Original Research Article

# Congenital anomalies of the kidneys as evidenced on multidetector CT in a tertiary care hospital, Tamil Nadu

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## Abstract

**Background**: Congenital anomalies of the kidneys or lower urinary tract (CAKUT) are the most common causes of renal failure in children and account for 25% of end-stage renal disease in adults. **Objective**: Present study was carried out to assess the incidence of congenital anomalies of the kidneys in adulthood in a tertiary care hospital. **Materials and Methods**: It was a descriptive study in which records of 1048 participants of who underwent CT KUB examination from January 2020 to JULY 2021 in the department of radiology, Sri Muthukumaran Medical college Hospital and Research Institute were studied for CAKUT. **Results:** In present study, overall incidence of congenital anomalies of kidney and urinary tract (CAKUT) was 6.96%. Duplex collecting system in our study was 2.29%. Overall PUJO was seen among 2% of the study participants. Mal-rotated and ectopic kidneys were seen among 0.86% and 0.76% of the study participants respectively. Renal Agenesis and Horse shoe kidney was seen among 0.38% of the study participants each. Overall cross fused ectopia seen among 0.29% of the study participants. **Conclusion**: Knowledge about CAKUT and their radiological findings helps to diagnose it and permit optimal patient management and thorough workup to prevent hypertension and progression from CAKUT to renal failure.

**Keywords**: CAKUT, congenital, kidney, lower urinary tract.



## Introduction

Congenital anomalies of the kidney and urinary tract (CAKUT) are a group of congenital diseases which include renal anomalies, pelviureteric anomalies, vesicoureteric junction anomalies, and anomalies of the bladder and urethra[1]. CAKUT is the leading cause of end-stage renal disease (ESRD) in children[2]. Congenital abnormalities of the kidney and urinary tract occur in 3-6 per 1000 live births and is the leading cause of end-stage renal disease (ESRD) in children and also cause subsequent renal problems in adulthood like stone formation, infection, hypertension, and renal failure. Congenital anomalies of kidney and urinary tract (CAKUT) occur in about 0.5% of all pregnancies and contribute to almost 50% of abdominal masses detected in infancy[3,4]. CAKUT can be classified on embryological basis in to abnormalities in the renal parenchymal development, aberrant embryonic migration and abnormalities of the collecting accuracy in the evaluation of the mucosal surface of the renal collecting system and of the ureters –, has been overcome with recent developments of multidetector computed tomography (MDCT), allowing the acquisition of increasingly thinner slices over a short period of time, which implies the utilization of a higher radiation dose. The multiplanar reconstructions and post-processing images of the MDCT apparatuses allow for a more accurate diagnosis[6,8]. Present study was carried out to assess the incidence of congenital anomalies of the kidneys in adulthood in a tertiary care hospital.

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system. Renal parenchymal abnormalities include multi cystic dysplastic kidneys, renal hypoplasia, number (agenesis or supernumerary), shape and cystic renal diseases. Aberrant embryonic migration encompasses abnormal location and fusion anomalies. Collecting system abnormalities include duplex kidneys and Pelvi ureteric junction obstruction[4,5]. Formerly, plain abdominal radiography and excretory urography (EU) were the methods of choice for imaging diagnosis of kidneys and urinary tract conditions. However, the introduction of computed tomography (CT) and magnetic resonance imaging (MRI) has a considerable influence on the utilization of imaging methods in the diagnosis and treatment of such conditions. Over the past decade, CT has overcome EU in the evaluation of the genitourinary tract[6,7]. The only potential limitation of CT – its limited

## Materials and methods

**Study design, study duration and study setting**

A descriptive study was conducted in the department of the Radiology, Sri Muthukumaran Medical college Hospital and Research Institute from January 2020 to JULY 2021.

**Study participants, sample size and sampling technique**

Purposively records of 1048 participants of who underwent CT KUB examination from January 2020 to December 2021 were studied for CAKUT.

**Study Tool**

All patients underwent multi-detector KUB CT examination in a 64 slice Siemens Somatom machine. Axial raw data base was acquired with 64 slice Siemens Somatom definition-AS with the Slice thickness of 1x1mm and recon interval 1x1mm. The study included both non-enhanced and contrast enhanced CT KUBs. The contrast enhanced study done by hand injection of non-ionic iodinated contrast with the scan delay of 40 seconds for venous phase and delayed scans in five minutes & 10 minutes done for renal excretion and ruling out bladder pathology respectively.

**Statistical analysis**

Data were entered and analysed through epi info 7. Categorical variables were expressed with percentages

**Ethical considerations**

Study was carried out after permission from institutional ethical committee. Informed consent was not obtained since it's a retrospective study.

**Results**

In present study, overall incidence of congenital anomalies of kidney and urinary track (CAKUT) was 6.96%. Duplex collecting system in our study was 2.29%. Among males it was 1.7% and among females it was 3.04%. Pelviureteric junction obstruction was seen more among females (2.83%) as compared to males (1.36%). Overall PUJO was seen among 2% of the study participants. Mal-rotated and ectopic kidneys were seen among 0.86% and 0.76% of the study participants respectively. Renal Agenesis and Horse shoe kidney was seen among 0.38% of the study participants each. Cross fused ectopia was more among males (0.34%) as compared to females (0.22%). Overall cross fused ectopia seen among 0.29% of the study participants.

**Table 1: Incidence of congenital anomalies (n=1048)**

| Anomalies | Total (n= 1048) n (%) | Male (n=588) n (%) | Female (n=460) n (%) |
|---|---|---|---|
| Duplex collecting system | 24 (2.29%) | 10 (1.7%) | 14 (3.04%) |
| PUJO | 21 (2.0%) | 08 (1.36%) | 13 (2.83%) |
| Mal rotated kidneys | 09 (0.86%) | 04 (0.68%) | 05 (1.09%) |
| Ectopic kidney | 08 (0.76%) | 03 (0.51%) | 05 (1.09%) |
| Renal agenesis | 04 (0.38%) | 03 (0.51%) | 01 (0.22%) |
| Horse shoe kidney | 04 (0.38%) | 02 (0.34%) | 02 (0.43%) |
| Cross fused ectopia | 03 (0.29%) | 02 (0.34%) | 01 (0.22%) |
| Total | 73 (6.96) | 32 (5.44%) | 41 (8.91%) |

**Table 2: Congenital anomalies of the kidneys among study participants**

| | Total (n=1048) | Male (n=568) | Female (n=460) |
|---|---|---|---|
| **Partial Duplex** | **19** | **10** | **09** |
| Right partial Duplex | 08 (42.10%) | 05 (50%) | 03 (33.33%) |
| Left Partial duplex | 11 (57.90%) | 05 (50%) | 06 (66.67%) |
| **Complete duplex** | **05** | **00** | **05** |
| Right complete duplex | 04 (80%) | 00 (0.0%) | 04 (80%) |
| Left complete duplex | 01 (20%) | 00 (0.0%) | 01 (20%) |
| **Cross fused ectopia** | **03** | **02** | **01** |
| Right Cross fused ectopia | 02 (66.67%) | 02 (100%) | 00 (0%) |
| Left Cross fused ectopia | 01 (33.33%) | 00 (0.0%) | 01 (100%) |
| **PUJO** | **21** | **08** | **13** |
| B/L PUJO | 06 (28.57% | 03 (37.5%) | 03 (23.08%) |
| Right PUJO | 12 (57.14%) | 03 (37.5%) | 09 (69.23%) |
| Left PUJO | 03 (14.29%) | 02 (25%) | 01 (7.69%) |
| **Renal agenesis** | **04** | **03** | **01** |
| Right Renal agenesis | 03 (75%) | 02 (66.67%) | 01 (100%) |
| Left Renal agenesis | 01 (25%) | 01 (33.33%) | 00 (0%) |
| **Mal-rotated kidneys** | **09** | **04** | **05** |
| Right side | 06 (66.67%) | 02 (50%) | 04 (80%) |
| Left side | 03 (33.33%) | 02 (50%) | 01 (20%) |

As per table 2, left sided partial duplex was more (57.9%) as compared to right side while complete duplex was more (80%) in right side. Right sided PUJO was much more common (57.14%) than left PUJO and BL PUJO. Right sided renal agenesis was see among 75% of the study participants while right sided mal-rotated kidneys were among 66.67% of the study partiicpants.

**Discussion**

Present study was carried out to find incidence and pattern of congenital abnormalities of kidney among the adults attending tertiary care hospitals. In present study the overall incidence of CAKUT was 6.95%. In our study, Duplex collecting system in our study was 2.29%. Among males it was 1.7% and among females it was 3.04%. Duplications of the renal collecting system and ureter are the most common congenital renal anomalies and can be classified as incomplete versus complete, depending on whether two ureters drain into the bladder via a single common ureter or separately. Many conditions, such as ureterocele, ectopic insertion of ureter, vesicoureteric reflux, renal dysplasia, and PUJO, occur more frequently with a complete duplex collecting system compared with a single collecting system[9,10]. In present study, Overall PUJO was seen among 2% of the study participants. Pelviureteric junction obstruction was seen more among females (2.83%) as compared to males (1.36%).PUJO is a common condition that affects adults and children. Potential causes for PUJO include intrinsic stenosis, insertional abnormalities, and extrinsic compression from crossing vessels[11]. CT and MR urogram findings of PUJO include hydronephrosis with abrupt transition from a dilated collecting system to a non-dilated ureter associated with decreased relative renal nephrogram. Crossing vessels could be accurately identified on the contrast- enhanced phase of a CT or MR urogram[12].In present study, renal agenesis was seen among 0.38% of the study participants. Renal agenesis thought to result from a lack of induction of the metanephric blastema by the ureteral bud. Bilateral agenesis is incompatible with life and is associated with pulmonary hypoplasia and limb defects. Unilateral renal agenesis is not uncommon, seen in 1/1300 pregnancies[13]. It is often asymptomatic and compensatory hypertrophy in other kidney may cause glomerulosclerosis in adults. Unilateral renal agenesis is often incidentally detected in adults in US or CT performed for other reasons[14,5].In our study,

horse shoe kidney was seen among 0.38% of the study participants Horseshoe kidney is the most common renal fusion anomaly, accounting for 90% of all renal fusion anomalies, and occurs in approximately 1 in 400 births[5]. Pancake kidney is associated with the absence of a renal capsule and fusion at both the upper and lower poles, whereas crossed-fused ectopia is associated with fusion at only one pole14. Horseshoe kidney is twice as common among men as among women5. It may occur as an isolated entity, but in approximately one third of cases, it is associated with other congenital anomalies of the urogenital, gastrointestinal, skeletal, and neurologic systems. Renal fusion anomalies can lead to a variety of complications, such as stone disease, infections (secondary to urinary stasis resulting from abnormal ureteric locations and consequent altered urodynamics), and a variety of both benign and malignant tumors14. Knowledge about CAKUT and their radiological findings helps to diagnose it and permit optimal patient management and thorough workup to prevent hypertension and progression from CAKUT to renal failure.

**Conclusion**

Knowledge about CAKUT and their radiological findings helps to diagnose it and permit optimal patient management and thorough workup to prevent hypertension and progression from CAKUT to renal failure.

**Representative cases**

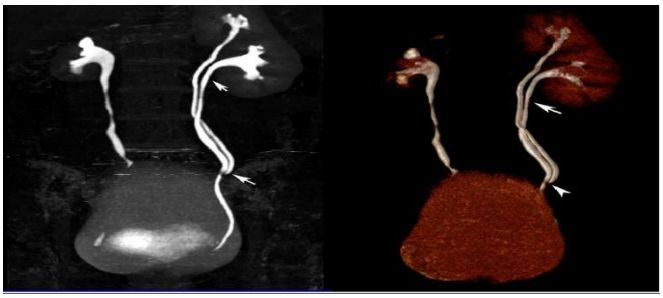

**Fig 1:3D volume rendering maximum intensity projection image of CT Urography in a study patient showing duplication of collecting system, upper and mid ureter (arrow). Both the ureters are joining in their lower thirds (arrow head).**

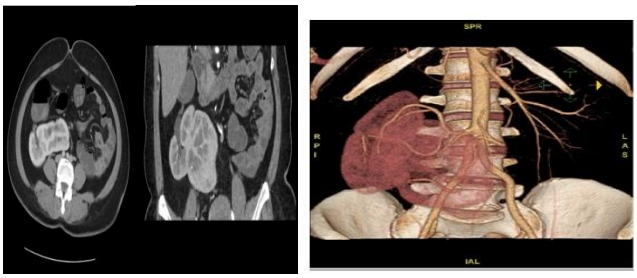

**Fig 2:CECT (axial, coronal VRT) images of a study patient showing ectopic left kidney seen right to the midline and fused to the medial aspect of the right kidney.**

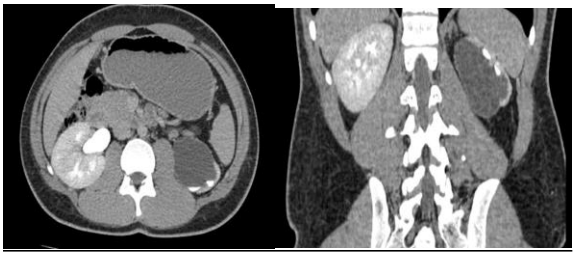

**Fig 3:CECT delayed images (axial and coronal) of a study patient showing smallleft kidney with severe parenchymal thinning and markedly dilated, ballooned renal pelvis and calyces with abrupt termination at the left pelvi-ureteric junction. No intraluminal/mural cause for obstruction detected.**

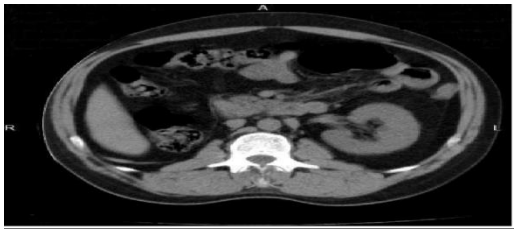

**Fig 4: Plain CT axial image of a study patient showing absent right kidney – rightrenal agenesis.**

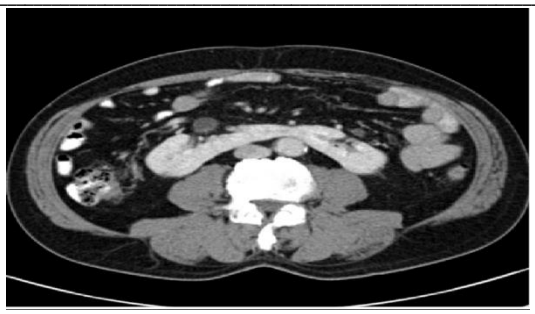

**Fig 5: CECT axial image of a study patient showing single kidney joined at the lowerpoles by an isthmus in the midline with functional parenchyma.**

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