CASE REPORT

Retroaortic Left Renal Vein: Three Case Reports

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A left renal vein passing behind the abdominal aorta is termed a retroaortic left renal vein (RLRV). RLRV is a relatively uncommon congenital anomaly. It has been suggested the RLRV can sometimes cause symptoms such as hematuria and abdominal/flank pain. We report three patients with this anomaly: one case of type I RLRV and two cases of type III RLRV. Abdominal pain, flank pain, fever and hematuria were the major symptoms and signs in our cases. The urological symptoms were probably due to the increased pressure of the LRV, secondary to posterior nutcracker phenomenon. RLRV can be easily diagnosed by using ultrasound, computed tomography or magnetic resonance imaging; however, ultrasound is the most convenient imaging modality.

Introduction

Anatomical variations and congenital anomalies of renal veins have been described by Gillot and Bergman et al [1,2]. Among many variations of the left renal vein, the retroaortic course is much less well known [1]. A retroaortic left renal vein (RLRV) is located between the aorta and the lumbar vertebrae and drains into the inferior vena cava (IVC) or left common iliac vein [3]. The incidence of RLRV has been reported from 0.5% to 3.6% [3–6]. RLRVs are classified into four types according to their drainage site: (1) RLRV joining the IVC in the orthotopic position; (2) RLRV joining the IVC at the level of L4–5; (3) circumaortic or collar LRV, containing both anterior and retroaortic LRVs; and (4) RLRV joining the left common iliac vein. The most common urological symptom of RLRV is hematuria [3]. The major etiology of urological symptoms is compression of the LRV between the abdominal aorta and vertebrae; the so-called posterior nutcracker phenomenon (NP). Computed tomography (CT), magnetic resonance imaging (MRI) and ultrasound are effective for detection of this congenital anomaly. Noninvasive sonography is routinely used for patients with symptoms of hematuria, urinary tract infection or flank pain. To establish the existence of RLRV is

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important before left renal surgery or other interventional procedures.

**Case reports**

**Case 1**

A 22-year-old man visited the emergency department due to epigastric pain. There was no chill or fever. The laboratory study showed a high white blood cell count (14,170/\mu L) and microhematuria. Gastroscopy revealed mild superficial gastritis. Sonography and CT scan of the abdomen showed a type I RLRV, that is, the LRV was located between the abdominal aorta and the vertebral body (Fig. 1).

**Case 2**

A 33-year-old woman was admitted via the emergency department due to chills, fever and bilateral flank pain for several days. Laboratory study showed hematuria and bacteriuria. Frequency and urinary tract infection were present. Abdominal contrast-enhanced CT showed a focal hypodense area in the right renal parenchyma, representing focal infarction or focal bacterial nephritis. An ectopic left kidney at the left lower retroperitoneum, with rotation of the renal axis, was also noted. A type III RLRV was identified on both CT and sonography (Fig. 2).

**Case 3**

An 88-year-old woman visited the emergency department due to fever and abdominal pain. Laboratory data revealed microhematuria and high C-reactive protein level (1.895 mg/dL). Abdominal CT showed a type III RLRV (Fig. 3).

**Discussion**

During development of the IVC there are anastomotic communications between subcardinal and supracardinal channels, which form a collar of veins encircling the aorta [3]. The ventral portion of the circumaortic collar persists as the normal LRV. If the dorsal portion of this collar persists, the LRV is posterior to the aorta, forming an RLRV [3]. Congenital anomalies of the LRV are classified into four types. In type I anomaly, the ventral preaortic limb of the LRV is obliterated, but the dorsal retroaortic limb persists and joins the IVC in the orthotopic position. Type II anomaly results from obliteration of the ventral limb of the LRV, and the dorsal limb turns into the RLRV and lies at the level of L4–5 and joins the gonadal and ascending lumbar veins before joining the IVC. Type III anomaly is the circumaortic LRV. In type IV anomaly, the ventral preaortic limb of the LRV is obliterated, and the remaining dorsal limb becomes the RLRV and joins the left common iliac vein [3,7]. On CT cross-sections of type IV RLRV, scans between the right renal vein and bifurcation of the IVC might mimic the images of a double IVC. However, the left IVC typically ends at a normal LRV, which crosses anterior to the aorta in the normal fashion to join the right IVC. Furthermore, the left
and right common iliac veins do not fuse in congenital double IVC, but do so in type IV RLRV. The most common type of RLRV is type I [7].

NP is also known as LRV entrapment, and refers to compression of the LRV, most commonly between the aorta and the superior mesenteric artery (SMA), with impaired blood outflow often accompanied by distention of the distal portion of the vein [8]. Compression of the LRV between the abdominal aorta and the SMA was first described in 1950 by El and Mina [9]. The most typical nutcracker morphological features imply compression of the LRV between the aorta and SMA, which is known as anterior nutcracker. Compression of the LRV between normal anatomical structures is also called NP [3,8–11]. The retroaortic or circumaortic renal vein may be compressed between the aorta and the vertebral body, which is called posterior nutcracker [8,12]. The clinical features of NP or posterior NP vary from asymptomatic microhematuria to severe pelvic congestion [8].

There are many urological symptoms and signs that are caused by the increased renal vein pressure due to compression. Symptoms are often aggravated by physical activity, and commonly include hematuria, pain (as part of gonadal vein syndrome), varicocele, proteinuria, and orthostatic intolerance [8]. Hematuria is the most common symptom and is due to rupture of thin-wall varices into the collecting system, secondary to elevated venous pressure [8–10]. Pain is the next most common symptom [8,10]. It is sometimes described as part of the gonadal vein syndrome, which is characterized by abdominal or flank pain that occasionally radiates to the posteromedial thigh and buttock [8]. Varicocele is also a common finding of high renal vein pressure, and the incidence of RLRV is significantly higher in patients with varicocele compared with controls [5,11,13,14]. In venous reflux with formation of collaterals, NP or posterior NP may become a cause of pelvic congestion. In these cases, chronic pelvic pain might

![Fig. 2](image_url) Type III RLRV. (A) Contrast-enhanced computed tomography revealed a normal LRV (arrow) between the abdominal aorta and superior mesenteric artery. (B) A focal hypodense area in the right renal parenchyma was seen, either due to septic emboli or focal bacterial nephritis (arrow). (C) Another LRV (large arrow) was located posterior to the abdominal aorta. The left kidney was ectopic with rotation of the axis (small arrow). (D) Sonography identified a normal anterior LRV (arrow). (E) Another LRV posterior to the abdominal aorta was evident (arrow). (F) Color Doppler sonography showed an RLRV with focal luminal narrowing (arrow). RLRV = retroaortic left renal vein.

![Fig. 3](image_url) Type III RLRV. (A) A normal LRV (arrow) between the abdominal aorta and superior mesenteric artery. (B) Another LRV (arrow) between the abdominal aorta and vertebrae. RLRV = retroaortic left renal vein.
be associated with dyspareunia, dysuria, dysmenorrhea, and polycystic changes in the ovaries [8]. The frequency of urological symptoms is highest in type II RLRV [3]. In our cases, abdominal pain, flank pain, urinary tract infection and hematuria were the major findings, and all the symptoms and signs might have been due to high pressure of the venous return of the LRV. In our sonography examination, focal narrowing of RLRV was noted in the prevertebral area, which might be compatible with the diagnosis of posterior NP.

The diagnostic methods for detecting LRV anomalies include renal venography, color Doppler ultrasound, CT angiography, and MRI. CT scan, especially multidetector CT (MDCT) angiography, might be the most effective and precise method. More detail about this type of anomaly is demonstrated by MDCT [3,6,12]. However, initially, for routinely evaluating the possibility of RLRV in symptomatic patients, ultrasound might be more suitable due to the real-time study, noninvasive and nonradiative procedure, lower cost, high accuracy, and ease of access. The first step of ultrasound evaluation of RLRV is to identify a normal LRV that crosses anterior to the abdominal aorta and joins the IVC. If a normal LRV is not seen, then any type of RLRV might be present. A normal LRV is present in type III RLRV; therefore, to find an RLRV is the second step. Further investigations, such as MDCT or MRA, are required to understand better the LRV anomalies if any type of RLRV is suspected at ultrasound screening.

In conclusion, RLRV is usually asymptomatic. It may sometimes cause hematuria, flank pain, varicocele and abdominal pain. The most common type of RLRV is type I and the frequency of urological symptoms is highest in type II [3,7]. It is important to establish the presence of RLRV if venous renin sampling is to be performed or any surgical procedure is indicated in this region [1,3]. The abnormality could be easily identified by CT, MRI and conveniently recognized by ultrasound. Color Doppler ultrasound is the best modality for detecting this anomaly due to its special characteristics, and convenience is the most important.

References