



CONGENITAL ANOMALIES OF KIDNEYS DETECTED IN COMPUTED TOMOGRAPHY

SASI KRISHNAN G

Department of Anatomy, STANLEY MEDICAL COLLEGE AND HOSPITAL

Abstract :

AIM OF STUDY To detect congenital anomalies of kidneys by computed tomography. **MATERIALS AND METHODS** Incidental observation for congenital anomalies of kidneys was made among 500 patients who came for CT abdomen for other varied indications, for a period of 9 months. **RESULTS** 8 out of 500 patients showed various anomalies, of which horseshoe kidney is the commonest one. Each one case of ectopic, crossed fused ectopic, and renal agenesis was detected. 2 cases of malrotation was noted. **CONCLUSION** The knowledge of these anomalies is very important for Radiologists and Urologists, which we can easily detect by computed tomography.

Keyword :

Congenital anomalies of kidneys, Horseshoe, Ectopic kidney, Crossed fused ectopic, Malrotation.

INTRODUCTION & AIM OF STUDY

In the modern era of all organ transplantation, the live and cadaveric transplantation of kidneys is very commonly done in day today medical practice. In favour of recent trend in conservative renal transplantation surgeries, a meticulous knowledge of Anatomy and congenital variations of kidneys is very important for General surgeons, Radiologists and Urologists. The current study was done in the aim of detecting congenital anomalies of kidneys that differs from its normal position and contour, based on the observation made in prospective way among the computed tomography images.

NORMAL ANATOMY OF KIDNEYS

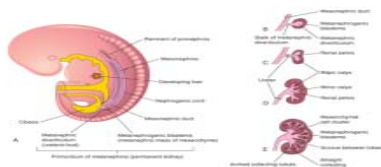
The pair of kidneys are bean shaped, with hilum directed medially and are situated retroperitoneally in the posterior abdominal wall by the side of vertebral column which extends from twelfth thoracic to third lumbar vertebrae. Right kidney is slightly lower than its left partner due to the presence of liver. Left kidney is longer, narrower and nearer to the vertebral column than the right one. On its long axis the kidneys are directed laterally so that upper end is nearer to the vertebral column than the lower end and on its transverse axis it is directed laterally and backwards, because the kidneys rest on the sloping paravertebral muscles. (susan stranding, Gray's Anatomy)⁵ Average measurements of each kidneys are, length – 11cms, breadth – 6cms, thickness – 3cms.



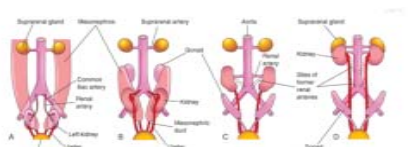
Axial section of 4 slice computed tomography at the level of kidneys shows its normal position and shape.

EMBRYOLOGY OF KIDNEYS

In higher forms of vertebrates including man three successive kidneys – pronephros, mesonephros and metanephros – develop in the intermediate mesoderm in cranio caudal direction. Pronephric and mesonephric kidneys are temporary and metanephros persists as permanent kidneys. Definitive kidneys developing from metanephros appears in the lumbosacral region and consists of two parts collecting and secretory, The former develops earlier. The collecting part develops as a ureteric diverticulum from the caudal part of mesonephric duct, and the secretory part from intermediate mesoderm which surmounts the branches of different orders of the ureteric bud and forms a series of bilaminar solid plates of cells known as metanephric blastema. At first the metanephric kidney lies in the pelvic cavity and receives blood supply from median sacral artery. Due to continuous lengthening of ureteric bud and small capacity of the pelvic cavity, the kidney ascends to the iliac fossa and receives blood supply from the common and internal iliac arteries. The final ascent of kidney is arrested by the diaphragm, where it gets the permanent arterial supply from the lowest suprarenal artery and this persists after birth as the renal artery. During the ascent the hilum of kidney is directed ventrally. When the kidney reaches the permanent position, it undergoes medial rotation around a vertical axis so that the hilum is directed medially. (T.W.Sadler - Langman's medical embryology)⁷ Failure of this results in various congenital anomalies and this include. Anomalies of rotation (malrotation), Anomalies of position (ectopic, thoracic), Anomalies of fusion (horseshoe & cross fused) Keith L. Moore - The human developing embryology) ⁶ .



A. Lateral view of 5 week embryo showing primordium of metanephros
B to E. Successive stages in development of metanephric diverticulum



A to D: Ventral view of embryo & fetus (6 to 9 weeks) showing Medial rotation and relocation of kidneys from pelvis to abdomen.

MATERIALS AND METHODS.

Incidental observation of congenital anomalies of kidneys was made among the patients who came for CT abdomen for other varied Indications, in Department of Radiology, Stanley Medical College. The study was done in a prospective way for a duration of 16 months from April 2013 to October 2014 among the computed tomographic images of 500 patients (285-Males, 215-females). All the images were obtained by 4 slice computed tomography, including both non contrast enhanced (plain) and contrast enhanced CT abdomen in axial views.

OBSERVATIONS

The following observations were made:

HORSESHOE KIDNEY

General comments:

Inferior poles of kidneys fused in front of lumbar vertebra, U or L shaped. 7% associated with Turner's syndrome

No. of observations	Horse shoe kidney	Percentage
500	03	0.6



Contrast enhanced and plain axial view of CT Abdomen shows fused lower pole of kidneys in front of vertebra.

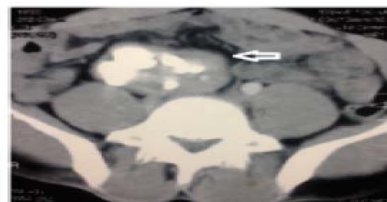


ECTOPIC KIDNEY

General comments:

One or both kidney in abnormal location Pelvic kidney is most common Receives blood supply from vessels that are near to them.

NO	ECTOPIC	PERCENTAGE
500	01	0.2



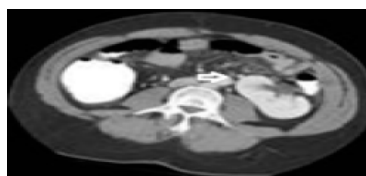
Pelvic kidney with multiple renal calculus noted.

MALROTATION

General comments:

Kidney fails to rotate 90°, faces anteriorly. Retains its embryonic position. Often associated with ectopic kidneys

NO	MALROTATION	PERCENTAGE
500	02	0.4



Left kidney hilum in the section faces laterally.



Right kidney anteroposterior direction is changed

CROSSED FUSED ECTOPIC

General comments:

Kidney Crosses to opposite side and fuses with lower Pole of orthotopic kidney. Without fusion is Very rare.

NO	CROSSED FUSED	PERCENTAGE
500	01	0.2



Left kidney crossed and fuses with lower pole of right kidney.

RENAL AGENESIS (UNILATERAL)

General comments:

Occurs when metanephric diverticula fail to develop or primordia of Ureter degenerates

NO	AGENESIS	PERCENTAGE
500	01	0.2



Left kidney is not visualized.

TOTAL NO	500	PERCENTAGE
ANOMALIES	08	1.6
NORMAL KIDNEYS	491	98.4

DISCUSSION

HORSHOE KIDNEY

In this condition the inferior poles of kidneys fused in front of lumbar vertebra, U or L shaped. It is the most common congenital anomaly among all, occurring 0.25% in general population. (Muttarak M and Sriburi et al 2012)³ The current study also shows horseshoe kidney is the common, occurring 0.6%, (2-male, 1-female) and is more in incidence than the previous study. No associated anomaly was seen.

ECTOPIC KIDNEY

One or both kidneys is in abnormal location Pelvic kidney is most common, receives blood supply from vessels that are nearer to them. The location in order of frequency is pelvic, iliac, abdominal and chest. The incidence is 1 in 900, and 10% of it is bilateral. (Dra monica and rodgruez et al 2013)² The current study shows incidence of 1 in 500 which is slightly higher than the previous study.

MALROTATION

Kidney fails to rotate to its normal position and faces 90° anteriorly. It retains its embryonic position and Often associated with ectopic kidneys. (Daneman and Alton et al 2010)⁴ The present study shows the incidence of 0.4%, (1-male & 1- female)

CROSSED FUSED ECTOPIC

One kidney crosses to opposite side and fuses with the lower Pole of orthotopic kidney. Left to right is most common. Without fusion is Very rare. Ureter of crossed kidney crosses midline & enters bladder on opposite side. The incidence is very rare, 1:2000, (Sharma and gupta et al 2014)¹, the current study shows incidence of 1:500.

RENAL AGENESIS (UNILATERAL)

Male>Female, Left side is more common Occurs when metanephric diverticula fail to develop or primordia of Ureter degenerates Often Associated with single umbilical artery. The current incidence 1:500 was noted in a male patient. Among the 500 observations that were made 8 (5-male), (3-female, one each of horseshoe, malrotation and cross-fused ectopic) individuals showed the congenital anomalies of kidneys in total. This shows an overall incidence of 1.6% (including of both sexes) of congenital anomalies of kidneys based on this current study.

CONCLUSION.

Congenital anomalies of kidneys is one of the main factor in end stage of renal disease. Knowledge of this condition and

observation is very important for Radiologists and Urologists in order to prevent morbidity in patients. Horse shoe kidney was the most common abnormality, in this study followed by malrotation and ectopic kidney. Computed tomography is the best imaging method to evaluate renal anomalies and its function which is proven by this study.

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