterior branch supplied the posterior segment of the HK. In addition to normal right and left renal arteries, six surplus arteries (As1-6) were found. As1-3 arose from the abdominal aorta to supply the posterior segment of the right kidney, middle and lower segments of the left kidney, and the isthmus, respectively. As4 and As5 arose just above the aortic bifurcation and ascended to the lower

segment of the kidney and the isthmus. As6 arose from the left common iliac artery and ascended to the isthmus. The venous system included the right (V1), the left (V2) renal veins, and three surplus renal veins (Vs1-3). Two tributaries from the right and the left kidneys drained into V1 and V2, respectively. Vs1 arose from the posterior surface of the right kidney. V1, V2, and Vs1 drained into the inferior vena cava. Vs2 and Vs3 emerged from the lower segment of the kidney and the isthmus and joined the left common iliac vein.

DISCUSSION

In the present case, the HK is an anomalous fusion of the inferior pole to form the parenchymatous isthmus. Its characteristics include a lower position at the level of the fourth lumbar intervertebral disc, an opened and anterior facing hilus, the ureters on the anterior surface of HK, and the abnormal blood vessels' appearance, which are similar to the previous studies.^{1,3}

About the mechanism of the HK formation, it has been suggested that the fusion of kidneys occurs prior to the fifth week of embryonic life.⁸ During the kidney ascent through the arterial fork formed by the umbilical arteries, both kidneys are sometimes so close that the inferior poles fuse.⁸ The ascent of kidneys is blocked by the origin of the inferior mesenteric artery which causes the lower

TABLE 1. Dimensions of the horseshoe kidney and its blood vessels.

Structures	Maximum dimensions (mm)	Right	Left
Horseshoe kidney	Length	113.8	114.4
	Width	46.9	50.1
	Thickness	33.7	33.9
Isthmus	Length		52.7
	Width		38.2
	Thickness		11.6
Hilus	Length	20.6	23.7
	Width	11.6	16.8
Ureter	Diameter	5.9	6.7
Renal artery	Diameter	6.5	7.2
Renal vein	Diameter	10.5	15.3

position than the normal kidney.⁸ Alternatively, a study postulated that posterior nephrogenic cells may migrate abnormally to form an isthmus or connection between the two developing kidneys to create the HK.⁹ However, nephrogenic cells alone cannot give rise to a kidney, so the ureteric bud induction time is also essential.⁸

Concerning the blood supply, the HK shows renal artery anomalies,^{2,5,10} some of which may have an anomalous origin related to embryologic development.¹⁰ The present case has eight arteries, which is relatively rare. They arose from the abdominal aorta, aortic bifurcation and left common iliac artery.

Moreover, the HK has the greater incidence of concomitant vascular or genitourinary anomalies, such as aortic aneurysm, ureteropelvic junction obstruction, vesicoureteric reflux hypospadias and undescended testis.^{2,4-6} Tumors of the kidneys or urinary tract were also reported to be associated with HK.² In this case, there were no anomalies found in other organs.

The HK presence can add a special challenge and are technically demanding during kidney surgeries, kidney transplants, or surgical and endovascular procedures on the aorta because of the anomalous complexity of the kidney, its collecting system, and renal blood vessels.^{2,5,7}

In conclusion, the HK is an unusual anomaly, but its existence and morphological structure are important factors to be considered. The bulky isthmus located anterior to the abdominal aorta, anatomical abnormalities and a variable blood supply associated with the HK as in this case can cause considerable difficulty in clinical practice for treatment.

ACKNOWLEDGMENTS

Special thanks are expressed to Mr. Rong Saichumdee for his help with the illustration and Ms. Sudarat Vejprasert for her help in the photograph taking.

REFERENCES

1. Basar H, Basar R, Basar MM, Erbil M. The comparison of the incidence of horseshoe kidney in autopsy cases versus urologic patient population. *Okajimas Folia Anat Jpn.* 1999 Aug;76(2-3):137-9.
2. Glodny B, Petersen J, Hofmann KJ, Schenk C, Herwig R, Trieb T, et al. Kidney fusion anomalies revisited: clinical and radiological analysis of 209 cases of crossed fused ectopia and horseshoe kidney. *BJU Int.* 2009 Jan;103(2):224-35.
3. Nakamura Y, Yi SQ, Iimura A, Terayama H, Naito M, Itoh M. Morphological observation of the horseshoe kidney with special reference to the vascular system in 2 Japanese cadavers. *Okajimas Folia Anat Jpn.* 2005 Nov;82(3):89-94.
4. Pitts WR Jr, Muecke EC. Horseshoe kidneys: a 40-year experience. *J Urol.* 1975 Jun;113(6):743-6.
5. Sidell PM, Pairolero PC, Payne WS, Bernatz PE, Spittel JA Jr. Horseshoe kidney associated with surgery of the abdominal aorta. *Mayo Clin Proc.* 1979 Feb;54(2):97-103.
6. Boatman DL, Kölln CP, Flocks RH. Congenital anomalies associated with horseshoe kidney. *J Urol.* 1972;107(2):205-7.
7. Stroosma OB, Schurink GW, Smits JM, Kootstra G. Transplanting horseshoe kidneys: a worldwide survey. *J Urol.* 2001 Dec;166(6):2039-42.
8. Sadler TW. *Langman's Medical Embryology.* 9th ed. Philadelphia: Lippincott Williams & Wilkins, 2004. p. 321-33.
9. Domenech-Mateu JM, Gonzalez-Compta X. Horseshoe kidney: a new theory on its embryogenesis based on the study of a 16-mm human embryo. *Anat Rec.* 1988 Dec;222(4):408-17.
10. Boatman DL, Cornell SH, Kölln CP. The arterial supply of horseshoe kidneys. *Am J Roentgenol Radium Ther Nucl Med.* 1971 Nov;113(3):447-51.