

Complications associated with the presence of a double collecting system. Presentation of two cases

Complicaciones asociadas a la presencia de doble sistema colector. Presentación de dos casos

Johan Sebastián Ramos Marín[1]
Maira Alejandra Jiménez Claros[2]
Ervin Andrés Corredor Quintero[3]
María Camila Pérez Vanegas[3]
Luis Antonio Galvis[3]

https://doi.org/10.53903/01212095.302

Key words (MeSH)

Urinary incontinence
Urinary tract infection
Vesicoureteral reflux
Tomography
Urography
Ureter

Palabras clave (DeCS)

Incontinencia urinaria
Infección urinaria
Reflujo vesicoureteral
Tomografía
Urografía
Uréter

Summary

Congenital abnormalities of the upper urinary tract are present in 3-11% of the population and alone account for up to 50% of malformations occurring during the embryonic stage. These embryogenesis alterations affecting the genitourinary system are classified according to renal morphology, the anatomical position of the kidney in the abdominopelvic cavity, number (agenesis and supernumerary kidneys), and abnormalities in the development of the collecting system, the latter being the most prevalent. The double collecting system is the most common alteration, usually asymptomatic, and often an anatomical variant without clinical relevance, typically diagnosed incidentally in most cases. However, in some scenarios, it can lead to significant complications that may compromise renal function and affect the quality of life of affected patients. Regarding imaging methods, there are many diagnostic aids that can be used to detect these different conditions, and depending on the patient's age, some diagnostic methods are preferred over others. The objective of this article is to demonstrate the complications associated with the double collecting system through two clinical cases.

Resumen

Las anormalidades congénitas del tracto urinario superior están presentes del 3-11% de la población, por sí solas constituyen hasta el 50% de las malformaciones producidas durante la etapa embrionaria. Estas alteraciones de la embriogénesis que afectan al sistema genitourinario se clasifican con respecto a la morfología renal, posición anatómica del riñón en la cavidad abdominopélvica, número (agenesias y riñones supernumerarios) y anormalidades en el desarrollo del sistema colector; estas últimas son las de mayor prevalencia. El doble sistema colector es la alteración más frecuente y en la mayoría de casos es asintomática, cursa como una variante anatómica sin relevancia clínica que se diagnostica de manera incidental en la mayoría de casos; sin embargo, en algunos escenarios puede cursar con complicaciones importantes que pueden comprometer la función renal y afectar la calidad de vida de los pacientes que la padecen. Con respecto a los métodos de imágenes, son muchas las ayudas diagnósticas que pueden emplearse para detectar estas diferentes patologías y, según la edad del paciente, algunos métodos diagnósticos se indican sobre otros. El objetivo de este artículo es demostrar, mediante dos casos clínicos, las complicaciones asociadas al doble sistema colector.

Case reports

Patient 1

A 25-year-old female patient with a history of recurrent urinary tract infections during childhood and adolescence, without regular follow-up. She is currently being evaluated for high blood pressure (142/90 mmHg) and persistent urinary tract infections with difficult-to-treat pyelonephritis. A Doppler ultrasound of the renal arteries revealed hydronephrosis of the lower calyx of the left kidney. A computed tomography (CT) urography was performed, revealing loss of left renal morphology with cortical atrophy and grade IV hydronephrosis of the lower calyx of the left kidney; in addition, an incomplete double collecting system causing urinary symptoms was identified. Due to findings suggestive of a complicated double collecting system and the patient's clinical history, it was decided to perform a partial left nephrectomy of the affected renal segment. A follow-up study showed retrograde filling of the ureter to its blind end, confirming uretero-ureteral reflux associated with an incomplete double collecting system (Figure 1).

[1]General practitioner, technologist in Radiology and Diagnostic Imaging. Hospital Universitario Erasmo Meoz. Cúcuta, Colombia.

[2]General practitioner, Hospital Universitario Erasmo Meoz. Cúcuta, Colombia.

[3]Resident physician, Hospital Universitario Erasmo Meoz. Cúcuta, Colombia.

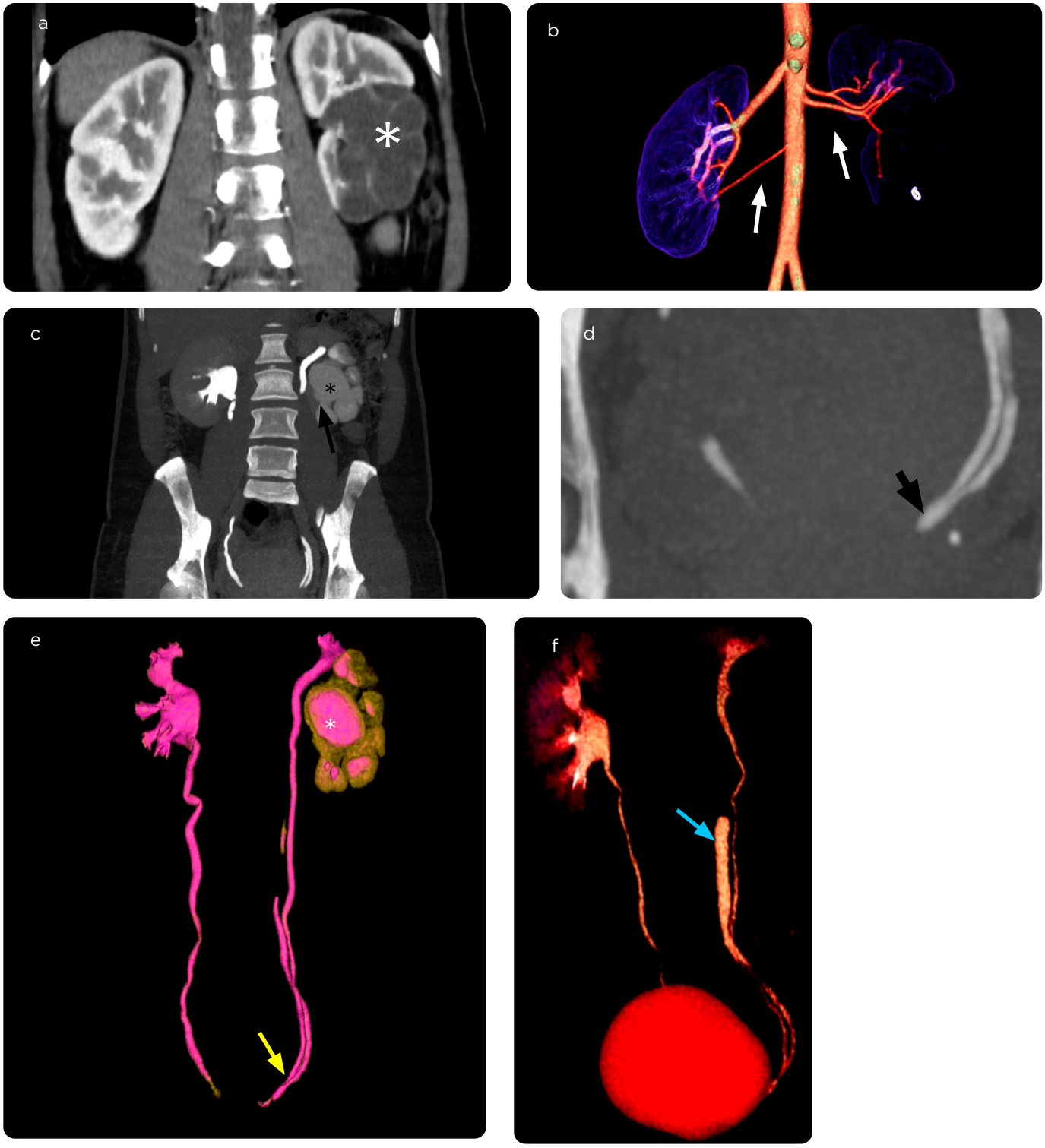


Figure 1. CT urography using the single-bolus technique. a) Coronal reconstruction of the arterial phase: multilobulated cystic image in the lower pole of the left kidney (asterisk). b) 3D reconstruction in the arterial phase: bilateral accessory renal arteries (arrows); additionally, an alteration in the left renal morphology is identified due to loss of renal parenchyma in its lower segment. c) Coronal reconstruction of the excretory phase in maximum intensity projection: the multilobulated cystic lesion observed in the previous phase is consistent with hydronephrosis of the lower calyx of the left kidney (asterisk); obstruction of the pyeloureteral junction (arrow) is also identified, and the double collecting system can be characterized. d) Coronal reconstruction: fusion of both left ureters before the vesicoureteral junction, with small dilation posterior to their confluence that could easily be confused with the cobra head sign of a ureterocele (arrowhead). e) 3D reconstruction in the excretory phase: left hydronephrotic sac (asterisk) and incomplete left double collecting system with small dilation posterior to the junction of both ureters (arrow). f) 3D reconstruction in the excretory phase following surgical treatment with partial left nephrectomy: retrograde filling of the ureter corresponding to the lower pole of the left kidney. Findings consistent with incomplete double left collecting system complicated by ureteral reflux and hydronephrosis of the lower calyx.

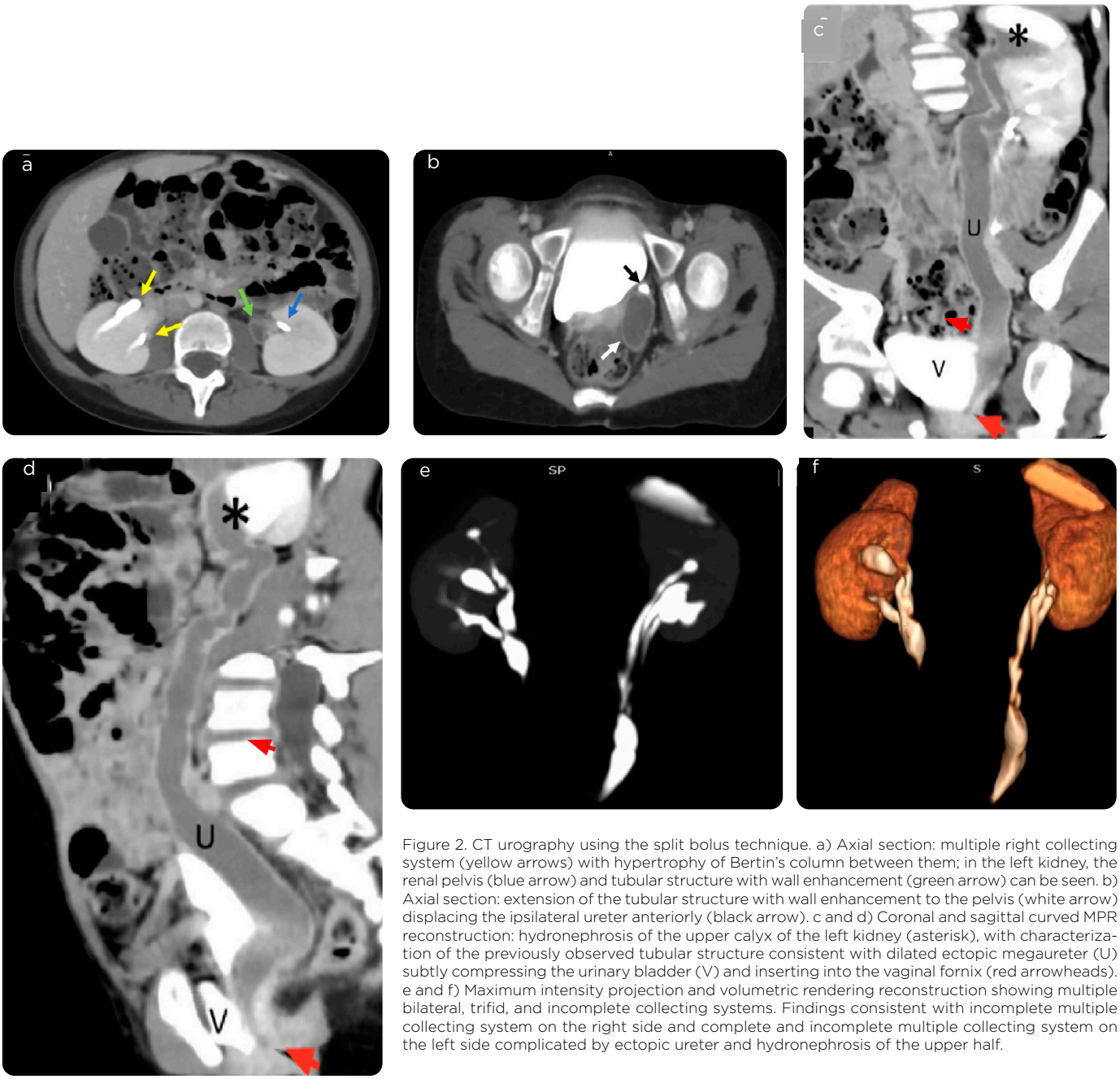


Figure 2. CT urography using the split bolus technique. a) Axial section: multiple right collecting system (yellow arrows) with hypertrophy of Bertin's column between them; in the left kidney, the renal pelvis (blue arrow) and tubular structure with wall enhancement (green arrow) can be seen. b) Axial section: extension of the tubular structure with wall enhancement to the pelvis (white arrow) displacing the ipsilateral ureter anteriorly (black arrow). c and d) Coronal and sagittal curved MPR reconstruction: hydronephrosis of the upper calyx of the left kidney (asterisk), with characterization of the previously observed tubular structure consistent with dilated ectopic megaureter (U) subtly compressing the urinary bladder (V) and inserting into the vaginal fornix (red arrowheads). e and f) Maximum intensity projection and volumetric rendering reconstruction showing multiple bilateral, trifid, and incomplete collecting systems. Findings consistent with incomplete multiple collecting system on the right side and complete and incomplete multiple collecting system on the left side complicated by ectopic ureter and hydronephrosis of the upper half.

Patient 2

A 9-year-old female patient with a history of recurrent urinary tract infections and episodes of persistent urinary incontinence since birth, with normal retrograde voiding cystourethrography. Physical examination reveals urine leakage from the vaginal introitus. A renal and urinary tract ultrasound report shows bilateral renal enlargement and hydronephrosis of the upper left pole with suspected complicated double collecting system. Given the patient's symptoms and history, physical examination findings, and ultrasound results, ectopic ureter is suspected, so a CT urography is performed, which confirms the diagnosis of an incomplete double collecting system on the right side and a complete double collecting system on the left side complicated by an ectopic ureter, draining into the vaginal fornix and secondary hydronephrosis of the upper kidney calyx, which explains the urinary symptoms (Figure 2). The patient underwent surgical correction by pediatric urology without complications.

Discussion

The double collecting system is defined as the separation of two pyelocaliceal systems (1-3). It is one of the most common abnormalities affecting the urinary system, affecting up to 0.7-4% of the healthy population, with a higher prevalence in women at a ratio of 2:1 (1, 2, 4). In

the vast majority of cases, its diagnosis is incidental and, exceptionally, it can cause complicated symptomatic presentations (1, 2). It can be classified as complete or incomplete, with the latter being three times more common than the former (1, 3, 5). In the complete system, there are two independent ureters with different openings and insertions in the bladder wall (1, 2). Incomplete systems can be subclassified depending on the degree of fusion, which can be bifid renal pelvises—fusion occurs in the proximal ureters—or bifid ureters—anastomosis occurs more distally and before insertion into the bladder wall (1, 2).

These abnormalities originate during embryogenesis. Under normal fetal development conditions, a single ureteric bud is produced, which arises from the primitive mesonephric duct (Wolffian duct) and migrates to meet the metanephros (renal precursor) in order to initiate the formation of nephrons (2). Once this process is complete, the metanephros sends a signal back to the ureteric bud to branch exponentially to form the collecting system, which includes the renal calyces and pelvis (2). When there is a failure in the feedback between the ureteric bud and the metanephros, abnormalities of the urinary tract are generated (1, 2). For example, when the ureteric bud bifurcates prematurely before contacting the metanephros, incomplete ureteral duplication occurs (2). On the other hand, when two ureteric buds form separately from the primitive mesonephric duct and independently contact the metanephros, a complete double collecting system is formed (2). In more extraordinary conditions, up to three ureteric buds can form, leading to the formation of a triple collecting system (2).

With regard to complications, women are more affected than men, and their presentation depends on their classification. For example, in the incomplete system, complications such as ureteral reflux and obstruction of the pyeloureteral junction in the lower half of the calyx may be observed, which in some cases may be associated with hydronephrosis of the lower pole (1-3,6,7). In complete systems, the ureter of the lower calyx has a normal insertion into the trigone; on the other hand, the upper calyx ureter is inserted ectopically (inferiorly and medially in the bladder with respect to the orthotopic ureter of the lower half) and this upper calyx ureter is obstructed in most cases, which explains the hydronephrosis of the upper pole (1-3). These anomalies of the insertion of the upper pole ureter are known as Weigert-Meyer's rule, who described that the upper half ureter can insert anywhere in the ectopic pathway, including structures originating from the mesonephric duct and urogenital canal—in boys (bladder, prostatic urethra, seminal vesicles, epididymis, and vas deferens) and in girls (bladder, urethra, vagina, uterus, and fallopian tubes) (1-3). When the insertion of this ectopic ureter occurs below the external urethral sphincter, it explains the symptoms of permanent urinary incontinence experienced by women (2, 8-10). Other disorders associated with the complete double system include ureteroceles, vesicoureteral reflux, and renal parenchymal dysplasias that cause impaired renal function (1-3).

There are many diagnostic methods that can identify the presence of a double collecting system (2). Ultrasound is generally recommended because it is a non-invasive, inexpensive method that does not use ionizing radiation, making it ideal for initial evaluation, including for detecting these abnormalities during the prenatal stage. Some findings that may raise suspicion of a double collecting system are renal duplications, renal asymmetry, abnormalities in the contour, pyelocaliceal dilatation of the upper or lower calyx, and it is even possible to detect ureteroceles (2). Retrograde voiding cystourethrography is mainly indicated in pediatric patients when there are recurrent urinary tract infections and vesicoureteral reflux is suspected. It can suggest or diagnose a double collecting system and ureteroceles. Its main disadvantage is the use of ionizing radiation and the need for a negative urine culture prior to the study, in order to prevent ascending urinary tract infections (2).

Excretory urography is another imaging method that may be indicated for the detection of double collecting systems and their complications; however, it has now been replaced by other more accurate diagnostic methods (2). Contrast-enhanced urography is a widely available method with sensitivity and specificity close to 100% in detecting any abnormality affecting the urinary tract. However, due to its high radiation dose, resulting from the multiple phases required, it is rarely indicated in children. However, split-bolus techniques are now available that significantly reduce the radiation dose to the patient without affecting spatial resolution or diagnostic quality, making it one of the most widely used methods for studying the various pathologies affecting the urinary tract (1, 2, 9, 11-13). Magnetic resonance urography, on the other hand, is a technique that does not use ionizing radiation, making it one of the preferred diagnostic methods in pediatrics for the evaluation of anatomical abnormalities of the urinary tract. It can even provide data on renal function similar to that obtained with nuclear medicine. Sequences that enhance fluid, such as T2-weighted images, help to determine the anatomy of the excretory system with great precision. Unfortunately, it is an expensive imaging method, less accessible, and requires more time to perform when compared to contrast-enhanced urography (2, 9, 10).

Conclusion

The double collecting system is a common and generally asymptomatic anomaly, although in some cases it may be associated with complications such as recurrent urinary tract infection, incontinence, and loss of renal function. Its recognition requires embryological understanding, clinical suspicion, and imaging findings such as alterations in renal length, asymmetric dilation of the collecting system, decreased parenchymal thickness, and ureterocele. Renal ultrasound is the initial study, useful even in the prenatal stage, but definitive diagnosis and evaluation of complications are achieved with advanced methods such as urography and uro-MRI. In the cases analyzed, urography was essential for detecting complications associated with the double collecting system.

References

1. Houat AP, Guimarães C, Takahashi M, Rodi G, Gasparetto T, Blasbalg R, et al. Congenital anomalies of the upper urinary tract: A comprehensive review. Radiographics. 2021;41(2):462-86. https://doi.org/10.1148/rg.2021200078
2. Didier R, Chow J, Kwatra N, Retik A, Lebowitz R.. The duplicated collecting system of the urinary tract: embryology, imaging appearances and clinical considerations. Pediatr Radiol. 2017;47(11):1526-38. https://doi.org/10.1007/s00247-017-3904-z
3. Fernbach SK, Feinstein KA, Spencer K, Lindstrom CA. Ureteral duplication and its complications. Radiographics. 1997;17(1):109-27. https://doi.org/10.1148/radiographics.17.1.9017803

4. Privett JT, Jeans WD, Roylance J. The incidence and importance of renal duplication. Clin Radiol. 1976;27(4):521-30. https://doi.org/10.1016/s0009-9260(76)80121-3
5. Amis ES Jr, Cronan JJ, Pfister RC. Lower moiety hydronephrosis in duplicated kidneys. Urology. 1985;26(1):82-8. https://doi.org/10.1016/0090-4295(85)90268-7
6. Rehder P, Petersen J, Hofmann KJ, Schenk C, Trieb T, Glodny B. Yo-yo reflux in an incomplete duplex system causing severe hydronephrosis in a patient with contralateral renal agenesis. Ren Fail. 2008;30(8):818-21. https://doi.org/10.1080/08860220802272605
7. Yonli DS, Chakroun M, Zaghbib S, Ye D, Bouzouita A, Derouiche A, Ben Slama MR et al. Bilateral duplex collecting system with bilateral vesicoureteral reflux: a case report. J Med Case Rep. 2019;13(1):128. https://doi.org/10.1186/s13256-019-2058-z
8. Chionardes MA, Kurniawan Liemarto A, Gunardi SL. Unilateral duplicated collecting system and ureter with severe hydroureteronephrosis and ectopic ureter insertion of upper pole moiety: A case report. Ann Med Surg. 2012;74:103255. https://doi.org/10.1016/j.amsu.2022.103255
9. Surabhi V, Menias C, George V, Matta E, Kaza R, Hasapes J. MDCT and MR urogram spectrum of congenital anomalies of the kidney and urinary tract diagnosed in adulthood. AJR. Am J Roentgenol. 2015;205(3):W294-304. https://doi.org/10.2214/AJR.14.12867
10. Melkamu A, Darge K, Dillman JR, Carr M, Epelman M. Magnetic resonance urography in evaluation of duplicated renal collecting systems. Magn Reson Imaging Clin N Am. 2013;21(4):717-30. https://doi.org/10.1016/j.mric.2013.04.002
11. Potenta SE, D'Agostino R, Sternberg KM, Tatsumi K, Perusse K. CT urography for evaluation of the ureter. Radiographics. 2015;35(3):709-26. https://doi.org/10.1148/rg.2015140209
12. Cheng K, Cassidy F, Aganovic L, Taddonio M, Vahdat N. CT urography: how to optimize the technique. Abdom Radiol (NY). 2019;44(12):3786-99. https://doi.org/10.1007/s00261-019-02111-2
13. Kawashima A, Vrtiska TJ, LeRoy AJ, Hartman RP, McCollough CH, King BF Jr. CT urography. Radiographics. 2004;24(Suppl 1):S35-54; discussion S55-8. https://doi.org/10.1148/rg.24si045513

Correspondence

Johan Sebastián Ramos Marín
Hospital Universitario Erasmo Meoz
Av. 11E # 5AN-71, Barrio Guaimaral
Cúcuta, Norte de Santander, Colombia
sebastian8912031@gmail.com

Received for evaluation: January 23, 2024
Accepted for publication: March 23, 2024