Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/14439
DOI URL: http://dx.doi.org/10.21474/IJAR01/14439

RESEARCH ARTICLE

GENETIC AND EMBRYOLOGICAL BASIS WITH CLINICAL IMPLICATIONS OF LOBULATED KIDNEY:A CADAVERIC STUDY

Divya Shanthi D'Sa, T.K. Vasudha and K. Anup Rao

Manuscript Info

Manuscript History
Received: 22 January 2022
Final Accepted: 24 February 2022
Published: March 2022

Key words:-
Kidney, Lobulations, Diagnostic Imaging, Renal scar

Abstract

Introduction: Lobation of kidney is a normal stage during development. Persistent foetallobulations of kidneysmay mimic inflammatory conditions like renal scars in computed tomography and also mistaken for a tumour. It may lead to errors in diagnosis and resulting in unwantedinvestigations and interventions.The present study's main emphasis was to look for foetallobulations in adult kidneys, study its genetic and embryological basis as well as describe its clinical significance.

Materials and methods:This observational study includes 25 formalin-fixed cadavers,sourced from Subbaiah Institute of Medical Sciences, Shimoga, Karnataka, India, during the period of 2015–21. Total of 50 kidneys were observed for lobulations and data obtained was tabulated.

Results:Of the 25 right and 25 left kidneys, five kidneys showed lobulations,amongwhich 2 were right and 3 left.

Conclusion: In the present study, we found 8% of lobulations on rightsside and 12% on left side.Theknowledgeoflobulationsis of importance in distinguishing a pathological kidney from a normal sized healthy kidney.

Introduction:-

Kidneys are paired retroperitoneal organs, situated in the posterior abdominal wall on either side of the vertebral column and extends from T1 to L3 vertebra. In intrauterine life they are developed in the form of lobules, derived from the intermediate mesenchyme. At birth, the kidneys have a lobulated appearance, but the lobulation disappears during infancy as a result of further growth of the nephrons, although there is no increase in their number [1,2]. They function as chief excretory organs, maintaining the electrolyte and water balance and also serve as endocrine organs [3].

It has two components- collecting part & excretory part. The collecting part is developed from ureteric bud and the excretory part is derived from metanephricblastema. Molecular development of renal system describes that the Transcription factor 'WT1', Glial Derived Neurotrophic Factor (GDNF) and Hepatocyte Growth Factor (HGF) produced by the mesenchyme of the metanephricblastema, helps in the epithelialization, branching and growth of the ureteric buds respectively. Differentiation of the epitheliumof nephron formation is mediated by the ureteric buds through expression of WNT9B and WNT6, which also upregulatePAX2 and WNT4 in the metanephric mesenchyme. PAX2 promotes condensation of the mesenchyme, preparatory to tubule formation, while WNT4 causes the condensed mesenchyme to epithelialize and form tubules [1].

Corresponding Author:- Vasudha T.K.

The metanephric kidney is lobulated throughout fetal life, but this condition usually disappears during the first year after birth[3]. In adult anterior and posterior lips of hilum presents notches, representing lobulated development [2].Varying degrees of lobulation occasionally persist through-out life. Functionally they are like normal adult kidneys but morphologically it shows the lobular pattern revealing its foetalgrowth.Theselobulations mimic as renal infarcts or renal scars in CT &MRI.Persistence of foetallobulations in adult life makes the renal outline appears larger than normal[4]. The present study was on lobulationsof kidney, its genetic & embryological basis and clinical implications.

Abbreviations:
CT-Computed tomography, MRI-Magnetic resonance imaging, WT1-Wilm's tumor suppressor gene, WNT-Wingless related integration site, PAX-Paired box gene, GDNF-Glial Derived Neurotrophic Factor and HGF-Hepatocyte Growth Factor.

Materials And Methods:-

The present study was conducted in the Department of Anatomy, Subbaiah Institute of Medical Sciences, Shimoga, Karnataka, India. A total of 25 cadavers were dissected by Cunningham's manual method. Total of 50 adult kidneys (25 right and 25 left) were collected and examined after routine dissection. Both the right and left kidneys were examined and measurements were taken with the help of digital verniercaliper.The data obtained was tabulated, analysed statistically and compared with the previous studies.

Observations:-

Out of 50 kidneys studied, 25 were right and 25 were left kidneys. Two cadavers showed bilateral lobulations and one showed unilateral lobulation on the left side. Among 25 right kidney specimens, 2 (8 %) showed lobulation (Table 1). Among 25 left kidney specimens, 3(12%) showed lobulation (Table 1). The lobulation of kidneys are represented in the figure 1,2 & 3.

The lobulations on the right kidneys were prominentthan theleft. Theaverage measurements ofright lobulated kidneyswere10.5cm in length,4.5cm in width, 3cm in thickness.The average measurements ofleftlobulated kidneyswere9.6cm in length,4.2cm in width and 3.4 cm in thickness.Thelobulations were few and big on the right side.

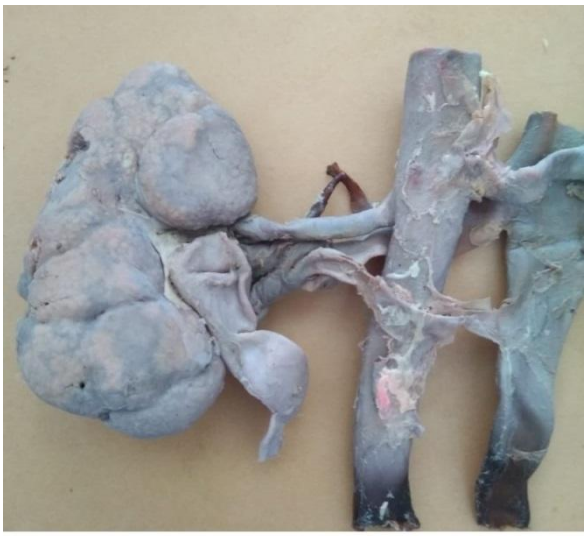

Fig 1: Posterior view of lobulated left kidney

Fig 2: Posterior view of lobulated right kidney

Fig 3: Anterior view of lobulated right and left kidneys

Discussion:-

Kidneys play an important role in maintaining the homeostatic function of the body and act as endocrine organs [3].The present study's main emphasis was to look for foetallobulations in adult kidneys, study its genetic and embryological basis as well as describe its clinical significance.We observed lobulation in 8% of right kidney specimens and 12% of left kidney specimens.

Embryologically, the kidneys develop in several lobules. In the foetus and new-born, the kidney normally has 12 lobules that fuse as they develop and grow[3]. Incomplete fusion of these renal lobules can persist postnatally and may be observed in 7% of adults as lobulated kidneys. After 28th week of gestation, varying degrees of assimilation of independent 14 renal lobes occur. Normally this lobulated structure of kidney remains apparent at birth and it gradually disappears during infancy as the nephrons grows and fully disappear over the first 5 years of life [4,5].

Congenital anomalies are seen in 2% of population as major abnormality. There are two typesof abnormalities namely malformation, where growth disturbance occurs during embryogenesisand other is deformation, which is a late change that appears in a structure which wasnormal earlier [6].

Lobulated kidney is the result of foetallobulation that persists into adulthood. Typically, thefoetal kidneys are subdivided into lobes by grooves that disappear by the end of the foetalperiod. It occurs due to incomplete fusion of developing renal lobules. It is discoveredincidentally and carries no clinical significance.But during imaging it is important to distinguishthis normal variation from inflammatory scarring, which can occur due to reflux or chronic infection, renal infarcts and tumours. It can also mimic as a pseudotumor. Lobulationcanbe seen on CT or USG as smooth regular indentations that occur between the medullary pyramids, compared with inflammatory renal scars, which are located overlying the medullary pyramids [7].

It can be distinguished from other causes ofirregularities of outline by its symmetry, shape and absence of any deformity of underlyingcalyces. They are limited to the middle and lower part of the kidney. A cortical defect opposite a calyx represents pathological loss of lobar tissue. OnIVU, foetallobulations appear as smooth regular indentations in between the renal caliceswithout parenchymal thinning or abnormalities in the underlying calyx. Whereas in vesicoureteric reflux, the scars occur over calyces which are abnormally clubbed. Inflammatory scars are deeper and typically associated with an abnormal underlying calyx. Renal infarcts are generally random in distribution and cause a broad flat depression in the outline [7].

Patil and his associates reported a rare congenital condition of kidney where bilateral lobulation and malrotation were observed in association with the open hilar structure of kidney [8]. Manish et al in their study observed lobulation in 5% of the right kidneys and 10% of the left kidneys [7].

Table 1:- Comparison of observations of present with the previous studies.

Study	Year of study	No. of specimens			Right kidney	%	Left kidney	%	Bilateral	%
		Total	Right	left						
SivanageswaraRaoSundaraSetty et.al [9]	2013	50	25	25	2	8	4	16	2	4
Manisha et al[7]	2015	40	20	20	2	5	4	10	-	-
PabbatiRaji Reddy et al [10]	2017	100	50	50	1	2	1	2	-	-
Choudhary U et al [11]	2017	64	32	32	1	3.13	3	9.38	1	1.56
AnujPratap et al [12]	2017	72	36	36	1	2.8	3	8.33	1	1.38
Swetha B et al [13]	2018	99	49	50	5	10.2	2	4	2	2.02
Himabindu et al [14]	2018	40	-	-	1	-	2	-	-	-
Present study	2022	50	25	25	2	8	3	12	2	4

In our study 5 kidneys out of 50 were lobulated, out of which 2 cadavers had bilaterallobulations and one had unilateral lobulation in left kidney. The lobulation observed in the present study although had no associations with any other structural variations or defects, that might highlight certain clinical significance.Our study is compared with similar studies done previously and shows statistical significance of occurrence as shown in the table 1.

Persistent foetallobulation of kidney is a rare anatomic variant and can pose pitfalls in diagnostic imaging [15].It can mimic a renal neoplasm and sometimes even diagnosed on subsequent surgery and histology as a wrong radiological diagnosis [16].The classic radiological investigations including arteriography have failed to differentiate between this aberrant anatomy and tumour [17].

Ultrasound scan is often the initial modality for kidney imaging. Besides the technical issues, it can be an error during image interpretation due to defects and developmental variants. This can lead to inappropriate characterisation of a focus of normal renal tissue such as congenital variant as renal neoplasm on imaging [18].Due to this diagnostic dilemma, cross-sectional imaging such as contrast enhanced CT scan or MRI is recommended which helps to avoid the need for any unnecessary surgery, further intervention and anxiety [19]. Careful evaluation of imaging characteristics of each renal mass with background knowledge of lobulations should assist in proper diagnosis and appropriate patient management. Persistent foetallobulation and pseudotumor are characterised by uniformity of vascular distribution with the surrounding parenchyma[19]. A pseudotumor remains isodense/intense to normal parenchyma in all phases of enhancement, while true tumours will show differential enhancement in at least one phase [19,20]. Radiological confirmation of persistent foetallobulation of kidney can be made by documenting the presence of renal pyramid in the bulge bounded by septa of Bertin on either side [21].

Conclusion:-

Persistent foetallobulation of the kidneys is an uncommon condition that causes the surface of the kidney to appear as several lobules instead of smooth, flat and continuous. It may mislead andresulting in unnecessary testing and subsequent clinical complications by masquerading as other lesions in diagnostic imaging.

In conclusion, it is necessary to distinguish a pathological kidney from a normal sized healthy kidney. Familiarity of normal and abnormal renal anatomical variants strengthens and improves the knowledge needed for surgical and radiological interventions.

Author contribution

DivyaShanthiD'Sa: data collection, analysis and manuscript writing.
T.K. Vasudha: data collection, analysis and manuscript writing.
K.AnupRao: manuscript writing and editing.

Compliance with ethical standards:
Not applicable.

Conflict of interest:
The authors declare that they have no conflict of interest.

References:-

1. Langman's Medical embryology,13th edition by T.W.Sadler, published by Wolters Kluwer
2. Datta AK. Essentials of Human Anatomy (Thorax and Abdomen) part I, 7th ed., Calcutta: Current books international, 2006; 301-320.
3. Standring S: Gray's Anatomy: The Anatomical Basis of the Clinical Practice, 39th edition. Edinburg: Elsevier Churchill Livingstone, 2006; 1269-84.
4. Datta AK. Essentials of Human Embryology part, 5th ed., Calcutta: Current books international, 2005; 220-224.
5. Keith. L. Moore. Clinically Oriented Embryology, 8th ed. Keith Lean Moore, Trivedi V. N. Persaud; 2008:244-245
6. Roizen, N. J. & Patterson, D. Down's syndrome. Lancet. 2003;361(9365), pp 1261-1289.
7. Manisha S More, Manoj D Togale, ShilpaBhimalli, Daksha Dixit, S P Desai. Human adult cadaveric kidneys. Med Pulse – International Medical Journal June 2015;2(6):364-368.
8. Patil ST, Meshram MM, Kasote AP. Bilateral malrotation and lobulation of kidney with altered hilar anatomy: a rare congenital variation. SurgRadiolAnat 2011;33(10):941-4.
9. SivanageswaraRao, SundaraSettyet. al. Morphometric study of human adult cadaveric kidneys. Int J Cur Res Rev, Oct 2013/ Vol 05 (20):109-115
10. PabbatiRaji Reddy et al. A study of congenital renal anomalies in adult cadavers. Indian Journal of Clinical Anatomy and Physiology, April-June, 2017;4(2):181-184
11. Choudhary U, Kumar S, Jee K, Singh A, Bharti P. A cadaveric study on anatomical variations of kidney and ureter in India. Int J Res Med Sci 2017; 5:2358-61.
12. AnujPratapKaundal, Puroshottam Kumar Kaundal. A cadaveric study on anatomical variations of kidney and ureter in a tertiary care teaching hospital. Indian Journal of Basic and Applied Medical Research; 2017; 6(3):300-305
13. Shweta B Shambharkar, Shabana Borate, Suresh Gangane. A human cadaveric study on incidence and morphology of anatomical variations of kidney and ureter with emphasis on its embryological, genetic and clinical significance. Int J Anat Res 2018;6(4.2):5892-5910. DOI: 10.16965/ijar.2018.370
14. Himabindu A, Muralikrishna S. Persistantfetallobulations and hypoplasia of adult kidneys. Indian Journal of Research. 2018;7(4):54-55
15. Hodson J. The lobar structure of the kidney. Br J Urol 1972; 44:246–61
16. Tynski Z, MacLennan GT. Renal pseudotumors. J Urol 2005; 173:600.
17. Felson B, Moskowitz M. Renal pseudotumors: the regenerated nodule and other lumps, bumps, and dromedary humps. Am J Roentgenol Radium TherNucl Med 1969; 107:720–9.
18. Bhatt S, MacLennan G, Dogra V. Renal pseudotumors. AJR Am J Roentgenol 2007; 188:1380–7.
19. Millet I, Doyon FC, Hoa D, et al. Characterization of small solid renal lesions: can benign and malignant tumors be differentiated with CT? AJR Am J Roentgenol 2011; 197:887–96.
20. Piscaglia F, Nolsøe C, Dietrich CF, et al. The EFSUMB guidelines and recommendations on the clinical practice of Contrast enhanced Ultrasound (CEUS): update 2011 on non-hepatic applications. Ultraschall Med 2012; 33:33–59.
21. Yeh HC. Some misconceptions and pitfalls in ultrasonography. Ultrasound Q 2001; 17:129–55.