

# Double Ureter and Duplex System

## A Cadaver and Radiological Study

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**Purpose:** To study the prevalence of duplex system and double ureter in cadavers and intravenous pyelograms in Indian population.

**Materials and Methods:** Fifty cadavers were dissected and 50 intravenous pyelograms were examined on both (right and left) sides for the presence of duplex system and double ureter.

**Results:** One male cadaver aged 43 years showed complete double ureter and duplex system on the right side and incomplete double ureter and duplex system on the left side. Another male cadaver aged 56 years showed incomplete double ureter and duplex system only on the right side. An intravenous pyelogram of a 43-year-old man showed incomplete double ureter along with duplex system on the right side.

**Conclusion:** Developmental anomalies of the kidney, ureter, and urinary bladder should be kept in mind and promptly detected before the manifestations of aforementioned complications increase the morbidity of the affected individuals.

Keywords: ureter, cadaver, anatomy, dissection

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### INTRODUCTION

Underlying embryological basis can be explained as development of two ureteral buds separately from a single mesonephric duct give rise to a duplex kidney with complete ureteral duplication. On the other hand, bifurcation of a single ureteral bud proximal to the ampulla (distal dilated part) gives rise to a duplex kidney with a bifid pelvis or ureter.<sup>(1)</sup> Double ureter, with the prevalence of 0.1% to 3%,<sup>(2,3)</sup> has been reported by various authors.<sup>(1,4-8)</sup>

Duplex system is explained as the kidney with two pyelocaliceal systems, which may have either single or bifid ureter (partial duplication) or double ureter draining separately into the urinary

bladder (complete duplication), with a single renal parenchyma that is drained by two pyelocaliceal systems.<sup>(9)</sup>

Double ureter and duplex system reported in the literature time and again have potential for future complications, such as the collecting system obstruction, lithiasis, ureterocele, and vesicoureteral reflux.<sup>(10-16)</sup> Hence, their early detection may be helpful in better management and increased survival rates.

Lee and colleagues through three-dimensional reconstructed computed tomography urography demonstrated that duplicated ureters on the right side joined at the upper proximal part of the

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ureter and duplicated ureters on the left side put together just above the ureterovesical junction.<sup>(17)</sup> Sun and associates presented one case of blind-ending bifid ureter originating from the middle third of the ureter.<sup>(18)</sup> Hasçalık and coworkers reported ureteral duplication with coexistent uterine myoma and colon adenocarcinoma in a young woman.<sup>(19)</sup> A case of double ureter and renal pelvis associated with double superior vena cava has been reported earlier.<sup>(3)</sup>

Sufficient information is lacking regarding study of duplex system and double ureter in Indian population. Cadaver study is important and relevant even in modern era of imaging techniques. Hence, present study was performed to study the prevalence of duplex system and double ureter in cadavers and intravenous pyelograms in Indian population.

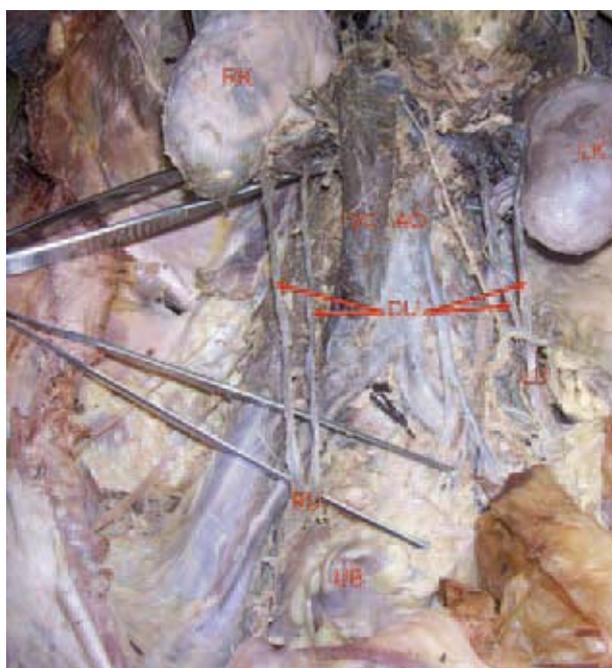
### MATERIALS AND METHODS

Properly embalmed and formalin-fixed cadavers were selected for the present study. Fifty cadavers, 38 men and 12 women, with the age range of 19 to 74 years, were dissected in the abdomen region. Skin incision was followed by fascia (superficial and deep) and muscles to expose the kidney, ureter, and urinary bladder. Each cadaver was examined on both (right and left) sides for the presence of duplex system and double ureter.

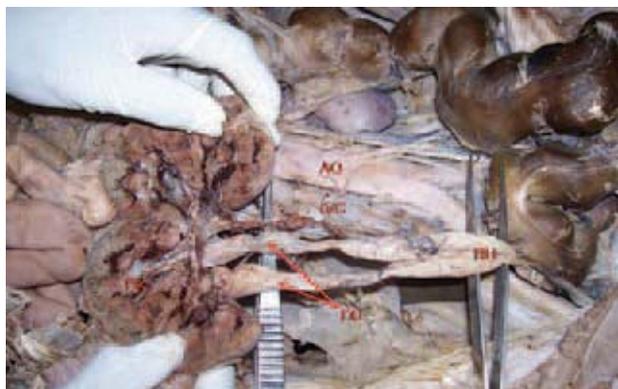
Fifty intravenous pyelograms (29 men and 21 women, in the age range of 16 to 65 years) collected from the radio-diagnosis department of our institute were studied for presence of double ureter and duplex system.

### RESULTS

Double ureter and duplex system were seen in a male cadaver aged 43 years (Figure 1). On the right side of the cadaver, the ureter draining the upper pole opened in the urinary bladder inferior and medial to the opening of the ureter draining the lower pole of the kidney. On the contrary, incomplete double ureter (Y-shaped), which joined in the middle of the duplex system was present on the left side of the aforementioned cadaver. The Y-shaped incomplete ureter on the left side was opening through a single opening on



**Figure 1.** Double ureter and duplex system are seen in a male cadaver. RK, indicates right kidney; LK, left kidney; IVC, inferior vena cava; AO, abdominal aorta; DU, double ureter; LU, left ureter; RU, right ureter; and UB, urinary bladder.



**Figures 2 and 3.** Incomplete double ureter (Y-shaped) in a male cadaver, which joined in the middle of the duplex system only on the right side. RK, indicates right kidney; IVC, inferior vena cava; AO, abdominal aorta; DU, double ureter; and RU, right ureter.



**Figure 4.** An intravenous pyelogram of a 43-year-old man with incomplete double ureter along with duplex system on the right side. RK, indicates right kidney; DU, double ureter; and RU, right ureter.

the posterior surface of the urinary bladder.

Another male cadaver aged 56 years showed incomplete double ureter (Y-shaped), which joined in the middle of the duplex system only on the right side (Figures 2 and 3). In the remaining 48 cadavers, single ureter and collecting system were present on both the right and left sides. An intravenous pyelogram of a 43-year-old man showed incomplete double ureter along with duplex system on the right side (Figure 4).

## DISCUSSION

Ureteral bud develops as an outgrowth from the mesonephric duct and ascends with increase in vertical length till it fuses with metanephric blastoma, which gives rise to future adult ureter and kidney.<sup>(1)</sup> Sun and colleagues suggested that if two ureteral buds form and one fails to contact with the metanephrogenic blastema, the blind-ending bifid ureter with double ureteral orifices presents.<sup>(18)</sup>

According to Dähnert, the prevalence of partial

duplication of the ureter is three times more than complete duplication of the ureters as found on urograms.<sup>(2)</sup> Of 50 studied intravenous pyelograms in our study, incomplete duplication was observed on the right side of one subject. On the other hand, of 50 cadavers in our study, complete duplication of the ureter was observed on the right side of one cadaver. Furthermore, partial duplication was observed on the right side of one cadaver and left side of another one.

Dähnert reported that occurrence of complete duplication in first-degree relatives of a patient with complete duplication of the ureters is sixty times more likely.<sup>(2)</sup> Hasçalık and associates reported that ureteral duplication may be genetically determined by an autosomal dominant trait with incomplete penetrance.<sup>(19)</sup> On the contrary, Bruno and colleagues opined that ureteropelvic obstruction is more common when a duplex kidney exists and can be inherited as an autosomal dominant pattern.<sup>(20)</sup>

In approximately 85% of subjects with complete double ureters, according to Weigert-Meyer rule, the orifices of the ureters draining the upper pole open inferior and medial to the orifice draining the lower pole of the kidney. The same finding was observed in our study.

In a duplex kidney drained by double ureter, the lower pole system is dominant in majority of the individuals; and hence the lower moiety is more frequently affected in pelvic-ureteric junction obstruction as compared to the upper moiety.<sup>(8)</sup> A duplex kidney with ureterocele can be associated with vesicoureteral reflux in the lower pole of the duplex system.<sup>(21)</sup> Ureteropelvic junction obstruction can be associated with anomalies of the renal system.<sup>(22)</sup> Vesicoureteral obstruction reflux involving the lower pole in a duplex system usually results from maldevelopment of the valve mechanisms. On the other hand, stenosis of the upper pole ureteral orifice results in hydronephrosis involving the upper pole of the duplex system. Mahajan and associates suggested that a duplex renal system associated with massive dilatation of the upper pole moiety may result from either vesicoureteral reflux or error in development.<sup>(23)</sup>

## CONCLUSION

Developmental anomalies of the kidney, ureter, and urinary bladder should be kept in mind and promptly detected before the manifestations of aforementioned complications increase the morbidity of the affected individuals.

## CONFLICT OF INTEREST

None declared.

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