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MR Urography in congenital anomalies of urinary Tract- Is it the most important imaging tool? A Case Series

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I. INTRODUCTION

The incidence of congenital urinary system anomalies is 38.42 per 10 000 live birthsand includes a wide range of anomalies of the kidney and urinary tract ranging from mild abnormalities like a double ureter or bifid pelvicalyceal system to severe, life-threatening pathologies like bilateral multicystic kidneys (1)**.**Many of these abnormalities need multiple imaging like fetalultrasonography, CT urography, MR urography, renal scintigraphy for diagnosis and conformation. Even then in many cases diagnosis remains challenge .Various abnormalitiesof urinary tract in children requiring imaging are – PUJ obstruction, renal calculi, and congenital abnormalities of renal system, megaureterand posterior urethral valve. Magnetic resonance urography (MRU) is used for detailed evaluation of urinary tract both anatomical and functional. MRU is nowadays becoming essential before surgical planning. It is highly beneficial in pediatric patients as ionizing radiation can be avoided (2). It can delineate the anatomy even in the absence of collecting system dilation which is usually not well visualized on USG (3).

We present here a case series of five children who underwent MR urography for various urogenital conditions and it proved to be a comprehensive technique in evaluation of complete urinary tract examination for surgical /clinical management of these patients removing the diagnostic dilemma.

CASE 1:

A 13 yrs. old boy presented to opd with chief complaints of pain abdomen , abdominal distension and constipation for 10 yrs. USG abdomen was initially done which revealed gross left sided hydronephrosis. However, cause of hydronephrosis was not identified; it was followed by IVP which revealed moderate left sided hydroureteronephrosis with cystitis. Micturatingcystourethrography study showed cystitis with grade 5 vesicouretric reflux on left side. It was followed by DMSA scan which revealed gross disparity in the functioning of the two kidneys. The function of left kidney was only 20% GFR -12.5 ml /min with normal functioning right kidney. Serum creatinine was found to be within normal limits (~0.6 mg /dL). Static MR Urography was performed and heavily T2 weighted images were taken. MR sequences that were used were single shot fast spin echo (SSFE), half Fourier rapid acquisition with relaxation enhancement (RARE) and single shot turbo spin echo (SSH TSE) on 1.5 Tesla MR machine with a slice thickness of 5 mm and gap of 1 mm, FAT SAT sequences were also used and Field of View (FOV) was adjusted to patient size. The findings revealed gross dilatation of left pelvicalyceal system and moderate dilatation of left ureter throughout its course with mildly tortuous and lower than normal insertion of ureter on bladder suggesting moderate gross left sided hydronephrosis. The final diagnostic impression was that patient had ectopic insertion of left ureter opening lower down and medially with moderate to gross left sided hydroureteronephrosis with cortical thinning of left kidney**(FIGURE 1a,band c).** The patient was treated surgically with ureteric reimplantation and DJ stent was inserted .Post operatively there was resolution of hydroureteronephrosis revealed on abdominal USG done six months after surgery however left kidney was found to be smaller in size compared to right kidney .

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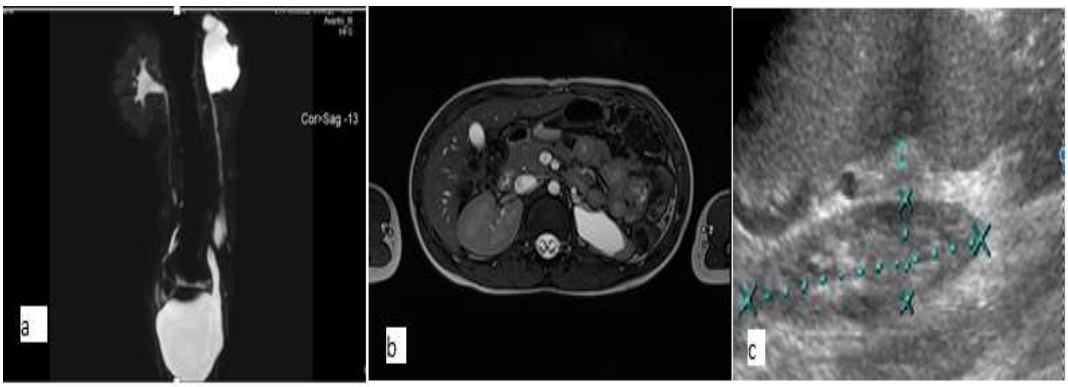

FIGURE 1a: Coronal Maximum intensity projection image from 3D T2 weighted sequence in a 13 year old boy with abdominal pain showing ectopic insertion of left ureter opening lower down and medially with gross dilatation of left pelvicalyceal system and ureter.Cortical thinning in left kidney is also well visualized.**FIGURE 1b**: Axial T2 weighted fat suppressed of the same patient showing gross dilatation of left sided pelvicalyceal system with cortical thinning of left kidney. **FIGURE 1c**: USG image showing resolution of hydronephrosis six months after surgery, however the kidney is smaller in size.

CASE 2

A 2.5yr old boy presented to OPD with chief complaints of fever, decreased appetite and decreased activity. The boy had recurrent episodes of admission to hospital. On examination it was found that the baby was having Cushingoid habitus with puffy cheeks**.** Bloodinvestigations revealed high creatinine (~1.7 mg /dL) suggesting chronic kidney disease**.** Micturatingcystourethrogram revealed dilated tortuous ureter with blunting of calyces with grade 5 vesicouretric reflux on left side with a small parauretric diverticulum on left side, right kidney was however found to be normal.Dynamic MR Urography was performed after injecting 36 ml of normal saline. Post saline infusion three sequences were taken axial T1 weighted TFE with slice thickness of 5 mm , gap of 1 mm with no fat suppression and field of view fit to the patient was taken , also axial T2 weighted images using mode TSE ,MV and MS were taken followed by injection of 6.5 mL of iv Lasix , and iv gadolinium .Post contrast 3D fast spin echo GRE axial and coronal images were taken at the delay of 20 and 45 seconds , which revealed distorted shape of bladder with increased capacity and contracted left kidney with normal right kidney**(FIGURE 2a ,b).** Final diagnosis made on MR urography was neurogenic bladder with contracted left kidney. Patient was managed conservatively with medication and intermittent catheterization

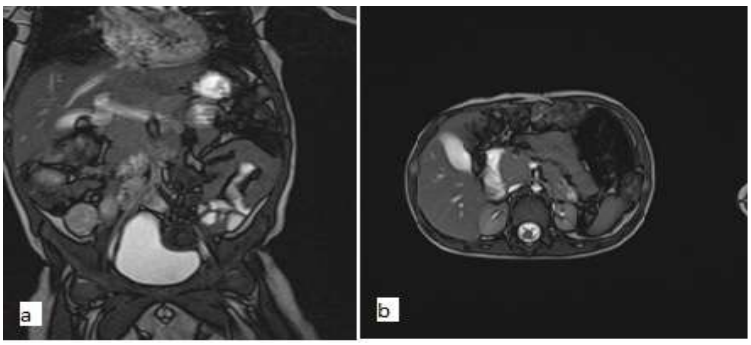

FIGURE 2a: T2 weighted image in coronal plane showing distorted shape of bladder with increased capacity suggestive of neurogenic bladder.**FIGURE 2b**: T2 weighted image in axial plane at upper lumbar region showing disparity in sizes of kidneys with contracted left kidney.

CASE 3:

A 6-month-old baby girl presented with chief complaints of excessive crying during micturition. Routine urine microscopy and Urine CS examination revealed urinary tract infection sensitive to amikacin. USG performed revealed disparity in size of kidney with mild hydronephrosis of left kidney with prominent left renal pelvis up to 8 mm diameter with normal ureter s/o left sided partial pelviureteric junction

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obstruction. It was followed by IVP which revealed normal functioning right kidney.In left kidney bifid pelvicalyceal system and dilated upper moiety was seen with abnormal Urinary bladder contour and small outpouching of bladder on left side was seen.Excretion of IV contrast was delayed on left side. DTPA scan revealed 11% functioning left kidney with significantly reduced GFR. Static MR Urography was performed and heavy T2 weighted images were taken, MR sequences used were single shot fast spin echo (SSFE), half Fourier rapid acquisition with relaxation enhancement and single shot turbo spin echo (SSH TSE). It revealed dilated tortuous cystic structure adjacent to left vesicouretric junction within the urinary bladder (intravesicalureterocele) with gross left sided hydrouretronephrosis with moderate cortical thinning. The pelvicalyceal system was bifid on left side with dilatation of upper part causing compression of pelvis **(FIGURE 3a, b, c).** Ureteric reimplantation followed by DJ stenting was done which lead to resolution of hydronephrosis that was detected on follow up USG after 6 months.

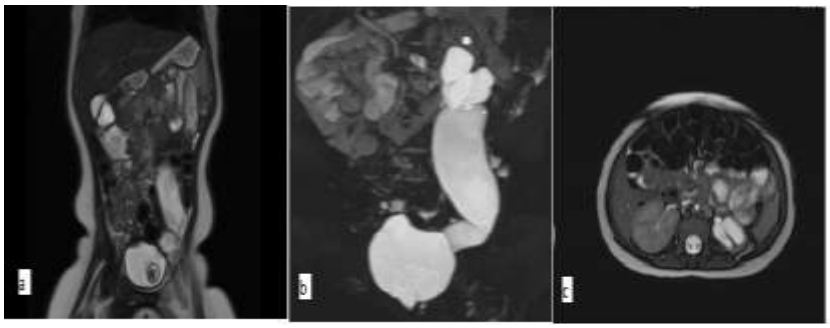

FIGURE 3a: T2 weighted image in coronal plane showing dilated cystic structure adjacent to left vesicoureteric junction suggestive of intravesicalureterocele with upstream dilatation of left ureter. **FIGURE 3b:** Coronal Maximum Intensity Projection image from 3D T2 weighted images showing gross dilatation of left sided pelvicalyceal system and left ureter with blunting of calyces.**FIGURE 3c:** T2 weighted image in axial plane showing gross left sided pelvicalyceal system with cortical thinning.

CASE 4

A 3 years old male child with history of perineal hypospadias presented to OPD with H/O excessive cry during micturition. USG revealed moderate left sided hydrouretronephrosis and gross hydronephrosis with multiple cysts in right kidney. DTPA scan revealed hydroureteronephrosis partially obstructed left kidney and nonfunctioning right kidney. It was followed by dynamic MR urography, 7.5 mL of iv gadolinium was injected, post contrast 3D fast spin echo GRE axial and coronal images were taken at the delay of 20 and 45 seconds, which revealed elongated neurogenic bladder with increased capacity, moderate left sided hydroureteronephrosis with blunting of calyces and gross right sided hydronephrosis with simple cysts in right kidney **(FIGURE 4a, b, c).** Tethered filum terminale was additionally observed on MRI of spine.Patient was managed conservatively with medication and intermittent catheterization and DJ stenting was performed on right side

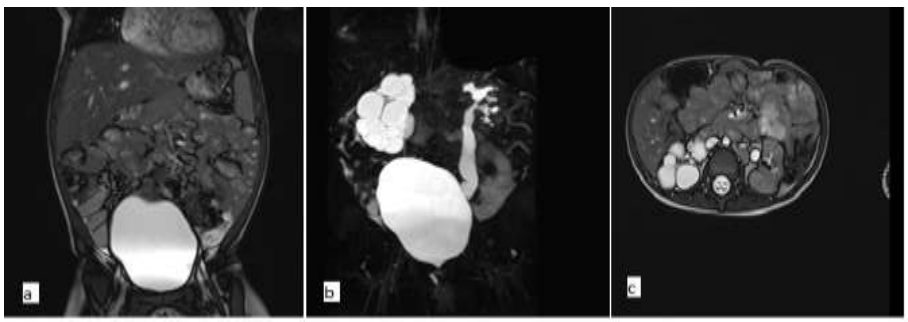

FIGURE 4a:T2 weighted image in coronal plane showing elongated and distorted contour of bladder suggestive of neurogenic bladder. **FIGURE 4b:** maximum intensity projection sequences from 3D T2 weighted image showing gross right sided hydroureteronephrosis with multiple cysts in right kidney and mild left sided

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hydroureteronephrosis as well as distorted contour of urinary bladder. **FIGURE 4c:** Axial T2 weighted MRI image showing right sided gross hydroureteronephrosis with multiple cysts in right kidney.

CASE 5

A 9 years old male presented to JNMCH with complaints of pain abdomen, fever and cough for 6 months. USG revealed no significant abnormality except for duplex pelvicalyceal system on left side, cause of recurrent abdominal pain was however not identified Static MR urography was performed which revealed bifid pelvicalyceal system in left kidney with mildly prominent lower pelvicalyceal system directed anterolaterally (malrotation of lower part of left kidney) fusing to form a single ureter at the level of pelvis **(FIGURE 5).**

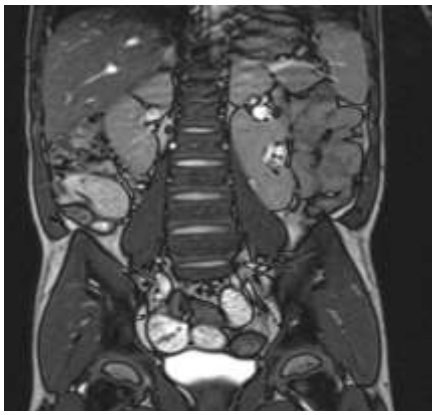

FIGURE 5:T2 weighted image in coronal plane showing malrotation of lower part of left kidney having pelvis which is directed anterolaterally.

II. DISCUSSION

Pathologies of the urinary tract in children has been mainly diagnosed with ultrasound and intravenous pyelography(IVP) in the recent past and even today at many places. USG is usually the main imaging modality for visualizing kidneys and distended pelvicalyceal system. However, it gives no information on the renal function (4) Intravenous pyelography provides morphological as well as functional information but it necessitates injection of contrast media and X-rays to obtain the images and thus is hazardous.CT scan allows axial and three dimensional images in a very short time. However, it has same limitations as IVP as also increased radiation dose .Because of these limitations MR imaging has gained progressive acceptance for evaluation of the urinary tract in children (5).

MR urography reveals detailed anatomy of the kidneys and collecting system in three dimensions as well as functional imaging when dynamic urography is performed along with static. Routine T1 and T2 weighted MR images of the abdomen and pelvis are obtained with True FISP images for renal system. High-resolution 2D and 3D T2-weighted images to focus on the collecting system allow multiplanar reformatting, reconstructions and maximum intensity projection images. In a dilated collecting system, mostly static MR urography suffices obviating the need for contrast injection (6).Functional MR urography allows the assessment of renal function and excretion into the collecting systems. It is done by obtaining images dynamically over a 10- to 15-min period of time following administration of intravenous gadolinium contrast. The data can be evaluated both qualitatively and semi-quantitatively.Dynamic MR Urography non-invasively evaluates the anatomy and functioning of renal parenchyma and collecting system (7-9). In the present study, we evaluated 5 children with MR Urography as previous investigations were inconclusive for surgical planning. MR urography provided advantages in the accurate identification of anatomical abnormalities in the urinary tract, particularly ectopic ureters. Intravenous urography is often considered obsolete nowadays with CT urography being performed more frequently.It has the advantage of shorter scanning time and cross sectional imaging but it gives significant radiation exposure. This assumes significance as many of these children require multiple and follow up imaging (10).

In our study ectopic insertion of ureter was found to be the cause of hydronephrosis in two cases which was associated with continuous

dribbling of urine in girls. Ureteric reimplantation followed by DJ stenting led to resolution of symptoms in the above two cases In one case of hydronephrosis MRU established not only the cause neurogenic bladder but also revealed additional findings of spina bifida. MR urography depicts the whole course of pelvicalyceal system and ureters from ureteropelvic junction to ureteric insertion. Maximum Intensity Projection (MIP) reconstruction in coronal and sagittal planes from source axial images allows better delineation of ureteric anatomy and pathology (11). The main disadvantages of MRU however are its high cost,technical know-how and long time for evaluation requiring sedation in children as well as contrast use in dynamic urography. Despite these limitations, MRU is gaining wide acceptance as a valuable diagnostic tool. However, recent studies suggest that non-contrast T2-weighted MRU alone is sufficient to diagnose ureteric anomalies to direct clinical or surgical management.With improvements in technology, cost and examination time of MR urography continue to decrease leading to its wider acceptability by urologists and pediatric surgeons.

III. CONCLUSION

Magnetic resonance urography enables an accurate detection and differentiation of pathological urological conditions because of its inherent contrast and ability to obtain images in any orthogonal plane. With improvements in technique and development of newer sequences, reducing cost and time of examination, we believe that in the future, the role of MR Urography in diagnosing urinary tract pathologies in children cannot be overemphasized.

REFERENCES

[1]. Bhide P, Gund P, Kar A. Prevalence of Congenital Anomalies in an Indian Maternal Cohort: Healthcare, Prevention, and Surveillance Implications. PLoS One. 2016;10:11(11):e0166408.

[2]. Leyendecker JR, Barnes CE, Zagoria RJ. MR urography: techniques and clinical applications. Radiographics. 2008;28(1):23-46.

[3]. Grattan-Smith JD, Jones RA. MR urography in children.PediatrRadiol. 2006;36(11): 1119-32.

[4]. DickersonE.C, Dillman J.R, Smith E.A., DiPietro M.A, Lebowitz R.L, Darge K. Pediatric MR Urography: Indications, Techniques, and Approach to Review. RadioGraphics 2015;35: 1208–1230.

[5]. F. Avni, M.A. Bali, M. Regnault, N. Damr y, F. Degroot, T. Metens, et al.MR urography in children.Eur J Radiol 2002;43:154-166.

[6]. Nolte-Ernsting C, Staatz G, Wildberger J, Adam G. MR-urography and CT-urography: principles, examination techniques, applications.Rofo.2003;175(2):211-212.

[7]. Hueper K, Gutberlet M, Bräsen JH, Jang MS, Thorenz A, Chen R, Hertel B, Barrmeyer A, Schmidbauer M, Meier M, von Vietinghoff S, Khalifa A, Hartung D, Haller H, Wacker F, Rong S, Gueler F. Multiparametric Functional MRI: Non-Invasive Imaging of Inflammation and Edema Formation after Kidney Transplantation in Mice. PLoS One.2016;15:11(9):e0162705.

[8]. Mahmoud H, Buchanan C, Francis ST, Selby NM. Imaging the kidney using magnetic resonance techniques: structure to function.2016. CurrOpinNephrol Hypertens.;25(6):487-493.

[9]. Peperhove M, Vo Chieu VD, Jang MS, Gutberlet M, Hartung D, Tewes S, Warnecke G, Fegbeutel C, Haverich A, Gwinner W, Lehner F, Bräsen JH, Haller H, Wacker F, Gueler F, Hueper K. Assessment of acute kidney injury with T1 mapping MRI following solid organ transplantation. 2018Eur Radiol.;28(1):44-50.

[10]. Mathys C, Blondin D, Wittsack HJ, Miese FR, Rybacki K, Walther C, Holstein A, Lanzman RS. T2' Imaging of Native Kidneys and Renal Allografts - a Feasibility Study.Rofo. 2011 Feb;183(2):112-9.

[11]. BlandinoA,GaetaM,MinutoliF,SalamoneI, MagnoC,Scribano E et al.MRUrography of the ureter. AJR Am J Roentgenol. 2002;179:1307–14.