International Journal of Anatomy and Research,
Int J Anat Res 2016, Vol 4(1):1886-91. ISSN 2321-4287
DOI: http://dx.doi.org/10.16965/ijar.2016.103

Original Research Article

SIMPLE RENAL ECTOPIA: A MULTIDETECTOR COMPUTED TOMOGRAPHY STUDY

Vinay Sharma [1], C.S. Ramesh Babu *[2], Vishnu Gupta [3], O.P. Gupta [4].

[1] Associate Professor of Anatomy, Muzaffarnagar Medical College, Muzaffarnagar (U.P), India.

[*2] Associate Professor of Anatomy, Muzaffarnagar Medical College, Muzaffarnagar (U.P), India.

[3] Professor of Anatomy, Muzaffarnagar Medical College, Muzaffarnagar (U.P), India

[4] Senior Consultant Radiologist, Dr. O.P. Gupta Imaging Centre, Bachcha Park, Meerut (U.P), India.

ABSTRACT

Background: When the kidney is not located in its normal position in the renal fossa, but located in an abnormal position on the same side, it is referred to as Simple renal ectopia. Migration of a kidney to the contralateral side is referred to as Crossed Ectopia. Simple renal ectopia can be unilateral or bilateral and is due to the partial arrest of normal renal ascent or excessive ascent. The reported incidence of simple renal ectopia is 1:500 to 1:1100 cases and is more prevalent on the left side without any significant difference in between the sexes. Though ectopic kidneys may remain asymptomatic, they are more susceptible to develop hydronephrosis and renal calculi.

Materials and Methods: We have retrospectively reviewed multidetector computed tomography angiographic scans of 960 patients (491 males; 469 females).

Observations: We have observed simple renal ectopia in seven patients (5 males and 2 females; 0.73%) which is higher than the reported incidence. We have observed 4 kidneys in pelvic, 2 in lumbar and 1 in iliac position. Out of 7 ectopic kidneys, 5 were on the left side and 2 on the right side. Hilum was abnormally positioned in all ectopic kidneys due to disturbance in axial rotation. In three cases the ectopic kidneys received arterial supply from the contralateral arteries arising from aorta or common iliac arteries which is a rare phenomenon. Renal calculi and hydronephrosis were noted in two cases.

Conclusion: Presence of an ectopic kidney might result in an atypical pattern of referred pain which may be confused with appendicitis or pelvic inflammatory disease, especially in women. Presence of an ectopic pelvic kidney can lead to complications during pelvic surgeries. Multidetector computed tomography angiography is an excellent imaging modality not only useful to define prevalence of renal ectopia in general population but also to detect associated complications and vascular anomalies in a single investigation.

KEY WORDS: Renal positional anomalies, Simple renal ectopia, uncrossed renal ectopia, Pelvic kidney, Ectopic kidney.

Address for Correspondence: C.S. Ramesh Babu, Associate Professor of Anatomy, Muzaffarnagar Medical College, N.H.58, Opp. Begrajpur Industrial Area, Muzaffarnagar- 251203 (U.P), India. Mobile: +91-9897249202 **E-Mail:** csrameshb@gmail.com

Access this Article online

Quick Response code

DOI: 10.16965/ijar.2016.103

Web site: International Journal of Anatomy and Research
ISSN 2321-4287
www.ijmhr.org/ijar.htm

Received: 02 Jan 2016 Accepted: 29 Jan 2016
Peer Review: 02 Jan 2016 Published (O): 29 Feb 2016
Revised: None Published (P): 29 Feb 2016

INTRODUCTION

Anomalies of kidney form a significant portion of congenital malformations. Anomalies may occur in the number, position, shape, size and rotation of kidney. Structural, positional and vascular anomalies are the most frequently

reported [1]. Ectopic kidney is a birth defect in which a kidney is located at an abnormal location. It can be a simple uncrossed ectopia in which one or both the kidneys are ectopic in position and in some cases a kidney is located ectopically on the contralateral side called as crossed renal ectopia. The frequency of ectopic kidney is 1:500 to 1:1100, ectopic thoracic kidney is 1:13000, solitary kidney is 1:1000, single pelvic kidney is 1: 22000 and one normal and one pelvic kidney is 1: 3000. Ectopic kidneys are most commonly found in the pelvis. Other locations can be iliac fossa, lumbar region of abdomen, and chest and in some cases on the contralateral side referred to as crossed renal ectopia [2,3].

Most ectopic kidneys are clinically asymptomatic and they are not more susceptible to disease than normally positioned kidneys, except for the development of hydronephrosis and urinary calculi formation [3]. The abnormal position of ectopic kidneys may result in a pattern of direct and referred pain that is atypical for colic and may be misdiagnosed as acute appendicitis or pelvic organ inflammatory disease especially in women. So they are often found only during physical or radiological investigations for urological or other unrelated medical complaints [4].

Renal ectopia is associated with anomalies of renal vessels [5]. The presence of multiple renal arteries is the most frequent variant, with a 20-30% occurrence rate, depending on gender and race. CT is reportedly superior to urography and ultrasonography (USG) in the detection and characterization of renal masses (6,7). It is also helpful in detection of associated renovascular variations and other anomalies and complications.

MATERIALS AND METHODS

The present retrospective review was done in a single diagnostic centre during the period from October 2012 to June 2015. MDCT angiography scans of 960 patients (491males; 469females) were reviewed and the renal ectopia was detected in seven cases. All the patients underwent contrast enhanced computed tomography (CECT) by 64 channel scanner (GE optima-660) for suspected pathologies of hepatobiliary, renal, pancreatic and gastrointestinal systems and received 85-100 ml of non-ionic contrast (Omnipaque, 300mg I/ml) at the rate of 5 ml/s intravenously. The diagnostic centre routinely obtains written informed consent from the patients before contrast injection. Sections of 0.625 mm thickness were obtained from diaphragm to upper part of thigh and delayed phase scans were also obtained. The scans were analysed in a separate work station (AW volume share 4.5) with multiplanar reformatting capability and maximum intensity projection (MIP) of axial, coronal and sagittal sections and volume rendered (VR) images were obtained.

OBSERVATIONS

In this retrospective study of 960 cases in which 491 males and 469 females were included, we observed seven cases of simple renal ectopia (5 males and 2 females; 0.73%). The incidence of renal ectopia of our study was higher than those stated earlier and more in males. All renal ectopias were located lower than usual site,four belongs to pelvic type (Figures –2C, 3B) ,two lumbar (Figure-6 B) and one iliac type (Figure- 5B) and none of the cases belongs to high subdiaphragmatic or thoracic type that means none of ectopic kidney was above the

Fig. 1: Male aged 25 years (A) Volume rendered image showing ectopic right kidney (RK) with a large calculus in the renal pelvis and laterally directed hilum. (B) Axial and (C) coronal images showing laterally directed hilum with a large calculus in the renal pelvis.

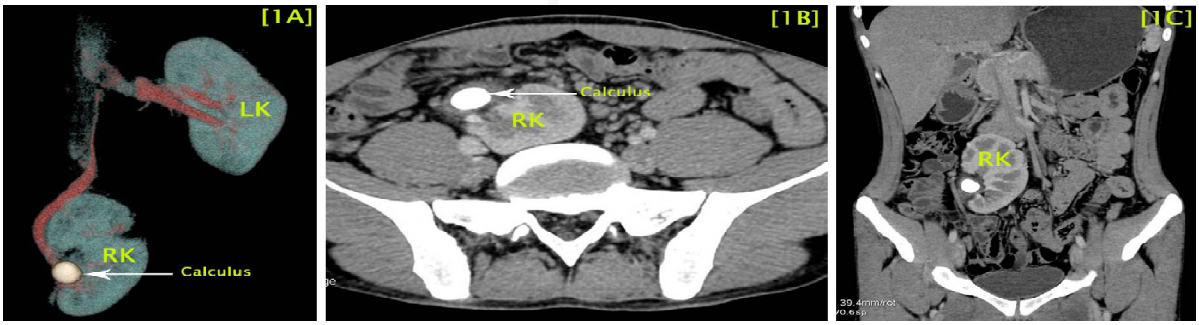


Fig. 2: Female aged 35 years (A) VR image showing pelvic type of ectopic left kidney (LK) located below aortic bifurcation and supplied by renal artery (LRA) from aortic bifurcation. (B) Axial image showing hydronephrotic normally located right kidney (RK) (C) Axial image showing pelvic type of ectopic left kidney (LK)

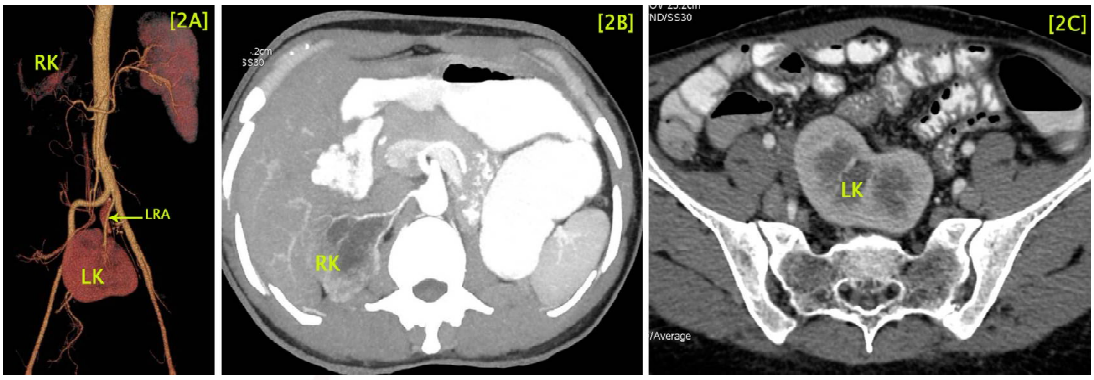


Fig. 3: Male aged 54 years (A) VR image showing ectopic left kidney lying anterior to left common iliac artery and supplied by two arteries – LRA-1 from right common iliac artery and LRA-2 from aortic bifurcation. (B) Axial and (C) Sagittal images showing pelvic type of left renal ectopia with anteriorly directed hilum.

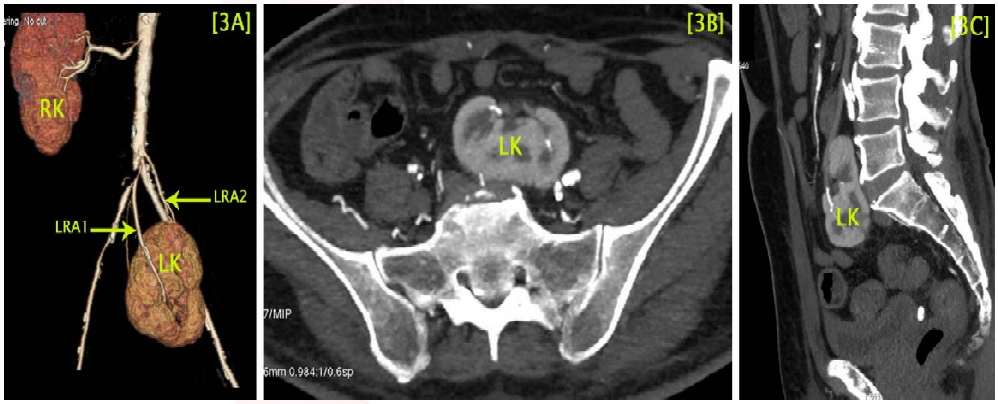


Fig. 4: Male aged 20 years (A) and (B- posterior view) VR images showing ectopic left kidney (LK) supplied by two arteries LRA-1 from right common iliac artery (RCIA) and LRA-2 from left common iliac artery (LCIA). (C) VR image showing both ureters (RU, LU) opening ipsilaterally into the bladder. (D) Coronal image showing lumbar type left kidney (LK).

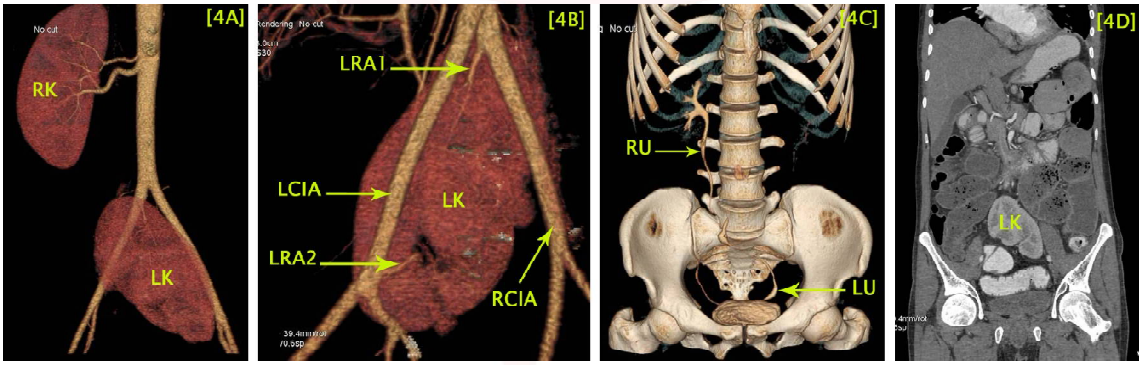


Fig. 5: Male aged 72 years (A) VR image showing ectopic right kidney (RK) supplied by two arteries – RRA-1 from aortic bifurcation and RRA-2 from right common iliac artery. (B) axial and (C) Coronal image showing precaval course of RRA-1 passing in front of inferior vena cava (IVC).

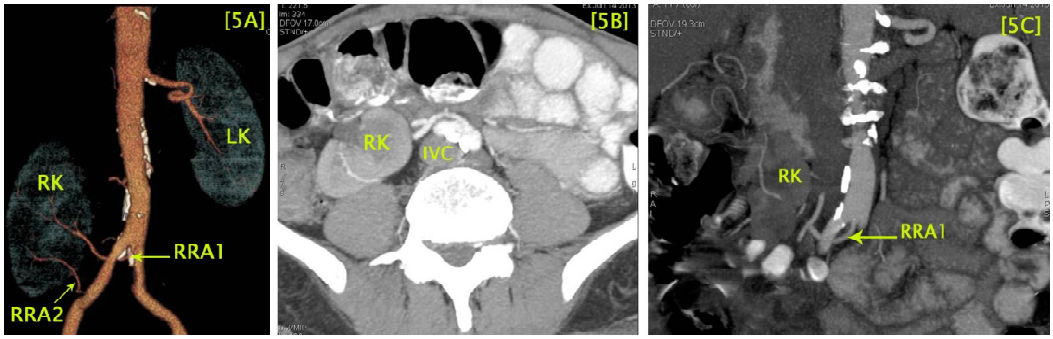
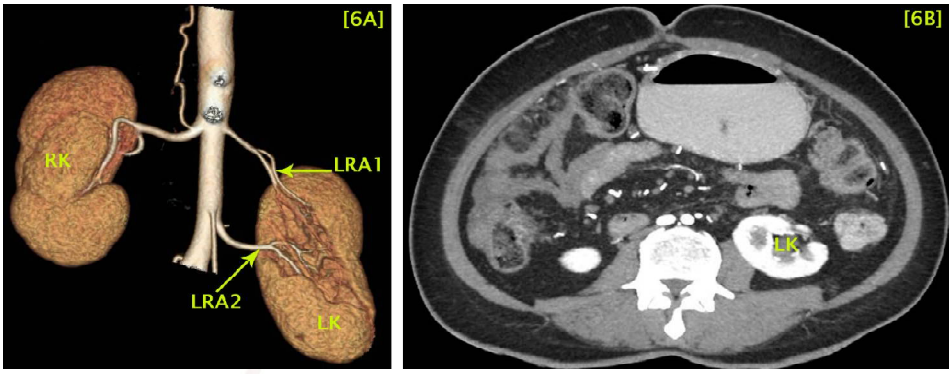


Fig. 6: Female aged 38 years (A) VR image showing double arterial supply (LRA-1. LRA-2) both from aorta supplying ectopic left kidney (LK) with anteriorly directed hilum. (B) Axial image showing lumbar type of ectopic left kidney (LK).



level of normal kidney. Out of seven ectopic kidneys, five were on left side (Figures-2A, 3A, 4A) and two on right side (Figures- 1A,5A). As noticed in other renal anomalies where ascent is hampered normal position of hilum is also affected. All renal ectopic cases of this study were having hilum anteriorly (Figure-6A), laterally (Figure-1A) or anterolaterally (Figure-5B) directed (malrotated) . Out of seven cases of ectopic kidneys four having dual arterial supply, and these arteries were originating from nearby vessels (bifurcation of aorta or common iliac). (Figures-3A, 4B, 5A) Two cases of ectopic kidney showed nephrolithiasis with hydronephrosis. (Figures-1A,1C, 2B)

DISCUSSION

Kidney develops between 4th to 12th weeks of intrauterine life. Developmentally at first the metanephric kidney lies in the pelvic cavity opposite the sacral segments. Gradually it ascends and reaches the iliac fossa after crossing the pelvic brim. Finally, it appears on the under surface of the diaphragm where its further ascent is arrested by the suprarenal gland. By 7th week, the hilum points medially and kidneys are located in the abdomen. The thoracic ectopic kidney with partial or complete renal protrusion above the level of the diaphragm into the posterior mediastinum is the rarest form of all ectopic kidneys [8].

The factors that may interfere with the normal renal development are teratogenic agents, genetic factors, and chromosomal anomalies, disorders in the fusion mechanism of the ureteric bud and the metanephrogenic blastema and medicines ingested by the mother [9]. They may cause developmental, positional or rotational anomalies and renal ectopia is one of them. The ectopic position of kidney is due to arrest of ascent or excessive ascent [10]. Cranial ectopia is usually intrathoracic, and caudal ectopia can be classified into iliac, lumbar and pelvic (sacral), the latter being most frequently found [11]. The incidence of renal ectopia noticed by different authors in general population, is typically reported as quite low, i.e. less than 1:1000 [12,13]. The prevalence of ectopic kidney has been reported at 0.023% in urban Taiwan (Sheih et al. 1989) and at <0.1% in urban Japan and Australia (Mihara et al. 1992) [12,13]. In Ireland, India, and the USA, the prevalence of pelvic foetal kidneys were noted at 0.003–0.05% [14,15,16]. Incidence reported in our study in Indian population is much higher (0.73%) possibly due to the sensitive imaging modality used or racial difference. It is reported that there is no difference in incidence between the sexes [17]. On the contrary, we found renal ectopia more in males and our observation was similar to Lozano et al (1975) and Sfaxi et al (2002) who stated that this condition is rarely bilateral and occurs mostly on the left with a preponderance in males [18,19]. Similarly we found left dominance and male predominance in our study.

In our study all cases of renal ectopia were having anterior, lateral or anterolateral hilum that means malrotated. If ascent of the kidney is hampered rotation of kidney is also affected. Out of seven cases of renal ectopia 4cases were pelvic, 2 lumbar, 1 illiac in position and no case of thoracic type was found justifying the statement that the pelvic is most common and thoracic is least common type of simple renal ectopia.

Before its ascent when the kidneys are located in the sacral region, branches from median sacral or internal iliac supply the kidneys. During its ascent branches arising from common iliac, aortic bifurcation and abdominal aorta successively supply the kidney. When more cranial arteries develop, the caudally placed branches from iliac arteries degenerate. When the iliac branches do not degenerate, then multiple renal arteries supply the ectopic caudally located kidney [20,21].

Blood supply to the ectopic kidney most frequently arises from the vessels on the ipsilateral side but occasionally arises from the contralateral side [22]. It's similar to our three cases where the ectopic kidney is having dual blood supply one artery coming from ipsilateral common iliac artery or from aortic bifurcation and another from contralateral common iliac artery. Two cases of renal ectopia in our study also had complication of nephrolithiasis and hydronehrosis as this is explained by the observation that an ectopic kidney is often associated with an increased incidence of stone formation as a result of stasis caused by the altered geometry of urinary drainage [4].

CONCLUSION

Simple renal ectopia is an abnormality of kidney which occurs during its ascent. It is mostly asymptomatic but may be associated with few complications. Its real incidence in a known population is a matter of debate. MDCT urography is not only very sensitive tool to find out real incidence, it is also helpful to evaluate related complications, associated anomalies and vascular variations in a single setting.

ACKNOWLEDGEMENTS

The authors sincerely acknowledge the technical assistance rendered by Sri. Arjun Kumar of Dr. O.P. Gupta Imaging Centre and Sri. Sushil Kumar and Sri. Tithender of Muzaffarnagar Medical College in the preparation of images and photographs.

Conflicts of Interests: None

REFERENCES

[1]. Apoorva D, Lalitha C. Unascended Left Kidney with Malrotation: A Rare Congenital Anomaly. Int J Sci Res. (IJSR). 2013;2(9):54-56.

[2]. Thyagaraju K, Subhadra Devi V, Yamini Devi C. Case report: Trilobar pelvic kidney with renal vascular variations in a fetus. Int J Biol Med Res. 2012;3(2):1854-1856.

[3]. Campbell MF, Wein AJ, Kavoussi LR. Campbell-Walsh Urology. 9th ed. Philadelphia, PA: Saunders Elsevier, 2007:3279.

[4]. Kumar S, Bolla S R, Vollala V.R. Unilateral Ectopic Kidney in the Pelvis – A Case Report. Chang Gung Med J. 2011;34(6 Suppl):10-12.

[5]. Das S, Amar AD. Ureteropelvic junction obstruction with associated renal anomalies. J Urol, 1984;131(5):872–874.

[6]. Warshauer DM, McCarthy SM, Street L, et al. Detection of renal masses: sensitivities and specificities of excretory urography/ linear tomography, US, and CT. Radiology.1988;169:363-5.

[7]. Jamis-Dow CA, Choyke PL, Jennings SB, et al. Small (< or = 3-cm) renal masses: detection with CT versus US and pathologic correlation. Radiology. 1996;198:785-8.

[8]. Sozubir S, Demir H, Ekingen G, Guvenc BH. Ectopic thoracic kidney in a child with congenital diaphragmatic hernia. Eur J Pediatr Surg. 2005;15:206-209

[9]. Gülsün M, Balkanci F, Çekirge S, Deger A. Pelvic kidney with an unusual blood supply: angiographic findings. Surg Radiol Anat, 2000;22(1):59-61.

[10]. Sadler TW. Langman's Medical embryology. In: Urogenital system. 10th ed; Philadelphia Lippincott Williams & Wilkins 2006;236.

[11]. Kim SH. Radiology illustrated – Uroradiology. 2nd ed. Berlin: Springer-Verlag; 2012.

[12]. Sheih CP, Liu MB, Hung CS, Yang KH, Chen WY, Lin CY. Renal abnormalities in school children. Pediatrics. 1989;84:1086-10.

[13]. Mihara M, Ito Y, Fukushima K, Yamashita F, Tsunosue M. Ultrasonographic screening for renal abnormalities in three-year-old children. Acta Paediatrica 1992;81:326-328.

[14]. Ashe RG, Campbell N, Dornan JC. Antenatal detection of renal abnormalities. Irish J Med Sci. 1992;161:626-629.

[15]. Hill LM, Grzybek P, Mills A, Hogge WA. Antenatal diagnosis of fetal pelvic kidneys. Obstetrics and Gynecology . 1994; 83:333-336.

[16]. Sanghvi KP, Merchant RH, Gondhalekar A, Lulla CP, Mehta AA, Mehta KP. Antenatal diagnosis of congenital renal malformations using ultrasound. J Trop Pediatr. 1998; 44: 235-240.

[17]. Stevens AR. Pelvic single kidneys. J Urol 1937;37:160-8.

[18]. Lozano R, Rodriguez C. Intrathoracic ectopic kidney: report of a case. J. Urol. 1975; 114:601-602.

[19]. Sfaxi M, Miladi M, Loussaief H, Mnif A, Chebil M, Ayed M. Intrathoracic kidney due to diaphragmatic hernia: A case report. Prog Urol. 2002;12:477-478. (in French).

[20]. Sadler TW. Urogenital system. In Langman's Medical Embryology. 12th. Edition, 2012. New Delhi, Wolters Kluver/Lippincott William & Wilkins. 230-240.

[21]. Cocheteux B, Mounier-Vehier C, Gaxotte V, Mc Fadden EP, Francke JP, Bergegi JP. Rare variations in renal anatomy and blood supply: CT appearances and embryological background. Eur Radiol. 2001;11(5):779-786.

[22]. Khan B, Khade B, Patil G. Unilateral etopic kidney with associated anomalies: A case report. International Journal of Recent Trends in Science and Technology. 2013;9 (1):29-32.

How to cite this article:

Vinay Sharma, C.S. Ramesh Babu, Vishnu Gupta, O.P. Gupta. SIMPLE RENAL ECTOPIA: A MULTIDETECTOR COMPUTED TOMOGRAPHY STUDY. Int J Anat Res 2016;4(1):1886-1891. **DOI:** 10.16965/ijar.2016.103