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## Retro-Aortic Left Renal Vein

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**Retro-Aortic Left Renal Vein**

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The term retro-aortic left renal vein (RLRV) is defined as the left renal vein coursing posterior to the abdominal aorta. RLRV is an uncommon condition in which the left renal vein passes posterior to the abdominal aorta and anterior to the vertebrae. RLRV may lead to left renal vein hypertension (LRVH) syndrome, which is also known as Nutcracker syndrome. Nutcracker syndrome (NCS) is a condition in which the left renal vein is compressed causing hypertension of the vessel. RLRV and Nutcracker syndrome are vascular anomalies considered to be of clinical importance especially during surgical procedures of the renal vasculature.

Keywords

retro-aortic, left renal vein, Nutcracker syndrome, hypertension

The development of the left renal vein coincides with the development of the Inferior Vena Cava. The left renal vein arises from the left kidney to eventually drain into the IVC. The IVC is formed from three pairs of veins including the posterior cardinal veins, the subcardinal veins, and the supracardinal veins. [3] The subcardinal and supracardinal veins anastomose to form a network of veins that course

along the ventral and dorsal aspect of the abdominal aorta. [3] Typically, the ventral portion of the network continues as the dorsal network deteriorates, causing the ventral network to form the left renal vein coursing anterior to the abdominal aorta (Figure 1). If the dorsal network continues, then the ventral portion deteriorates and the left renal vein passes posterior to the abdominal aorta (Figure 2). When the left renal vein courses posterior to the aorta it is referred to as retro-aortic left renal vein (Figure 3). Occasionally, there may be a duplication of the left renal vein in which the vessel passes both anteriorly and posteriorly to the aorta to drain into IVC.

Left renal vein hypertension syndrome, also known as Nutcracker Syndrome, was described by Grant: "the left renal vein as it lies between the aorta and the superior mesenteric artery resembles a nut between the jaws of a nutcracker". [7] Nutcracker syndrome is defined as compression of the left renal vein leading to hypertension of the vessel. There are two forms of NCS including the anterior nutcracker phenomenon and the posterior nutcracker phenomenon. [5] Anterior NCS describes hypertension of LRV due to compression of the vein between the superior mesenteric artery and the abdominal aorta. Posterior NCS refers to hypertension of the LRV due to compression of the vein between the abdominal aorta and the vertebral column.

Nutcracker syndrome may present with left flank and/or abdominal pain and hematuria (macroscopic or microscopic). The key symptom in detecting posterior NCS is hematuria. In females, LRVH may present as Pelvic Congestion Syndrome which is characterized by lower abdominal pain, dysmenorrhea, emotional distress, or varices of the lower limbs. In males, compression of the left renal vein may cause reflux between the left renal and gonadal veins resulting in varices of the lower limbs. [6]

The etiology of Nutcracker syndrome has not yet been medically proven. However, several factors may be of cause for the disorder including inadequate stretching of the left renal vein or abnormal branching of the SMA. [7] Normally, the SMA originates from the aorta at a 90 degree angle and travels about 4-5mm before taking a caudal descent, which typically avoids compression of the LRV. However,

in the case of NCS the SMA branches from the aorta at an acute angle, immediately descending caudal to the vessel which increases the risk of compression of the LRV. [7]

There are several methods that can be used to diagnose compression of the left renal vein. It is important to know and remember that compression of the left renal vein is increased if the patient is in a standing position due to the weight of the bowel. Therefore, compression of the vein may not be accurately diagnosed with exams that require the patient to be in an upright or decubitus position. Duplex ultrasound is a useful method that demonstrates both color and spectral Doppler to detect compression of the left renal vein (Figure 4). Duplex scanning is used to detect anomalies of the LRV including stenosis, flow abnormalities, or collateral pathways. [2] Evaluation of a stenosis would include the comparison between the anteroposterior diameter of LRV to the left of the aorta before draining into the IVC and at the level of the stenosis. Flow abnormalities would be evaluated by calculating the peak systolic velocity at the level of the stenosis and within the hilum of the left kidney. The main collateral pathway of the LRV is the gonadal vein which should be carefully evaluated and measured. [2] Duplex scanning is also used to evaluate the SMA to ensure its location, angle, and the distance between the SMA and the aorta at the level of the LRV. Computed tomography angiography (CTA) and magnetic resonance angiography (MRA) are also useful methods in detecting compression of the LRV because they both show the LRV and reveal its relation to other structures and organs surrounding it. Phlebography and pressure measurements can also be used to evaluate compression of the LRV. [2]

Treatment of Nutcracker syndrome depends upon the severity of the disorder. Patients may be asymptomatic which would result in conservative treatment. Patients with severe or ongoing symptoms may undergo various surgical procedures to reduce compression including left renal vein transposition, renal autotransplantation, or stenting of the left renal vein. [2] Transposition of the left renal vein involves dividing the left renal vein as it intersects the IVC. The LRV is re-positioned to a lower level than its initial junction with the IVC. [8] Renal autotransplantation involves the anastomosis of the left renal vein and artery to the common iliac vein and artery. It is an invasive procedure in which a kidney is removed

from its original origin, repaired, and then transplanted to another location within the body. Typically, the kidney is transplanted into the iliac fossa by attaching the renal vein and artery to the common iliac vein and artery. [4] Stenting of the left renal vein is used to reduce compression of the vein and eliminate symptoms. A balloon angioplasty is typically performed after the stent is inserted to dilate the vein and decrease the pressure gradient within the vessel. (1)

Renal vein anomalies can influence the effects of retroperitoneal surgery. Severe hemorrhage and/or renal failure can result in failure to detect renal vein anomalies prior to surgical procedures. [6] The left renal vein is longer than the right renal vein because it travels a longer distance to drain into the IVC, which is anatomically located on the right (Figure 5). Due to the longer length of the left renal vein, surgeons prefer the left over the right renal vein with renal transplantations. This is a crucial reason for why it is important to know whether the left renal vein passes anterior to the aorta or whether it is retro-aortic. It is always useful to look up clinical history prior to surgery to avoid venous and organ damage, or even death.

The left renal vein generally courses anterior to the abdominal aorta. There are instances when the left renal vein takes a different path, traveling posterior to the aorta. Retro-aortic left renal vein is an anomaly of the renal vein that may cause damage to the vessel. RLRV can lead to Nutcracker syndrome which results in venous hypertension. This anomaly is relatively uncommon and most patients are asymptomatic. It is crucial to identify the course of the left renal vein so that surgical procedures of the vessel can be accurately performed. Anomalies of the renal vein are frequently overlooked but with appropriate testing and imaging, abnormalities can be detected and properly maintained.

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