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Incidence of Bifid Ureter and Its Clinical Significance: A Cadaveric Study

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Abstract

Introduction: Bifid ureter or incomplete type of double ureter is a rare congenital anomaly where separate pelvicalyceal system drain into separate ureter because of branching of ureteric bud, but they unite before draining into urinary bladder to open through single ureteric orifice. It's more common in females and on right side.

Objectives: The knowledge about the incidence of bifid ureter and its surgical and embryological significance is of immense value for urologist and renal transplant surgeon.

Methods: 25 cadavers embalmed in 10% formalin formed material of this study, identification of bilateral ureter and tracing of their course till urinary bladder was done, bifid ureter were seen on right side. After removal of intestine and mesentery, posterior abdominal wall was exposed, kidneys were cleaned by removing the fascia and meticulous dissection was done to trace ureters till pelvic cavity, number of bifid ureter were noted and photographs were taken.

Results: 2 cases showed presence of bifid ureter on right side where two ureters were descending down from the hilum posterior to renal vessels were seen, in one case they were uniting at a distance of 13.5 cm and in second case at a distance of 3.5 cm from the ureteric opening into urinary bladder. Course of ureter in pelvis was normal.

Conclusion: Review of literature suggests that duplication of ureter is seen very infrequently. It may be an accidental radiological finding in a patient or may be detected during autopsy. Therefore surgeons and clinicians should be aware of this anomaly to prevent iatrogenic injuries during surgeries and treating renal pathologies.

Keywords: Bifid ureter; Hilum of kidney; Urinary bladder; Renal surgeries.

Introduction

Ureter is a long muscular tubular structure having length of 25–30 cm and diameter of 3–4 mm. It extends from renal pelvis (superiorly) to lateral angle of base of bladder (inferiorly). It start from renal pelvis as posterior most structure at the hilum behind the renal vessels, descends down retroperitonealy in front of posas major muscle, crossed by genitofemoral nerve and gonadal vessels, further down it crosses pelvis brim anterior to common iliac vessels, descends down till it reaches opposite to ischial spine from where it turns anteromedially to enter base of bladder.[1]

The right and left ureters have different relations during their trajectory. The right ureter is related to the inferior vena cava, the descending portion of the duodenum, and it is crossed by the right colic and ileocolic vessels, while the left ureter is crossed by the left colic vessels, and passes posteriorly to the sigmoid colon and its mesocolon.[2]

Normally each kidney is drained by a single ureter, which conveys urine from the kidneys to the

urinary bladder. Single kidney drained by double, triple and quadruple ureters has been reported.[3]

Duplication of ureter is the most common congenital anomaly of urinary system. This anomaly might be complete or incomplete. Incomplete duplication of ureter is known as bifid ureter.[4]

Complication such as collecting system obstruction, urolithiasis, ureterocele, and vesicoureteral reflux[5,6] along with frequent urinary tract infections, ureteric stenosis, non-functioning of kidney units are associated with bifid ureter.[7]

Materials and Methods

Twenty-five cadavers fixed in 10% of formalin were procured from the Department of Anatomy, D. Y. Patil Medical College. Anterior abdominal wall and organs were dissected by 1st year MBBS students during routine dissection. Dissection of posterior abdominal wall was done as per steps of dissections given by Cunningham dissecting manual.[8] The steps were as follows:

1. After removal of stomach, intestine and mesentery, posterior abdominal wall was exposed.
2. Kidneys were cleaned by removing fascia and fat over it.
3. Hilums of the kidneys were dissected meticulously and ureters were traced down till pelvic cavity bilaterally.
4. Muscles of posterior abdominal wall were cleaned.

Incidence of bifid ureter were noted and photographed.

Results

Out of 25 cases two cases showed presence of bifid ureter. They were seen on right sided kidney in both the cases. Ureters were coming out from the hilum posterior to renal vessels, thus maintaining the relation with vessels at hilum. One coming from the upper end of hilum and other from lower end of hilum. Although level of union of two ureter were different in both the cases.

In first case they were joining 13.5 cm above their opening in urinary bladder (in abdominal cavity) as shown in Fig. 1, while in second case they were joining at 3.5 cm above their bladder opening (in pelvic cavity) as shown in Fig. 2, also in second case ureter crossed once each other. After joining, rest of their course was normal till their opening in urinary bladder.

No other associated anomalies like arterial variations were observed.

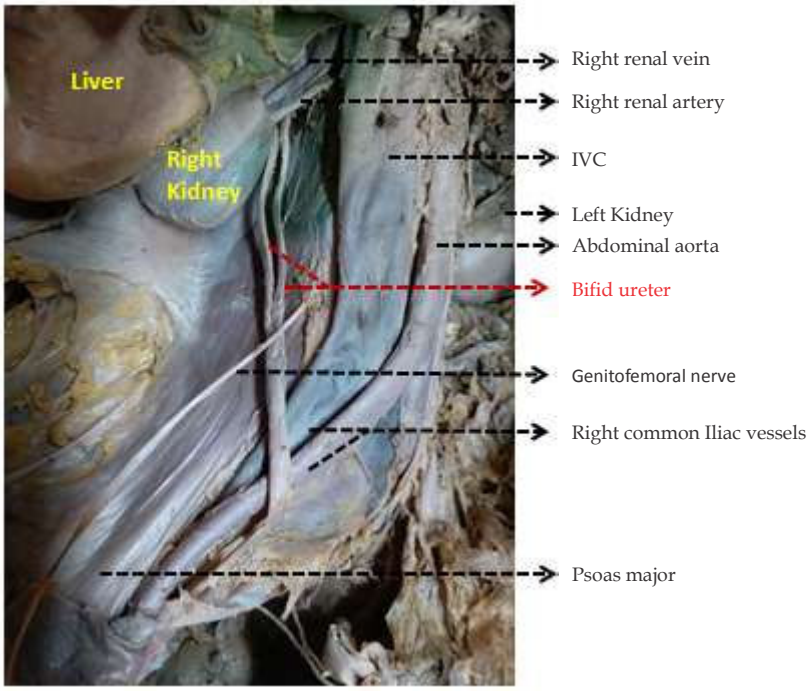

Fig. 1: Bifid ureter joining 13.5 cm above their opening in urinary bladder.

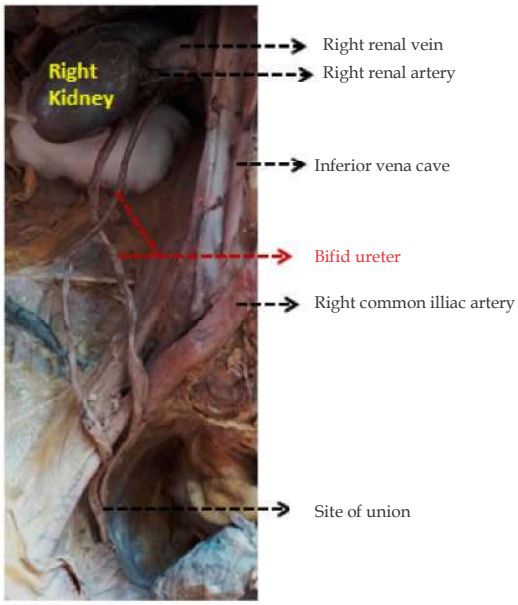

Fig. 2: Bifid ureter joining 3.5 cm above their opening in urinary bladder.

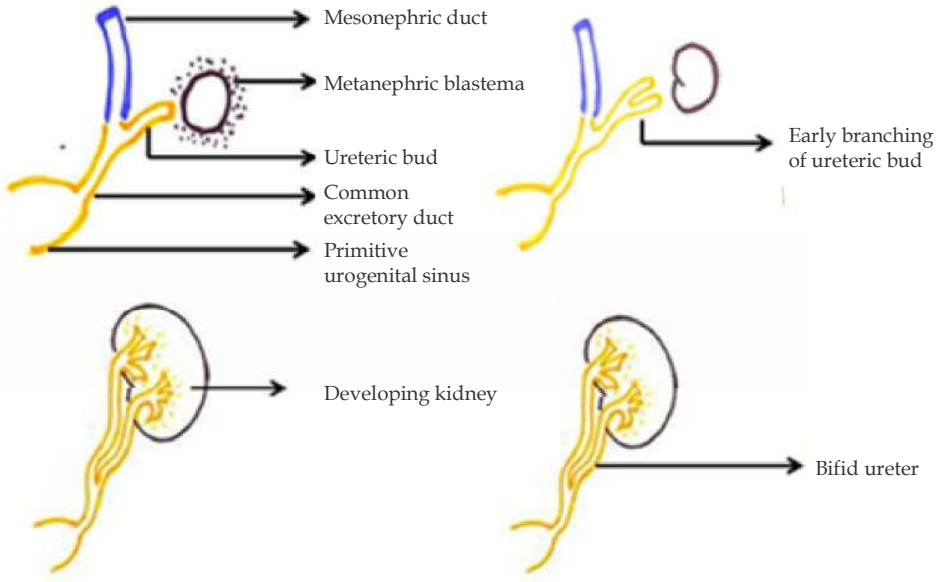

Fig. 3: Embryological basis of bifid ureter.

Discussion

The incomplete duplication is three times more common than complete duplication, with a frequency of one in 500 cases. Previous studies showed that the incidence of bifid ureteris 3% more in female than in males.[3]

Mandal et al.[6] and Rege VM et al.[9] reported cases of left sided bifid ureter in their studies with various renal and gonadal vessels abnormalities. In present study no renal vessels abnormalities were observed.

Other associated conditions with this anomaly are Goltz syndrome[10], (Also known as focal dermal hypoplasia, a multisystemic genetic disorder that principally involve skin, skeletal system, eye, and face, occasionally dental anomalies, abdominal wall defects and urinary system are also involved) High cephalad kidney[11], along with Ectopic ureter and L3 Hemivertebra.[12]

Anatomy textbooks emphasizes the three different areas in which the ureters suffer a constriction: First as it exits the renal pelvis (ureteropelvic junction), second when it crosses

the iliac vessels, third when it enters the urinary bladder. We believe that the incomplete bifid ureter presented here had a higher probability of constriction and subsequent calculi formation at the site of junction between both ureters, as it had an acute angle. Furthermore, it has been stated that once the ureters merge at different level and join the urinary bladder through one orifice (such as our case presented), an stenosis on the pyeloureteral transition or retrograde peristalsis could cause the YOYO-phenomenon saddle or seasaw reflex, where urine goes from one ureter to another, unable to move forward to the bladder, although this phenomenon is more common on blind end ureters.

Cystoscopy, ureteroscopy, computed tomography, magnetic resonance imaging, ultrasonography, and renal scintigraphy are useful to determine the presence of these anomalous ureters.[13-14-15] Symptomatic patients should be treated accordingly with the intensity of the symptoms, and no intervention should be performed in asymptomatic patients.[15]

Embryological Basis

Urinary system is formed from intermediate mesoderm during 4^{th} – 6^{th} week of intrauterine life. Initially there is formation of pronepheric tubules and duct, which regress almost completely apart from portion which continues as mesonephric tubules and duct, during 5^{th} week of intrauterine life ureteric bud arise from the distal end of mesonephric bud/wolffian duct (excretory part), at the same time metanephric tissue from metanephricblastema (secretory part), later on uretric bud grows to reach metanephric tissue to from calyceal system. Early or prior splitting of ureteric bud results in formation of complete or incomplete bifid ureter, as shown in Fig. 3 and metanephric tissue may also be divided into two parts each with its own pelvis and ureter.[16]

Molecular Explanantion

Actin Depolymerising Factors (ADF's), Cofilin 1 (Cfl1) and Destrin (Dstn) are required for ureteric bud branching morphogenesis. SatuKurre et al.[17] in his studies observed that lack of these genes arrests branching morphogenesis at an early stage, revealing considerable functional overlap between cofilin 1 and destrin. Thus, resulting faulty splitting of ureteric bud.

Conclusion

Bifid ureter may be an accidental radiological finding or may be detected during autopsy. Surgeons should be aware of this anomaly to prevent iatrogenic injuries during renal transplant surgeries while clinicians should take care for treating cases of nephrolithiasis as it is the most common pathological condition associated with bifid ureter.

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