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Incidence of congenital anomalies of kidney using computed tomography: A retrospective hospital-based study

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ABSTRACT

Background: Inherited abnormalities of the kidney are considered frequent anomalies in children. Kidney congenital disease often passes without a diagnosis. The majority of these abnormalities are detected at later stages in patients. Renal failure might occur as a result of a delayed diagnosis. The study's goal was to determine the prevalence of these anomalies in Al-Karak, Jordan. The medical records of patients who attended the radiology department of AL Karak governmental hospital were examined. *Methods:* The study examined and analyzed 950 medical records of patients with kidney abnormalities, with an age group extending from 2 years to 30 years old. The study started in October 2020 and completed in January 2022. *Results:* The outcomes of the study showed that the peak incidence in males was seen in foetal lobulation anomaly (14.03 per 1000), followed by polycystic kidney (5.3 per 1000); whereas, in females the highest incidence was identified for polycystic kidney anomaly (23.7 per 1000) followed by foetal lobulation (13.2 per 1000). *Conclusions:* We propose that all parents get their children ultrasonography scanned on a regular basis. Early detection and treatment of any disease is preferable than late detection and therapy.

Keywords: Kidney, abnormalities, pathology, anatomy, diagnostic imaging, Jordan.

1. INTRODUCTION

The kidneys develop from the intermediate mesoderm during the period between the 6th week and the 8th week of the intrauterine life (Eid et al., 2018). Kidney growth is a complicated process consists of three stages overlap each other; these are the: pronephros, mesonephros, and metanephros stages (Simeoni et al., 2017). The two masses of metanephrogenic tissue lie in the

pelvis then they reach their definitive position in the lumbar region by ascent, lateral migration, axial deflection, and internal rotation (el-Galley and Keane, 2000; Houat et al., 2021). Various types of renal congenital anomalies might occur due to failure of any embryogenic phases; however, some of these abnormalities are uncommon and generally asymptomatic (Eid et al., 2018). It is essential for medical students and professional to be knowledgeable of these inherited variations, whether normal anatomical or abnormal congenital, in surgical treatment and patient treatment.

Asymptomatic healthy adults are a useful population in which to examine the prevalence and perceived significance of kidney abnormalities (Lentine et al., 2017). Imaging of the kidneys describes surgical anatomy and identifies hidden pathology (Lorenz et al., 2010). Numerous researches studied the prevalence of renal radiographic defects in normal adults have been restricted by insignificant sample size (Habbous et al., 2019). The intention of the study is to investigate the incidence of kidney abnormalities detected using computed tomographic (CT) by examining apparently medically fit adults and whether these defects were different between two genders.

2. MATERIALS AND METHODS

This retrospective study was conducted on the medical records and CT studies of 950 persons. The age group of studied samples range from 2 years till 30 years. The CT angiographic images were collected from AL Karak governmental hospital during the period from October 2020 till January 2022. CT of the abdomen in our cases was performed with Elite 2400, a CT Twin, or a Marconi MX 8000. Contiguous 6.5- to 11-mm slices were obtained. The collected renal angiographic images of all 950 individuals were analysed for presence of renal anomalies, and the results were statistically analysed.

3. RESULT

Table 1 shows the sex-specific congenital anomalies incidence per 1000 population. As regards males, the highest incidence was identified for foetal lobulation anomaly (14.03 per 1000) followed by polycystic kidney (5.3 per 1000), whereas, the least incidence was identified for horseshoe kidney, atrophic kidney, and VUR respectively (1.8 per 1000). In females, the highest incidence was identified for polycystic kidney anomaly (23.7 per 1000) followed by foetal lobulation (13.2 per 1000), whereas the least incidence was identified for horseshoe kidney, pelvic kidney, and renal cyst respectively (2.6 per 1000).

Table 1 Sex-specific renal congenital anomalies incidence per 1000 population (Al-Karak, 2021)

	Male Renal Congenital Anomalies (n= 570)	Female Renal Congenital Anomalies (n= 380)
Unilateral Agenesis	3.5 per 1000	5.3 per 1000
Foetal Lobulation	14.03 per 1000	13.2 per 1000
Polycystic Kidney	5.3 per 1000	23.7 per 1000
Horseshoe Kidney	1.8 per 1000	2.6 per 1000
Pelvic Kidney	-	2.6 per 1000
Unilateral double Kidney	3.5 per 1000	-
Accessory renal artery	3.5 per 1000	-
Retro Aortic left vein	-	5.3 per 1000
Atrophic Kidney	1.8 per 1000	-
VUR	1.8 per 1000	-
Renal Cyst	-	2.6 per 1000

Table 2 shows the sex-specific incidence of renal congenital anomalies by side of the body. As regards males the highest incidence on the right was identified for foetal lobulation (36.2%) followed by unilateral double kidney and accessory renal artery (18.1%), whereas foetal lobulation (66.7%) was the highest renal congenital anomaly on the left side of the body followed by unilateral agenesis (33.3%). The highest percentage of renal congenital anomalies on both sides of the body in males was identified for foetal lobulation and polycystic kidney (33.2%, respectively).

Table 2 Sex-specific incidence of renal congenital anomalies by side of the body (Al-Karak, 2022)

	Male Renal Congenital Anomalies			Female Renal Congenital Anomalies		
	Right side (n=11)	Left side (n= 3)	Both sides (n= 6)	Right side (n= 6)	Left side (n= 5)	Both sides (n= 10)
Unilateral agenesis	(1) 9.1%	(1) 33.3%	-	(1) 16.7%	(1) 20.0%	
Foetal Lobulation	(4) 36.2%	(2) 66.7%	(2) 33.2%	(1) 16.7%	(3) 60.0%	(1) 10.0%
Polycystic Kidney	(1) 9.1%	-	(2) 33.2%	-	-	(9) 90.0%
Horseshoe Kidney	(1) 9.1%	-	-	(1) 16.7%	-	-
Pelvic Kidney	-	-	-	-	(1) 20.0%	-
Unilateral double Kidney	(2) 18.1%	-	-	-	-	-
Accessory renal artery	(2) 18.1%	-	-	-	-	-
Retro Aortic left vein	-	-	-	(2) 33.2%	-	-
Atrophic Kidney	-	-	(1) 16.7%	-	-	-
VUR	-	-	(1) 16.7%	-	-	-
Renal Cyst	-	-	-	(1) 16.7%	-	-
Total	100%	100%	100%	100%	100%	100%

As regards females, the highest incidence on the right was identified for retro aortic left vein (33.2%) followed by unilateral agenesis, foetal lobulation, horseshoe kidney, and renal cyst (16.7%, respectively), whereas the foetal lobulation (60.0%) was the highest incidence on the left side of the body followed by unilateral agenesis and pelvic kidney (20.0%, respectively). The highest percentage of renal congenital anomalies on both sides of the body in females was identified for polycystic kidney (90.0%).

4. DISSCUSSION

In the current study, the male incidence of unilateral renal agenesis is 3.5/1000, whereas the female incidence is 5.3/1000. According to a similar study, unilateral renal agenesis is commonly asymptomatic (Tantisattamo et al., 2019), although its prevalence is unknown. Around 1 in 1500 people have symptomatic unilateral renal agenesis (Ahmed et al., 2017). The male-to-female ratio is 1.8:1, and it is more prevalent on the left, which is consistent with the findings of this study. The incidence of multicystic dysplastic kidneys (MCDK) varies depending on the research and nation (Tantisattamo et al., 2019). Multicystic dysplastic kidneys (MCDK) incidence varies, depending on the study and country, but ranges from 1 in 3640 to 1 in 4300 live births (Akbalık Kara et al., 2021; Feldenberg and Siegel, 2000).

A recent study has found that, the occurrence of horseshoe Kidney is 1.8 per 1000 in males, 2.6 per 1000 in females (Koratala et al., 2019) almost agree with us as they found that Horseshoe kidneys incidence is 1 in 400–500 adults but the (Male: Female ratio is 2:1). The incidence of the pelvic kidney in our study is 2.6 /1000 but previous study found that Prevalence rate of the pelvic kidney was one among 724 paediatric analyses (Eid et al., 2018). In These cases, the kidneys are usually smaller than normal besides they are atypically rotated. In the current study we found that the incidence of unilateral double kidney is 3.5/1000 which is exclusive for male, in review study who found that the crossed ectopia of the kidney was an infrequent abnormality took place in 0.05–0.1% of the studied population.

There is a documented study that the tendency is higher in males with a 2: 1 ratio (Modi et al., 2009; Patel et al., 2022). Moreover, the literatures alleged that Left-to-right ectopia is more common. In case of crossed renal ectopia, you can see that the right and left kidneys are located on the same side of the human body. This study revealed that the incidence of polycystic kidney is 5.3 /1000 in males, 23.7 /1000 in females. These ratios differ from previous paper that indicated found the prevalence of autosomal dominant polycystic kidney disease is estimated to be 1 in 400 to 1 in 1,000 births (Rastogi et al., 2019), also differs from the results of other paper which found the frequency of autosomal recessive type of polycystic kidney was one within 26,500 alive child birth (Alzarka et al., 2017). In the current study foetal lobulation of kidney is present in 14.03 per 1000 in males, 13.2 per 1000 in females. In our study the accessory renal artery is found in 3.5 per 1000 cases while, Coleman et al., (2021) found that Accessory renal arteries were frequent variant and were detected in 20-30% of cases and are bilateral in approximately 10% of the population.

The current study found that the incidence of retroaortic left renal vein (RLRV) is 5.3 per 1000 while, Nam et al., (2010) stated that from 0.5-3.6 % of studied sample had retroaortic left renal vein anomalies. The abnormalities in left renal vein were categorised into four categories. In type I abnormality, the anterior preaortic branch of the left renal vein was eliminated, but the posterior retroaortic branch continued and linked to inferior vena cava vein in the orthotropic kidney position. In Type II incongruity develops from elimination of the anterior branch of the left renal vein, and the posterior branch turns into the retroaortic left renal vein and lied parallel to the two lowest vertebrae of the lumbar spine and then joins the lumbar veins, in particular the gonadal and ascending branches, before draining into the inferior vena cava vein. The circumaortic left renal vein is type III anomaly, while in type IV anomaly is the remaining posterior branch becomes the left retroaortic vein then joined the common iliac vein in the left side. Renal atrophy incidence is 1.8 per 1000 in our study which is found only in males but (Chen et al., 2021; Davran et al., 2014) found that the incidence of atrophic kidney is 1.5%. Renal cysts are found in 2.6 per 1000 cases in our study but this incidence is much lower than that of (Chen et al., 2021) who found that 41% of the cases have simple renal cysts.

5. CONCLUSION

In conclusion, although this study did not calculate the relative incidence of renal congenital malformations compared with other malformations, the increasing trend in incidence is of particular interest. Routine renal and renal tract examinations should be performed to identify congenital anomalies, especially if they are associated with abnormalities of other systems. Once a diagnosis of any variant has been made, a full assessment of any existing abnormalities and recommendations for postpartum care should be made.

Author Contributions

Amal Albtoosh: Conceptualization, drafting, and writing the final paper, corresponding author.
Mahmoud AlKhasawneh: data collection and supervision and approve the final version
Youssef Hussein: supervision and approve the final version
Ashraf A. Zaghloul: methodology and statistical analysis and approve the final version
Abulmaaty M. Elsayed: drafting the papers and literature review and approve the final version
Hussein Youssef: proofreading and approve the final version.

Ethical approval

The study was approved by the Human Research Ethics Committee of Mutah University/Faculty of medicine, Ethical approval number is 212022.

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Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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