

# Imaging of Type I Retroaortic Left Renal Vein & Nutcracker Syndrome

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## INTRODUCTION

Renal veins development derives from the articulate developmental process of the inferior vena cava (IVC), between the fourth and eighth week of conception.

The IVC itself derives from a three pairs of veins, which are parallel and are called, in order of appearance, the posterior cardinal veins, the sub-cardinal and supra-cardinal veins [1,2]. Supra and sub-cardinal veins are, between the fourth and eighth week of conception, in communication through anastomoses which basically encircle the aorta as a collar.

The normal left renal vein arises from the ventral arch of this circumaortic collar; a retroaortic left renal vein (RLRV) is then formed when the dorsal portion of the circumaortic collar persists and the ventral limb obliterates, creating a posterior vein.

The anomalies of the left renal vein can be divided into 4 different types [3,4]:

- I. RLRV originating from the obliteration of the ventral preaortic limb, joining the IVC in the orthotopic position - the incidence of type I RLRV is 0.3-1-9% [5,6];
- II. RLRV originating from the obliteration of the ventral preaortic limb, joining the IVC at the level of L4-L5, after joining the gonadal and ascending lumbar veins - the incidence of type II RLRV is 0.4-0.9%[7,8];
- III. RLRV originating from a circumaortic arch or collar, created by the persistence of subsupracardial and intersupracardial anastomoses and the dorsal limb of the left renal vein - the incidence of type III RLRV is 1.5-8.7% [5, 9], but can reach 16% if all small retroaortic veins that drain into the IVC are considered [10,11,12,13];

IV. RLRV originating from the obliteration of the ventral preaortic limb, joining the left common iliac vein, after coursing caudally and obliquely behind the aorta - the incidence of type IV RLRV is 0.16% [12].

This often overlooked, but no so rare anatomic anomaly might cause a few aspecific symptoms and signs, especially flank or inguinal pain, microscopic or even gross hematuria; in the vast majority of cases it is, thought, totally asymptomatic.

The nutcracker syndrome that might arise in the case of RLRV is mainly due to the reduced space between aorta and the vertebral body and the consequent compression on the venal rein; this might in turn cause upstream hypertension, hematuria, varicocele, pain.

The compression of RLRV leads to hematuria because of renal venous hypertension, consequent left renal congestion [14]. Gonadal, ascending lumbar, adrenal, ureteral, and capsular veins are well known potential collateral venous pathway, when the left renal vein is compressed or obstructed and might be directly responsible for hematuria.

This upstream venous congestion might result, in some cases, in left-sided varicocele in men and pelvic congestion syndrome in women [15].

In the case of kidney surgery, the presence of RLRV might influence the actual technical feasibility of the procedure; if not preventively recognised and know, the presence of RLRV might cause severe hemorrhage and/or renal damage [16].

## IMAGING

From a radiologic point of view, considering that CECT has now become the main tool for a prompt diagnosis of the condition, which was once only observed at autopsy or, incidentally, during angiography, it is of utmost important to detect the anomaly, recognising the specific type and duly reporting it, both because of the symptoms and conditions that may arise from it and the possible complications and potential fatal haemorrhage in the case of left kidney surgery [4].

In our pictorial essay, we will discuss as an example the case of a 52-year old man with left flank pain and macroscopic hematuria, initially referred for a CT-KUB for a suspected acute renal colic. Images were acquired using a tri-phasic protocol after the infusion of 100 ml of iodinated contrast, at a speed of 3.5 ml/s.

Figure 1 clearly depicts a type I RLRV, draining into the IVC after coursing behind the aorta. The space formed by the aorta and the lumbar vertebra, through which the RLRV passes, is just 8 mms wide. This very narrow space created by the spine and the aorta is the



Figure 1. Left renal vein draining into the inferior vena cava, after coursing behind the aorta. The space between the aorta and the lumbar vertebra is just 8 mm wide.

main cause of the 'nutcracker' mechanism and syndrome. This vascular stricture causes, in



Figure 2. Engorged, ectatic RLRV course, due to the 'nutcracker' mechanism caused by the abnormal, retroaortic course of the left renal vein, through a very small space.



**Figure 3. Retroaortic course of the left renal vein as seen from behind in a 3D reconstruction.**

turn, RLRV engorgement and lumen dilation, as seen in Figures 2 and 3; in this case, there is no involvement of lumbar or gonadic vessels.

## CONCLUSIONS

RLRV is a relatively common anatomic variant, usually not presenting with clinical consequences. However, in a few cases it may be the cause of otherwise unexplained hematuria, gross or microscopic, flank pain, varicocele or pelvic engorgement syndromes; in patients with planned kidney surgery, the presence of RLRV has to be clearly stated, because of possible technical difficulties or surgical/postsurgical complications.

That is why, from a radiologic point of view, the presence of RLRV and the precise reporting its subtypes is mandatory.

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