

A Case of Bilateral Duplicated Ureter - Gross Anatomy

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Abstract

Duplicated ureter is a frequent malformation that occurs in approximately 1 in 20 people. We herein report the detailed case of bilateral duplicated ureter in which two ureters originated from a single renal pelvis and merged just proximal to the ureterovesical junction.

Keywords: Duplicated ureter; Bifid ureter; Ureteric bud; Gross anatomy

Introduction

The kidneys are the main organs of the urinary system. The renal hilum is the entry and exit site for structures servicing the kidneys: vessels, nerves, lymphatics, and ureters.

The renal artery originates from the aorta at the area between L1 and L2, just inferior to the origin of the superior mesenteric artery (SMA). These arteries are typically posterior to the renal veins and anterior to the renal pelvis. The left renal artery arises at a higher level than the right renal artery and follows an upward course, but the right one is longer and passes posterior to the vena cava, with a downward course to the right kidney.

The left renal vein is longer and crosses the midline anterior to the abdominal aorta and posterior to the SMA. This vein receives the left testicular or ovarian vein from below, the left suprarenal vein from above, and the lumbar vein before joining to the inferior vena cava.

There are many anomalies in kidneys. The extra renal artery, duplicated ureter and horseshoe kidney are observed in many cases.

Duplicated ureter is a frequent malformation that occurs in approximately 1 in 20 people. Advances in diagnostic imaging have resulted in an increase in the number of clinical cases reported [1-6]; however, very few studies have reported the gross findings of this condition at autopsy [7-11]. In addition, although there are many reported cases of unilateral double ureter [1-6], few cases of its bilateral counterpart have been reported [7-11].

Duplicated ureter is typically associated with double renal pelvis, and is therefore termed double renal pelvis and ureter. Duplicated ureter is found in 5% of urinary tract malformations. Two renal pelvises and two ureters entering the bladder separately are referred to as complete duplicated ureter, and two renal pelvises and two ureters that merge just proximal to the ureterovesical junction are referred to as incomplete duplicated ureter. The incidence rate of incomplete duplicated ureteris is three times more than complete duplicated ureter.

In this paper, we report the detailed case of bilateral duplicated ureter in which two ureters originated from a single renal pelvis and merged just proximal to the ureterovesical junction.

Subject and Methods

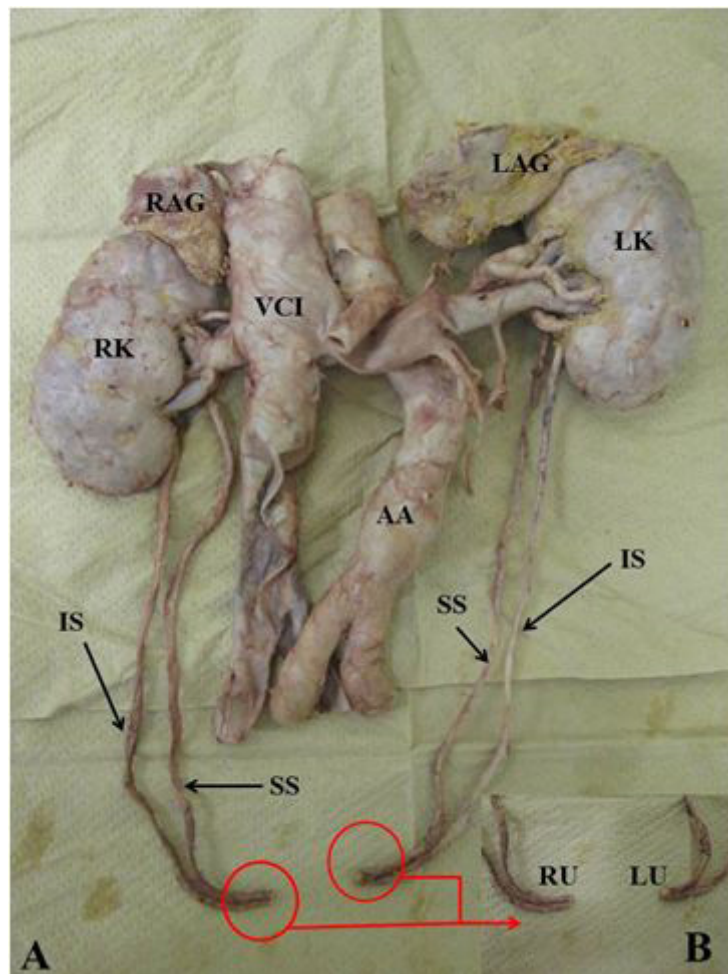
The subject was a cadaver (No. 1,896, a 100-year-old woman who died of old age) that had been donated to the Department of Oral

Anatomy of Kanagawa Dental University for use in gross anatomy dissection in the 2016 academic year, and had been embalmed by injecting a mixture of formaldehyde and ethanol into the left femoral artery.

To facilitate gross examination, the abdominal aorta and inferior vena cava were cut off at a distance of 1 cm above the origin of the celiac artery, at the bifurcation of the external and internal iliac arteries. The duplicated ureters were cut off at the ureterovesical junction, and the urinary organ system and its vascular system were removed en bloc. In addition, the renal parenchyma was crushed using forceps to examine the anatomical connections between the ureters and renal pelvis.

Results

Figure 1a shows the urinary organs and their vasculature that were removed en bloc.



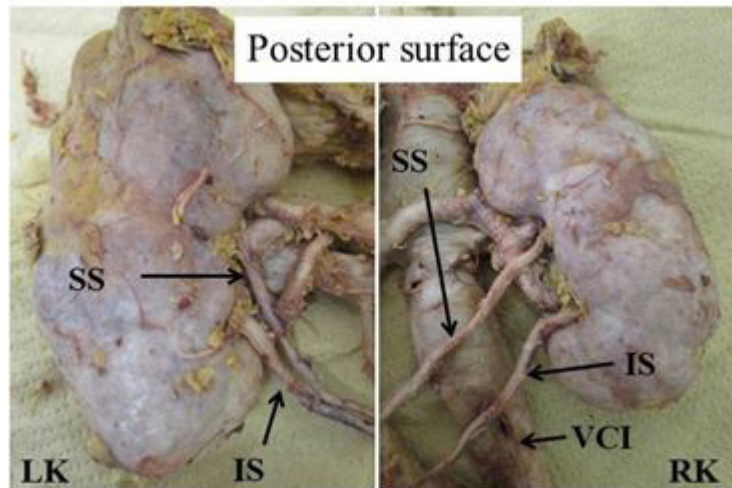
LK: Left kidney; RK: Right kidney; LAG: Left adrenal gland; RAG: Right adrenal gland; VCI: Inferior vena cava; AA: Abdominal aorta; SS: Superior segment; IS: Inferior segment; LU: Left ureter; RU: Right ureter; VCI: Inferior vena cava
Figure 1: (a) The organs removed; (b) Confluence of two ureters

Left duplicated ureter

The superior segment (SS) running from the renal hilum (simply referred to as the superior segment) measured 210 mm in length and 5 mm in diameter, and emptied into the posterior aspect of the bladder. The inferior segment (IS) running from the renal hilum (simply referred to as the inferior segment) measured 190 mm in length and 4 mm in diameter, reaching the ureterovesical junction. Duplicated ureters descended without following the Weigert-Meyer law, and merged at 30 mm below the origin of the left common iliac artery before joining the bladder (Figure 1a, 1b, and 2).

Right duplicated ureter

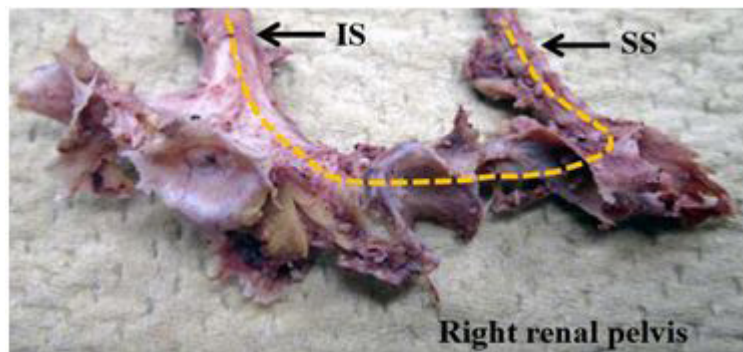
The SS measured 220 mm in length and 5 mm in diameter, and emptied into the posterior aspect of the bladder. The IS measured 180 mm in length and 4 mm in diameter, and reached the ureterovesical junction. Duplicated ureters descended without following the Weigert-Meyer law, and merged at 32 mm below the origin of the right common iliac artery before joining the bladder (Figure 1a, 1b, and 2).



LK: Left kidney; RK: Right kidney; SS: Superior segment; IS: Inferior segment
Figure 2: Posterior view of the kidneys and ureters

Bilateral renal pelvises

Renal pelvises were crushed using forceps, but no bilateral double renal pelvis was observed (Figure 3).



SS: Superior segment; IS: Inferior segment
Figure 3: The renal parenchyma was crushed to dissect the right renal pelvis and duplicated ureters. The yellow dotted line indicates the connection of the renal pelvis and duplicated ureters

Discussion

Although bilateral duplicated ureters were observed, vessel variations in courses were not found. Bilateral duplicated ureter is the most common anomaly of the renal pelvis and ureter [7-11]. Two types of this anomaly exist. In the complete type [5,6], two superior and two inferior segments empty separately into the bladder [1-4,7-11]. In the incomplete type, two superior and two inferior segments merge to form a Y stem emptying through a single orifice [8,12]. In the complete type, the SS opens into the bladder at a lower level than the IS (the Weigert-Meyer law) [13,14].

Embryologically, the complete type results if two ureteric buds arise from the mesonephric duct at 4-5 weeks of intrauterine life. The two ureters cross each other, and the SS enters the bladder more caudally than normal, while the IS opens into the bladder normally or cranially [11]. The incomplete type results if the ureteric bud bifurcates halfway, making the two ureters merge between the renal pelvis and bladder [11].

In the present cadaver, no double renal pelvis was found on either side, and two ureters originated from the pelvis of each kidney (Figure 2 and 3). In addition, without following the Weigert-Meyer law, the two ureters merged just before ending at the ureterovesical junction (Figure 1a and b).

At the end of 5 weeks of human embryonic development, the final adult kidney, referred to as the metanephros, is formed. Around the same time, the ureteric bud forms the collecting ducts, papillary ducts, calyces, renal pelvises, and ureters [11]. If the ureteric bud splits early (after 5 weeks), a double renal pelvis results [11].

This cadaver had single pelvis. The superior segment (SS) was observed upper than middle of renal hilus and the inferior segment (IS) was found lower than middle of renal hilus.

With these observations in view of embryological study, the ureteric bud did not split and formed two ureters on either side. Thus,

this a rare case of bilateral duplicated ureter in which two ureters merged just proximal to the ureterovesical junction.

Operating surgeons need not only to interpret CT images and MRI images, but also to have deep knowledge about ureter and vascular system around ureter in view of clinical study.

Conclusion

Double pelvis results if the ureteric bud splits early (after 5 weeks of gestation). In the present cadaver, the ureteric bud did not split and formed two ureters on either side. Thus, this is a rare case of bilateral double ureter in which two ureters merged just proximal to the ureterovesical junction.

Acknowledgments

Ethical clearance - taken from the "Guidelines of Japanese Society of Anatomy".

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