

Utility of ureteric jet: A simple yet useful tool for the evaluation of complex urogenital anomaly

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Abstract

In infants and young children with suspicion of genitourinary tract anomalies, ultrasonography (USG) is usually the first imaging modality. Advantages of USG are well described. In the evaluation of complex congenital urogenital anomalies, ultrasound examination needs to be tailored according to the clinical suspicion and to yield maximum information. Primary megaureter is a congenital anomaly, which is associated with dilatation of ureter above an adynamic segment at the vesicoureteric junction (VUJ). Two different types are described in the literature: refluxing and obstructive. Absence of ureteric jet on USG in conjunction with vesicoureteric reflux (VUR) on voiding cystourethrogram (VCUG) prompts to the diagnosis of refluxing type of obstructed megaureter. Here we describe a case of duplex moiety with refluxing type of obstructed megaureter, where gray-scale USG and real-time color Doppler evaluation of the ureteric jet established the diagnosis. The aperistaltic segment of lower ureter near the VUJ with an absence of ureteric jet for the same moiety suggested the possibility of an obstructed megaureter. VUR was demonstrated on VCUG; thus, pointing toward a diagnosis of obstructed refluxing megaureter.

Key words: Duplex moiety; megaureter; ultrasonography; ureteric jet

Introduction

Urogenital anomalies are among one of the most common congenital anomalies.^[1] Duplex collecting system is the most common congenital anomaly of the urinary tract, with a reported incidence of 1 out of 125 (0.8%) population.^[2]

Primary megaureter is a rare congenital condition, where the bladder and the bladder outlet are normal but the ureter is dilated to some extent with no identifiable anatomic cause at the vesicoureteral junction (VUJ).

Primary megaureter associated with duplex moiety, especially the refluxing obstructed variety, is very rare

and seen in 2% cases of refluxing megaureter.^[3] We report here a case of duplex moiety involving the left kidney; the upper moiety of which demonstrated significant reflux and obstructed megaureter, while the lower moiety showed only reflux. Routine ultrasonography (USG) usually relies on the morphological change (tapered appearance of lower ureter) for the diagnosis of megaureter. However, presently, we emphasize the role of ureteric peristalsis and jet in the diagnosis of obstructed megaureter.

There are six different patterns of ureteric jet identified under different physiological and pathological conditions because of VUJ sphincteric activity. Among them biphasic,

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triphasic, and polyphasic patterns are grouped under the mature complex jet, while the monophasic jet is classified as immature jet being common in younger age group.^[4]

Case Report

We report a case of child referred to our institution with antenatal diagnosis of left-sided hydronephrosis. USG kidney, ureter, bladder (KUB) of this child done at a private center confirmed the antenatal finding of left hydronephrosis with normal right kidney. The child then visited our department for voiding cystourethrogram (VCUG) and USG to rule out any reflux. VCUG showed complete duplication of pelvicalyceal system (PCS) and the ureter. The upper moiety showed grade 5 vesicoureteral reflux (VUR), with ureter inserting into the bladder neck. The lower moiety demonstrated grade 2 VUR with normal ureteric insertion into the trigone of urinary bladder [Figures 1 and 2]. USG KUB was then performed (AcusonS2000, Siemens, Erlanger, Germany) with 12 MHz linear high-frequency transducer

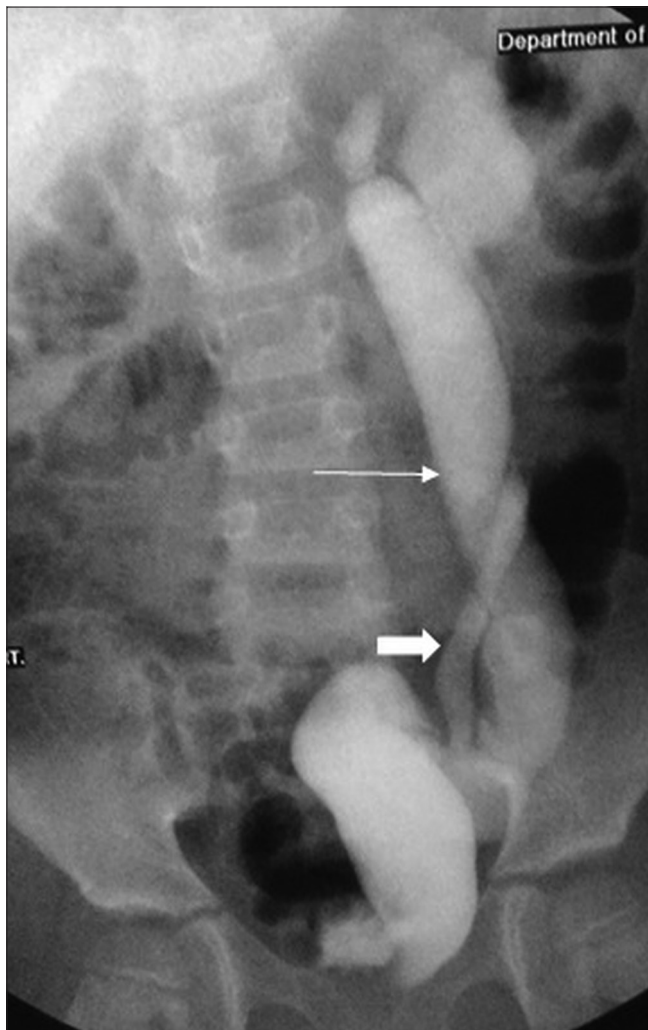


Figure 1: A VCUG image of a young child showing VUR into a duplicated ureter and PCS. The upper moiety shows grade 5 VUR (arrow) and lower moiety shows grade 2 VUR (block arrow)

to resolve the issue of insertion of lower end of the ureter. Color Doppler interrogation was made to evaluate ureteric jet. Real-time evaluation was done for assessment of ureteric peristalsis. The clips demonstrated two ureter of the duplex moiety to be lying in close proximity to each other. On axial images, the upper moiety ureter was seen lying deeper to the lower moiety ureter. On real-time assessment, the lower moiety ureter showed normal peristalsis, while the upper moiety ureter was found dilated and did not show any peristaltic movement in a segment just above the VUJ. On color Doppler study, the upper moiety ureter near VUJ did not show any color flow and no ureteric jet was visible, whereas the lower moiety demonstrated normal ureteric jet with monophasic pattern (open and close pattern)^[4] [Figure 3A and B]. Hence, a diagnosis of obstructed megaureter was made on USG with reflux on VCUG.

Discussion

In 1923, Caulk^[5] described the term megaureter or megaloureter. Incidence of obstructed megaureter is 1 per 10,000 population with majority of cases as unobstructed and nonrefluxing. Smith^[6] classified megaureter into obstructed, refluxing, refluxing with obstruction, and nonrefluxing/nonobstructing. King^[7] later subdivided it into primary and secondary. King's classification system is summarized in Table 1.^[7-9] The pathology of the ureter can be primary or secondary. It is important to distinguish between primary and secondary pathology as in cases of secondary causes, the treatment is directed at the initiating

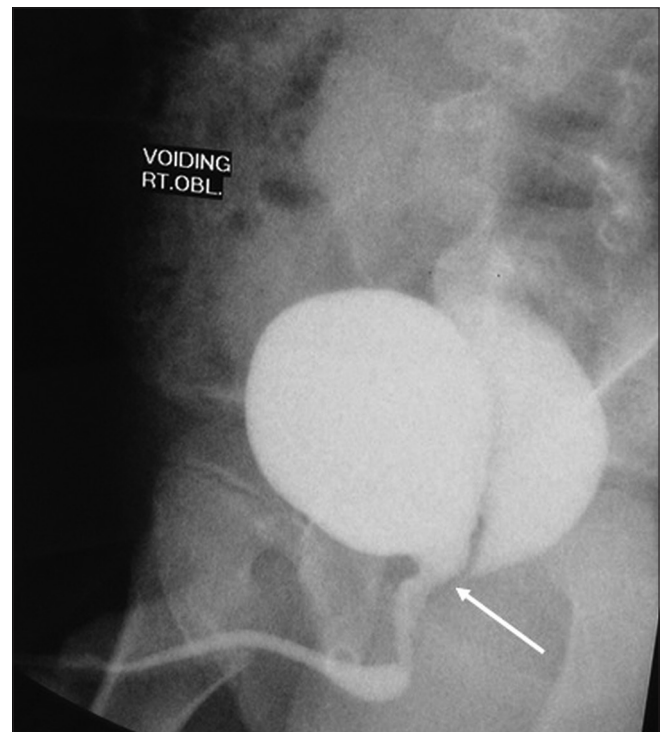


Figure 2: An oblique VCUG image showing ectopic insertion of upper moiety ureter into the bladder neck (arrow)

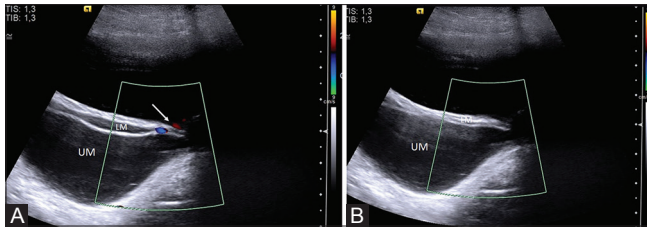


Figure 3 (A and B): (A and B) Real-time USG of the left lower ureter and VUJ reveals a change in shape due to peristalsis of the lower moiety ureter (LM) (A and B). The LM also shows presence of ureteric jet (arrow in A). The upper moiety ureter (UM) shows dilated lower end and no peristalsis (B)

Table 1: King's classification system of megaureter^[7-9]

	Class	Primary	Secondary
A	Refluxing	Reflux is the abnormality	Associated with bladder outlet obstruction or neurogenic bladder
B	Obstructing	Intrinsic ureteric obstruction, adynamic segment	Infravesical lesion, neurogenic bladder, extrinsic obstruction
C	Non-refluxing, nonobstructed	Idiopathic ureteric dilatation	Polyuria, infection
D	Refluxing, obstructed	Refluxing ureter without peristalsis in the distal part	Ectopic insertion at bladder neck (refluxes when relaxed and obstructs when tightened)

pathology and not at the ureter.^[3] In 2% cases of refluxing, megaureter obstruction is seen.^[3]

Duplex collecting systems consist of two PCS that may be associated with a single ureter or with double ureter. The Weigert-Meyer rule^[10] is followed most of the times in cases with complete duplex system with two ureters. This rule states that the ureter from the upper moiety inserts caudally and medially, ending as ureterocele or an ectopic ureter, while the ureter from the lower moiety inserts cranially and laterally and often has a perpendicular course, therefore predisposing it to reflux. Hence reflux is more common in the lower moiety as compared to upper.^[10]

Megaureter is usually suspected through clinical presentation and on gray-scale USG before and after birth; the diagnosis is then confirmed by intravenous urography and radioisotope renography. Reflux is usually diagnosed without any difficulty on VCUG.^[8] USG features of primary megaureter include fusiform dilation (>7mm) of the distal third of the affected ureter proximal to its insertion into the bladder and a smooth tapered adynamic far distal ureter on realtime.^[11] The imaging differentials of ureteric dilation include primary and secondary megaureter, megacystis-megaureter, prune belly syndrome, and primary VUR. However, obstructed megaureter may cause a diagnostic dilemma as in our case, where in ureteric jet and real-time USG can be used as a problem-solving modality. Real-time USG reveals active peristaltic waves passing to and fro in the dilated ureter above the narrowed segment^[12] and disproportionate dilatation of the lower ureter relative

to the upper ureter and renal pelvis in primary obstructed megaureter, whereas in VUR, thickening of the wall of the renal collecting system and patulous juxtavesical segment is seen.^[12]

The different Doppler waveforms of ureteric jet are due to sphincteric action of VUJ. There are dual components, whereby the monophasic pattern of ureteric jet is due to contraction caused by myogenic component of the VUJ, while the complex pattern of ureteric jet is due to the neural component in response to distal intraureteric pressure. The monophasic pattern is more commonly seen in children with VUR, UTI, and nocturnal enuresis, whereas complex wave patterns are seen in adults and older children due to neural component modulating the myogenic component.^[4]

The Doppler waveform parameters of jet direction, duration, frequency, velocity, and shape do not help in predicting VUR. Lateral ureteric orifice can be seen in children with VUR and other urinary tract disorders as compared to normal children.^[13]

No statistical difference was seen in refluxing and nonrefluxing ureter with regard to the ureteric jet length, angle, and midline-to-orifice distance after endoscopic subureteric collagen injection for the treatment of VUR. Hence these parameters cannot be used to predict recurrence of reflux in children.^[14]

Ureteric jet is seen as low-intensity echoes emerging from the ureteric orifice.^[4] During the evaluation of the lower urinary tract, the distal ureteral orifice is visualized in the transverse plane and the Doppler window is inserted on the distal ureteral orifice with low pulse repetition frequency (1500–1700 mHz) and Doppler angle at 45°–60°. With this scan technique, ureteric jet flow from ureteral orifices into the bladder can be demonstrated with mean velocity/range of 20–40 cm/s and duration less than 4 s in child.^[4,15] The ureteric jet can be useful in cases of VUR and primary enuresis by understanding the physiological pattern of ureteric jets^[4] and can be used to exclude ureteric obstruction. Complete absence of jet or a continuous low-level waveform is diagnostic for high-grade obstruction from ureteric calculi.^[16]

In our case of duplex moiety, the nonobstructed ureter was the lower moiety ureter showing ureteric jet at the VUJ and peristalsis on real time in its lower part, thus differentiating it from the obstructed megaureter which was the upper moiety ureter. Although the gray-scale imaging showed ureteric dilation, ascertaining the cause of this dilation was difficult, owing to the presence of a high-grade (grade 5) VUR. This is because grade 5 VUR alone can be a cause for the massive ureteric dilation. Hence, assessment of motility of the lower ureter becomes more reliable to label the ureteric dilation as “congenital megaureter.”

Regardless of the cause of megaureter (reflux or obstruction), megaureter is treated to prevent urinary tract infection and possible kidney damage. No surgery should be performed as long as renal function is not significantly affected and urinary tract infections are not a major issue.^[3] The surgical techniques used for the definitive treatment of refluxing and obstructive megaureter involve ureteral reimplantation of the dilated ureter. The distal adynamic segment must be completely amputated from the ureter and when the obstruction is relieved, there will be decrease in the ureteral diameter that allows for standard reimplant without tapering. However, most refluxing and obstructive megaureter does require tapering, to allow for a submucosal tunnel size that will fit the pediatric bladder.^[17]

Conclusion

USG can not only serve as the initial investigative modality in urogenital anomalies, rather it may prove to be a problem-solving tool in many complex anomalies. Interrogation of the ureteric jet is such a domain that gives real-time USG an edge over other investigations.

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Conflicts of interest

There are no conflicts of interest.

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