Complete Ureteral Duplication and an Accessory Renal Artery: Two Case Reports

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ABSTRACT

Background: Anatomical variations of the urinary collecting system and renal vasculature are clinically important because they may affect diagnostic imaging as well as surgical and interventional procedures involving the kidneys, ureters, and retroperitoneum. These case reports describe two developmental variations identified during routine human donor dissection: complete unilateral ureteral duplication and an accessory renal artery (ARA). **Methods:** As part of the Distinction in Dental Human Anatomy (DDHA) program, dental students performed routine dissection of the abdomen. The abdominal and retroperitoneal structures were carefully dissected to expose the kidneys, renal vessels, renal pelvises, and ureters while preserving their anatomical relationships. We traced the ureters from the renal pelvises toward the urinary bladder, and traced the renal arteries from the abdominal aorta to the kidneys. We carefully dissected and photographically documented the identified variations. The study protocol was reviewed and approved by the Institutional Biosafety Committee (IBC #26006). **Results:** We identified two anatomical variations in separate human donors. A 97-year-old female donor demonstrated complete unilateral duplication of the right ureter, with two distinct renal pelvises each giving rise to a separate ureter that remained distinct throughout its course to the urinary bladder. A 76-year-old male donor demonstrated a left ARA arising independently from the lateral aspect of the abdominal aorta, inferior to the main left renal artery. The accessory artery was smaller in caliber than the main renal artery and coursed directly to the inferior pole of the left kidney rather than entering through the renal hilum. **Conclusion:** Complete ureteral duplication and ARA represent clinically relevant developmental variations that may influence urologic, vascular, transplant, and retroperitoneal procedures. Recognition of these variations is important for accurate interpretation of diagnostic imaging and prevention of inadvertent vascular or ureteral injury during surgical procedures. These findings also highlight the value of human donor dissection for understanding anatomical variability and integrating gross anatomy, embryology, and clinical practice.

Keywords: Accessory renal artery (ARA); Duplicated renal pelvis; Ureteral duplication

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Received: Aug 31, 2026; **Accepted**: Sep 14, 2026; **Published**: Sep 21, 2026

Citation: Fayazi M, Castillo B, Daryani N, Hu Y, Devaney K, et al. (2026) Complete Ureteral Duplication and an Accessory Renal Artery: Two Case Reports. J Anatomical Variation and Clinical Case Report 4:127.

DOI: https://doi.org/10.61309/javccr.1000127

INTRODUCTION

Anatomical variations of the renal collecting system and renal vasculature are important considerations in clinical anatomy because of their potential implications for diagnostic imaging, urological and abdominal surgery, renal transplantation, and other retroperitoneal procedures. Among these variations, ureteral duplication represents a developmental alteration of the urinary collecting system that may occur as either complete or incomplete duplication [1-3]. In complete ureteral duplication, two separate ureters arise from duplicated collecting systems and remain distinct as they course toward the urinary bladder, whereas in incomplete duplication, the two ureteral components unite before reaching the bladder. Although duplicated ureters may remain asymptomatic and identified incidentally, they may also be associated with abnormal ureteral insertion, vesicoureteral reflux, ureterocele, obstruction, recurrent urinary tract infections, and other urological complications [3]. Previous clinical reports have also described duplicated ureteral systems in association with ectopic ureters, hydronephrosis, urinary calculi, renal injury, and renal pelvic malignancy [4-8].

Variations in renal arterial anatomy are likewise clinically significant. The kidneys undergo substantial positional and vascular changes during embryonic development, receiving successive arterial branches from the developing aorta as they ascend to their definitive location. Normally, the more inferior vessels regress as new arterial connections develop; persistence of these embryonic vessels may result in ARAs. These vessels may arise independently from the abdominal aorta and supply a specific region of the kidney, including the superior or inferior pole. ARAs most commonly arise from the abdominal aorta, although less frequent origins from the common iliac, superior mesenteric, and inferior mesenteric arteries have also been reported [9-14]. Variations in number are also well documented, ranging from two to three or even four renal arteries [10,15,16]. Studies using human donors have further documented ARAs arising directly from the abdominal aorta, demonstrating substantial variability in renal vascular anatomy [14,17]. Recognition of ARAs is particularly important during renal transplantation, nephrectomy, renal vascular interventions, and abdominal or retroperitoneal surgery because inadvertent injury or ligation of an accessory vessel may compromise the blood supply to the renal tissue it supplies. Their clinical relevance also extends to endovascular and aortic procedures, in which ARAs may require specific consideration regarding preservation, coverage, or reconstruction [14,18,19]. Bachul et al. [20] demonstrated the clinical importance of such variations by reporting successful transplantation of a kidney with multiple renal arteries, duplication of the pyelocaliceal system, and a double ureter.

A thorough understanding of both urinary collecting-system and renal vascular variations is therefore essential for anatomists, radiologists, surgeons, and other healthcare professionals. Dissection of human donors provides a valuable opportunity to identify and directly examine such variations while preserving their three-dimensional relationships with surrounding structures. The present study reports two distinct human donor cases: complete unilateral duplication of the right ureter with two renal pelvises in a 97-year-old female donor and a left ARA arising from the abdominal aorta and supplying the inferior pole of the kidney in a 76-year-old male donor. The purpose of this report is to describe the anatomical characteristics of these variations, discuss their

embryological basis and potential clinical significance, and emphasize the importance of recognizing variations of the renal collecting system and vasculature during anatomical education, diagnostic evaluation, and clinical procedures.

MATERIALS AND METHODS

We conducted these case reports during routine human donor dissection of the abdomen as part of the Distinction in Dental Human Anatomy (DDHA) program. Dental students participate in human donor dissection to enhance their understanding of clinically relevant anatomy. The study protocol was reviewed and approved by the Institutional Biosafety Committee (IBC #26006). During dissection, we reflected the anterior abdominal wall and exposed the abdominal cavity. We carefully mobilized the greater omentum and intestinal structures as necessary to provide adequate access to the posterior abdominal wall and retroperitoneal structures. We then carefully dissected the retroperitoneum to expose the kidneys and associated structures. We identified and carefully dissected the renal coverings in sequence, including the pararenal (paranephric) fat, renal fascia (Gerota's fascia), and perirenal (perinephric) fat. We carefully removed the perirenal fat to expose the renal surfaces and hila while preserving the normal anatomical relationships of the kidneys, renal vessels, renal pelvises, and ureters. We traced the ureters inferiorly from the renal pelvises to the urinary bladder and dissected the renal arteries from their origins at the abdominal aorta to their points of entry into the kidneys. During this dissection, we incidentally identified variations involving the renal collecting system, ureters, and renal vasculature. Following identification, we carefully dissected the surrounding tissues to demonstrate the origins, courses, anatomical relationships, and terminations of these variations while preserving the relevant structures. We photographed the variations to document their anatomical features and relationships.

RESULTS

We identified two unilateral anatomical variations during routine human donor dissection. A 97-year-old White female donor demonstrated complete unilateral duplication of the right ureter, her documented cause of death was senile degeneration of the brain. We identified two distinct renal pelvises at the right renal collecting system, and each continued as a separate ureter. The duplicated ureters remained completely separate throughout their course from the kidney to the urinary bladder, with no evidence of fusion, consistent with complete ureteral duplication (Figure 1 and 2). The contralateral ureter showed no evidence of duplication. In a second human donor, a 76-year-old White male with a documented history of hypertensive heart disease and chronic kidney disease (CKD), we identified a unilateral left ARA supplying the inferior pole of the left kidney. The accessory artery arose independently from the lateral aspect of the abdominal aorta, inferior to the origin of the main left renal artery, and coursed toward the inferior pole of the kidney. The ARA was noticeably smaller in caliber than the main left renal artery and entered the kidney directly at the inferior pole rather than through the renal hilum (Figure 3 and 4). We carefully dissected and photographically documented both variations to demonstrate their anatomical course and relationships to surrounding structures.

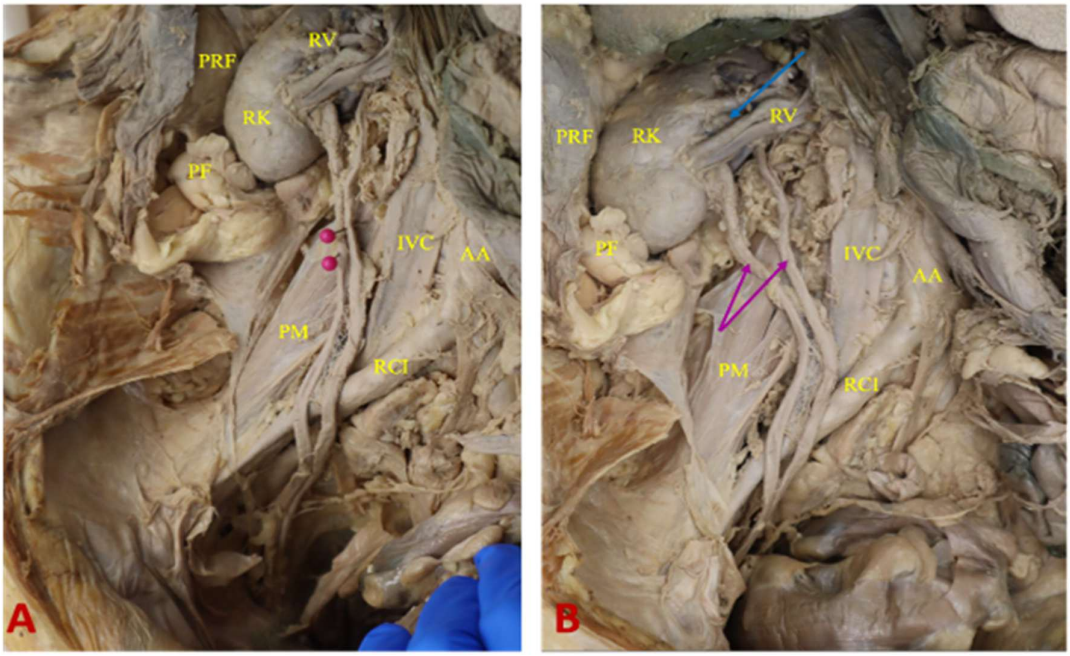

Figure 1A and 1B: Abdominal dissection following removal of the pararenal fat, renal fascia (Gerota's fascia), and perirenal fat, exposing the kidneys and ureters. Complete unilateral duplication of the right ureter is demonstrated, with two distinct renal pelvises giving rise to two separate ureters. The duplicated right ureters were traced inferiorly across the pelvic brim and remained separate throughout their course to the urinary bladder. Two pink pins and pink arrows indicate the duplicated right ureters. Abbreviations: AA: abdominal aorta; IVC: inferior vena cava; RK: right kidney; RCI: right common iliac artery; PM: right psoas major muscle; PF: perirenal fat; PRF: prerenal fascia; RV: right renal vein; and blue arrow: right renal artery.

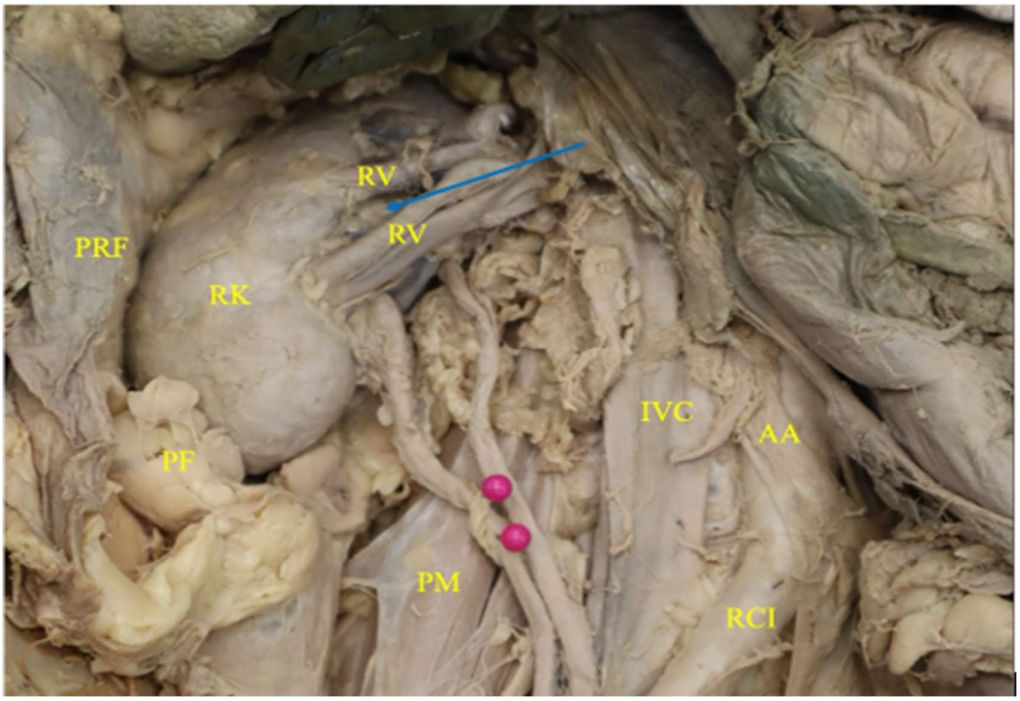

Figure 2: Higher-magnification view of the exposed right kidney and duplicated right ureters. Two pink pins indicate the duplicated right ureters. Abbreviations: AA: abdominal aorta; IVC: inferior vena cava; RK: right kidney; RCI: right common iliac artery; PM: right psoas major muscle; PF: perirenal fat; PRF: prerenal fascia; RV: right renal vein; blue arrow: right renal artery.

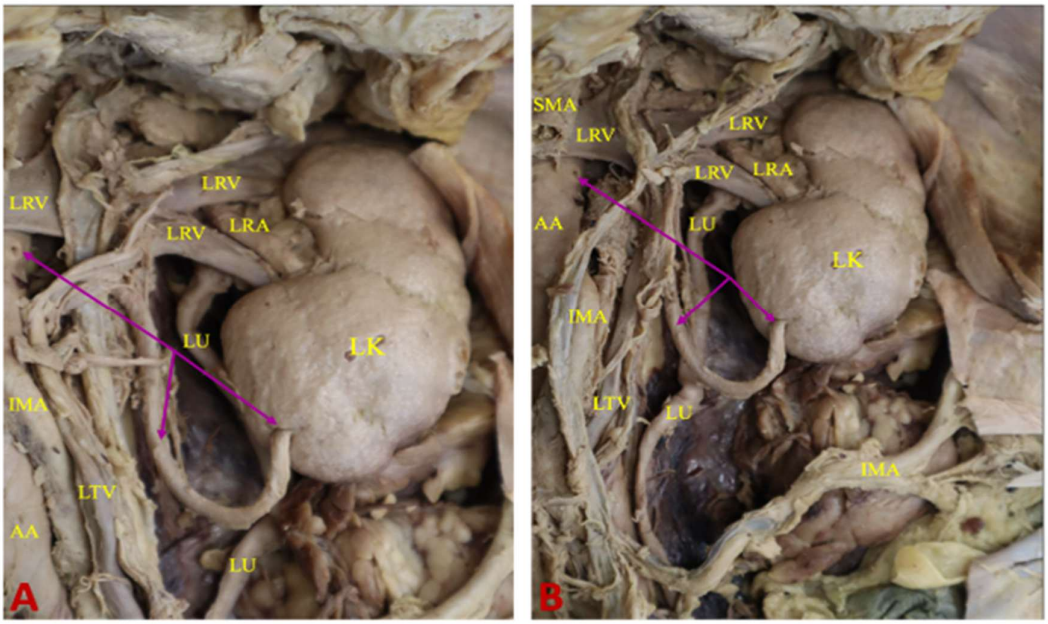

Figure 3A and 3B: Abdominal dissection following removal of the pararenal fat, renal fascia (Gerota's fascia), and perirenal fat, exposing the kidneys, ureters, and vasculature of the posterior abdominal wall. At the left renal hilum, the left renal vein, main renal artery, and renal pelvis are arranged from anterior to posterior. In addition to the main left renal artery arising from the lateral aspect of the abdominal aorta, a smaller unilateral left accessory renal artery (ARA) arises independently from the lateral aspect of the abdominal aorta, inferior to the main left renal artery. The ARA courses inferiorly in a curved path to supply the inferior pole of the left kidney. Three pink arrows indicate, respectively, the origin of the left ARA from the abdominal aorta, its course, and its entry into the inferior pole of the left kidney. Abbreviations: AA: abdominal aorta; IMA: inferior mesenteric artery; SMA: superior mesenteric artery; LK: left kidney; LU: left ureter; LRV: left renal vein; LRA: main left renal artery; LTV: left testicular vein.

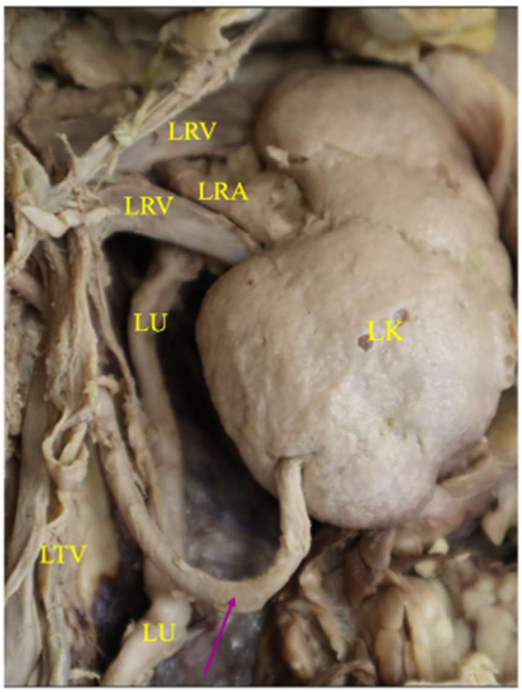

Figure 4: Higher-magnification view of the exposed left kidney, left ureter, and left renal vasculature of the posterior abdominal wall. At the left renal hilum, the left renal vein, main renal artery, and renal pelvis are arranged from anterior to posterior. In addition to the main left renal artery arising from the lateral aspect of the abdominal aorta, a smaller unilateral left accessory renal artery (ARA) arises independently from the lateral aspect of the abdominal aorta, inferior to the main left renal artery. The left ARA courses inferiorly in a curved path to supply the inferior pole of the left kidney. The pink arrow indicates the left ARA. Abbreviations: LK: left kidney; LU: left ureter; LRV: left renal vein; LRA: main left renal artery; LTV, left testicular vein.

DISCUSSION

The present human donor study identified two clinically important developmental variations of the urinary system: complete unilateral duplication of the right ureter associated with a duplicated renal pelvis and a left ARA supplying the inferior pole of the kidney. Although both variations were incidental findings during routine educational dissection, their identification is clinically relevant because variations of the ureters and renal vasculature may influence diagnostic imaging,

urologic and abdominal surgery, renal transplantation, and other procedures involving the retroperitoneum [21].

The complete duplication of the right ureter observed in the 97-year-old female donor was characterized by two distinct renal pelvises giving rise to two separate ureters that remained separate throughout their course from the kidney to the urinary bladder. This configuration is consistent with complete ureteral duplication, which differs from incomplete duplication in which the duplicated ureters unite before reaching the urinary bladder. Embryologically, complete duplication can result from the development of two separate ureteric buds from the mesonephric duct [1,2,22,23]. Each ureteric bud interacts with the metanephric mesenchyme and contributes to the formation of a separate collecting system, resulting in duplication of the renal pelvis and ureter [22,23]. In addition to its developmental basis, genetic factors may contribute to the occurrence of duplicated collecting systems. Santavá et al. [24] reported duplication among first-degree relatives and suggested a possible autosomal dominant pattern with low penetrance, although the precise mode of inheritance could not be definitively established.

Recognition of this variation is clinically important because duplicated collecting systems may be associated with abnormal ureteral insertion, vesicoureteral reflux, obstruction, ureterocele, recurrent urinary tract infections, or other urological complications [7,25]. In a retrospective study of 301 children with renal duplication, Ubetagoyena Arrieta M et al. [7] found that complete and incomplete duplications demonstrated different clinical patterns and that the greatest risk of renal injury occurred when duplication was accompanied by upper-system obstruction related to ectopic ureteral insertion or ureterocele. Vesicoureteral reflux was also frequently observed in duplicated systems. These findings demonstrate that the clinical consequences of a duplicated collecting system depend substantially on its specific anatomical configuration [7]. Ectopic insertion of the upper-pole ureter is another clinically important manifestation of duplication anomalies and may require surgical correction. Liu et al. [26] reported successful transvesicoscopic reimplantation of ectopic upper-pole ureters in pediatric patients with duplication anomalies, with improvement in hydroureteronephrosis and no postoperative vesicoureteral reflux during follow-up. Their findings demonstrate the importance of understanding the anatomy of duplicated ureters when selecting and performing an appropriate reconstructive procedure. Similarly, Singh et al. [8] reported bilateral complete ureteral duplication with an ectopic ureter in a 17-year-old female presenting with persistent urinary dribbling and recurrent urinary tract infections, further demonstrating the potential clinical consequences of ectopic ureteral insertion in duplicated collecting systems. Chacko et al. [27] further demonstrated that ipsilateral ureteroureterostomy can be a viable surgical option for duplicated systems complicated by severe ureteral dilation, reflux, or obstruction. Urolithiasis represents another clinically relevant complication in patients with duplicated ureters. Ye et al. [4] described an inverted Y ureteral duplication associated with an ectopic ureter and multiple urinary calculi and emphasized the importance of accurately determining the type of ureteral duplication before surgical intervention because different anatomical configurations may require different treatment strategies. Complete ureteral duplication may also complicate the diagnosis and management of urolithiasis. Aiken et al. [28] reported bilateral complete ureteral duplication with calculi obstructing both limbs of a duplicated

ureter, emphasizing the importance of recognizing duplicated anatomy during ureteroscopic intervention. Similarly, Tsikopoulos et al. [29] described previously undiagnosed unilateral complete ureteral duplication complicated by obstructive urolithiasis, highlighting the importance of accurate diagnosis of duplicated systems before intervention.

Complete ureteral duplication may also coexist with other clinically significant urinary tract conditions. Alsaffaf et al. [5] reported bilateral complete ureteral duplication in a 25-year-old male presenting with hydronephrosis and a ureteral calculus, illustrating the potential for urinary obstruction and stone-related complications in a duplicated system. In another clinically distinct example, Nirei et al. [6] described renal pelvic urothelial carcinoma in a patient with complete duplication of the renal pelvis and ureter and demonstrated the importance of defining the duplicated anatomy and ectopic ureteral orifice during diagnostic ureteroscopy and surgical planning.

The clinical significance of ureteral duplication also extends to surgical management, as preservation of the vascular supply to duplicated ureters is important during operative separation or reconstruction, and the specific anatomy of the duplicated system may influence the appropriate surgical intervention. Previous surgical experience has demonstrated that extensive separation of duplicated ureters may compromise their vascular supply and that the configuration of the duplex system should therefore be carefully considered during reconstruction [7,25]. The clinical relevance of complete ureteral duplication also extends to renal transplantation. Hassan et al. [29] reported successful transplantation of a donor kidney with complete ureteral duplication without postoperative urinary complications, demonstrating that this anatomical variation does not necessarily preclude successful transplantation when it is appropriately recognized and surgically managed. The importance of recognizing concurrent collecting-system and vascular variations is further illustrated by Bachul et al. [20] who successfully transplanted a kidney with multiple renal arteries, duplication of the pyelocalyceal system, and a double ureter. Together, these reports emphasize the importance of accurate preoperative identification of duplicated collecting systems and careful surgical planning.

Previous surgical experience in patients with ureteral duplication has demonstrated that the anatomical configuration of the duplicated system can directly influence surgical management. In particular, extensive separation of duplicated ureters may compromise their vascular supply, while complete duplication associated with vesicoureteral reflux may require reimplantation of the duplex system [25]. These considerations emphasize the importance of accurately identifying duplicated ureters and understanding their anatomical relationships before surgical intervention.

The occurrence of complete ureteral duplication in a female donor in the present study is consistent with previous reports demonstrating a higher prevalence of ureteral duplication and duplicated collecting systems in females than in males [31,32]. However, because this variation was identified during human donor dissection and detailed clinical and imaging information regarding the donor's urinary system was unavailable, no association between the duplicated ureter and any specific clinical condition can be established in this case.

The second variation was a left ARA identified in a 76-year-old male donor. The vessel arose independently from the lateral aspect of the abdominal aorta inferior to the normal left renal artery and entered the inferior pole of the left

kidney. Its caliber was noticeably smaller than that of the main left renal artery. ARAs represent a relatively common renal vascular variation. A recent systematic review and meta-analysis of 111 studies involving 54,814 kidneys reported a pooled prevalence of 21.10%, with the abdominal aorta representing the most common site of origin (88.39%) [14]. These data provide important anatomical context for the aortic origin observed in the present case.

ARAs are developmental vascular variations related to the embryological ascent of the kidneys [14]. During renal ascent, the developing kidneys receive a succession of arterial branches from the aorta, with the more inferior vessels normally regressing as new vessels develop at higher levels. Persistence of one of these embryonic arteries can result in an ARA [14]. The inferior origin and lower-pole distribution observed in the present specimen are therefore consistent with the developmental basis of this variation. A comparable observation in a human donor specimen was reported by Mohammed et al. [17] who identified a unilateral vascular variation in which the right kidney received two renal arteries arising separately from the abdominal aorta. In their case, the two renal arteries were approximately equal in size and entered the kidney through the renal hilum. In contrast, the ARA in the present case was identified on the left side, was noticeably smaller in caliber than the main left renal artery, and entered the inferior pole of the kidney rather than the renal hilum. These differences further demonstrate the variability in the caliber, course, and site of entry of ARAs. Of particular relevance to the present case, Gesase et al. [13] described supernumerary renal vessels supplying the lower pole of the left kidney, further demonstrating the variability of lower-pole renal vascularization. Other investigators have reported accessory or multiple renal arteries arising from the common iliac and mesenteric arteries, as well as configurations involving two, three, or four renal arteries [10-12,16]. These observations place the present inferior-pole accessory artery within the recognized spectrum of renal arterial variation.

The ARA was identified in a 76-year-old male donor with a documented history of hypertensive heart disease and CKD. These clinical conditions should be interpreted cautiously and should not be considered causally related to the presence of the accessory artery, because ARAs are developmental rather than acquired vascular structures. Although the donor had a history of hypertension, a causal relationship between the ARA and hypertension cannot be established in the present human donor because stenosis of the ARA and relevant functional parameters could not be assessed. Saba et al. [33] investigated the relationship between ARA stenosis and hypertension using multidetector-row computed tomographic angiography and found no definitive association between the two. However, more recent studies have reported an association between ARAs and higher blood pressure and have suggested that altered renal perfusion and activation of the renin-angiotensin–aldosterone system may contribute to this relationship [34,35]. Therefore, although the coexistence of hypertension and an ARA in this human donor is noteworthy, it should not be interpreted as direct evidence of causation. Knowledge of ARAs is particularly important during renal transplantation, nephrectomy, renal vascular procedures, abdominal aortic surgery, and other retroperitoneal interventions (14). An accessory artery supplying the inferior pole may provide blood to a distinct renal segment; therefore, unrecognized injury or ligation could potentially compromise perfusion of the tissue it supplies. The clinical importance of recognizing these vessels is reinforced by the wide range of reported renal

vascular configurations and their associations with other vascular variations, including testicular, suprarenal, and inferior phrenic vessels [36-41]. Karmacharya et al. [18] evaluated ARA coverage during endovascular abdominal aortic aneurysm repair and found that although segmental renal infarction occurred in some patients, accessory artery coverage was generally well tolerated without significant deterioration in renal function or hypertension. Conversely, preservation or reconstruction may be important in selected patients. Zhou et al. [19] reported successful reconstruction of an ARA in a patient with renal malperfusion and impaired renal function, with subsequent improvement in renal perfusion and function. Together, these findings indicate that management of an ARA should be individualized according to its contribution to renal perfusion, baseline renal function, and the planned surgical or endovascular procedure.

More broadly, recognition of both renal vascular and ureteral variations is important during abdominal, pelvic, urological, and retroperitoneal procedures. Failure to recognize an additional ureter may increase the risk of inadvertent ureteral injury, while failure to identify an ARA may compromise renal perfusion. Preoperative imaging and careful evaluation of renal vascular and collecting-system anatomy are therefore important when such variations are suspected. These findings also demonstrate the educational value of careful human donor dissection. Systematic exposure of the kidneys, renal vessels, renal pelvises, and ureters allowed the students to identify, preserve, and document anatomical variations that might otherwise have been overlooked. Observing these variations directly provides an opportunity to integrate gross anatomy with embryological development and clinical application. The identification of complete ureteral duplication and an ARA during student dissection further demonstrates the value of human donor-based education in exposing learners to clinically relevant anatomical variability beyond the patterns typically illustrated in textbooks.

CONCLUSION

In conclusion, these case reports document complete unilateral duplication of the right renal pelvis and ureter and a left ARA arising from the abdominal aorta and supplying the inferior pole of the kidney in two human donor specimens. Both findings can be explained by developmental processes involving the urinary system and renal vasculature and have potential relevance to diagnostic and surgical practice. Recognition of these variations is particularly important for preoperative imaging, surgical planning, renal transplantation, and procedures involving the retroperitoneum. Careful documentation of such variations contributes to the anatomical literature and emphasizes the importance of understanding anatomical variability in both health professions education and clinical practice.

REFERENCES

1. Young HH, Davis EG (1917) The Embryology and Surgery of Double Ureter and Kidney. Tex Med J 32: 512.
2. Summers JE (1901) V. Double Ureter. Report of a Nephrectomy done upon a Young Child with this Condition Present. Ann Surg 33: 39-41.
3. Stow B (1907) IX. Ureteritis Cystica Chronica: Report of a Case with Bilateral Double Ureters. Ann Surg 46: 233-243.
4. Ye WX, Ren LG, Chen L (2022) Inverted Y ureteral duplication with an ectopic

ureter and multiple urinary calculi: A case report. World J Clin Cases 10: 1326-1332.

5. Alsaffaf Y, Razzouk A, Arab H, Shehadeh M (2024) Bilateral complete ureter duplication presenting with hydronephrosis and spontaneous stone passage in a 25-year-old male: A rare case report. Radiol Case Rep 19: 4482-4484.
6. Nirei T, Tabei T, Ito H, Kobayashi K (2021) A Case of Renal Pelvic Cancer with a Complete Duplication of the Renal Pelvis and Ureter. Case Rep Oncol 14: 202-206.
7. Ubetagoyena Arrieta M, Sarasqueta Eizaguirre C, Arruebarrena Lizarraga D, Areses Trapote R (2012) Urinary tract duplication. Anales de Pediatría 77: 261-266.
8. Singh S, Bhusal NP, Mishra S, Singh S, Rai K, et al. (2022) Bilateral complete duplication of ureter with ectopic ureter presenting as persistent urinary dribbling with normal voiding pattern in 17-year-old female: Case report. Ann Med Surg 84: 104824.
9. Harvey RW (1914) A case of multiple renal arteries. The Anatomical Record 8: 333-339.
10. Pestemalci T, Mavi A, Yildiz YZ, Yildirim M, Gumusburun E (2009) Bilateral triple renal arteries. Saudi J Kidney Dis Transpl 20: 468-470.
11. Asala SA, Masumbuko-Kahamba N, Bidmos MA (2001) An unusual origin of supernumerary renal arteries: case report. East Afr Med J 78: 686-687.
12. Lacout A, Thariat J, Marcy PY (2012) Main right renal artery originating from the superior mesenteric artery. Clin Anat 25: 977-978.
13. Gesase AP (2007) Rare origin of supernumerary renal vessels supplying the lower pole of the left kidney. Ann Anat 189: 53-58.
14. Triantafyllou G, Paschopoulos I, Węgiel A, Olewnik Ł, Tsakotos G, et al. (2025) The accessory renal arteries: A systematic review with meta-analysis. Clin Anat 38: 660-672.
15. Kara A, kurtoğlu Z, oğuz İ, Öztürk AH, Uzmansel D (2006) Two accessory renal arteries with histological properties. Turkish Journal of Medical Sciences 36: 135-140.
16. Madhyastha S, Suresh R, Rao R (2001) Multiple variations of renal vessels and ureter. Indian journal of urology 17: 164-165.
17. Ali Mohammed AM, Elseed Abdalrasol RG, Alamin Abdalhai K, Gommaa Hamad M (2012) Accessory renal vessels. Acta Inform Med 20: 196-197.
18. Karmacharya J, Parmer SS, Antezana JN, Fairman RM, Woo EY, et al. (2006) Outcomes of accessory renal artery occlusion during endovascular aneurysm repair. J Vasc Surg 43 :8-13.
19. Zhou K, Duan H, Hu H, Guo Q, Zhao J (2024) Reconstruction of the accessory renal artery with autogenous vessels in aortic hybrid surgery: A case report. Vascular 32: 756-759.
20. Bachul PJ, Osuch C, Chang ES, Bętkowska-Prokop A, Pasternak A, et al. (2017) Crossing Anatomic Barriers-Transplantation of a Kidney with 5 Arteries, Duplication of the Pyelocalyceal System, and Double Ureter. Cell Transplant 26: 1669-1672.

21. Cicek SK, Ergun S, Akıncı O, Sarıyar M (2012) Renal Vascular and Ureteral Anatomic Variations in 1859 Potential Living Renal Donors. Transplant Proc 53: 2153-2156.
22. Kozlov VM, Schedl A (2020) Duplex kidney formation: developmental mechanisms and genetic predisposition. F1000Res 9.
23. Hopkins LM (2021) Duplicated collecting system. Am J Obstet Gynecol 225: B12-b3.
24. Santavá A, Utíkalová A, Santavý J (1990) Heredity and origin of duplication of the pelvicalyceal collecting system. Acta Univ Palacki Olomuc Fac Med 126: 209-218.
25. Barrett DM, Malek RS, Kelalis PP (1975) Problems and solutions in surgical treatment of 100 consecutive ureteral duplications in children. J Urol 114: 126-130.
26. Liu W, Du G, Wu X, Wang X, Wu Y, et al. (2021) Peadiatric transvesicoscopic dismembered ureteric reimplantation for ectopic upper ureter in duplication anomalies. J Pediatr Urol 17: 412.e1-.412.e5.
27. Chacko JK, Koyle MA, Mingin GC, Furness PD (2007) 3rd. Ipsilateral ureteroureterostomy in the surgical management of the severely dilated ureter in ureteral duplication. J Urol 178: 1689-1692.
28. Aiken WD, Johnson PB, Mayhew RG (2015) Bilateral complete ureteral duplication with calculi obstructing both limbs of left double ureter. Int J Surg Case Rep 6c :23-25.
29. Tsikopoulos I, Cuziurova D, Galanoulis K, Kalogiannis D, Skriapas K (2022) Incidental finding of unilateral complete duplication of ureter in a patient with large ureteric calculus obstructing both left limbs. Folia Med (Plovdiv) 64: 844-848.
30. Hassan M, Iqbal Q, Afridi N, Khan TFT (2024) Donor Kidney With Complete Duplication of Ureter: Is It Safe for Transplantation? Exp Clin Transplant 22 :396-398.
31. Fernbach SK, Feinstein KA, Spencer K, Lindstrom CA (1997) Ureteral duplication and its complications. Radiographics 17: 109-127.
32. Malligiannis Ntalianis K, Cheung C, Resta C, Liyanage S, Toneva F (2022) Unilateral Duplicated Collecting System Identified During Pelvic Lymphadenectomy: A Case Report and Literature Review. Cureus 14: e26331.
33. Saba L, Sanfilippo R, Montisci R, Conti M, Mallarini G (2008) Accessory renal artery stenosis and hypertension: are these correlated? Evaluation using multidetector-row computed tomographic angiography. Acta Radiol 49: 278-284.
34. Wu F, Yuan X, Sun K, Zhang Y, Zhu L, et al. (2024) Effect of Accessory Renal Arteries on Essential Hypertension and Related Mechanisms. J Am Heart Assoc 13: e030427.
35. Kang K, Ma Y, Jia C, Cheng Y, Yang Y, et al. (2020) Relationship between Accessory Renal Artery and Clinical Characteristics of Middle-Aged Patients with Primary Hypertension. Int J Hypertens 2020: 7109502.
36. Nayak BS (2008) Multiple variations of the right renal vessels. Singapore Med J 49: e153-e55.

37. Kayalvizhi I, Monisha B, Usha D (2011) Accessory left testicular artery in association with double renal vessels: a rare anomaly. Folia Morphol 70: 309-311.
38. Bergman RA, Cassell MD, Sahinoglu K, Heidger P (1992) Jr. Human doubled renal and testicular arteries. Ann Anat 174: 313-515.
39. Topaz O, Topaz A, Polkampally PR, Damiano T, King CA (2010) Origin of a common trunk for the inferior phrenic arteries from the right renal artery: a new anatomic vascular variant with clinical implications. Cardiovasc Revasc Med 11: 57-62.
40. Bakheit MA, Motabagani MA (2003) Anomalies of the renal, phrenic and suprarenal arteries: case report. East Afr Med J 80: 497-498.
41. Bakheit MA, Motabagani MA (2004) Anomalies of the renal, phrenic, suprarenal arteries. Saudi Med J 25: 376-378.