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Incidence of retro-aortic left renal vein and its relationship with varicocele

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Abstract The retro-aortic left renal vein (RLRV) is a malformation characterized by the presence of a vessel that drains the left renal blood up to the inferior vena cava crossing behind the aortic artery. Varicocele is defined as venous dilation of the pampiniform plexus, and the left side is the most commonly affected. Several theories concerning the possible aetiology of varicocele are reviewed in the literature, but RLRV was not mentioned as an aetiologic factor of varicocele. in this study we investigated the percentage of RLRVs and their relation with varicocele. A total of 1,125 contrast-enhanced abdominal CT scans was examined to identify RLRVs. RLRVs were found in nine women (1.6%) and ten men (1.7%). We performed scrotal Doppler ultrasonography (US) for all affected men except one. Varicocele of varying degrees was found in seven of the nine male patients with RLRV (77%). RLRV could be one of the aetiological factors in the development of varicocele, and the cases with RLRV should be examined by scrotal Doppler US for the presence of varicocele.

Keywords Retro-aortic left renal vein · Varicocele · CT

Introduction

The highly complex embryological development of the left renal vein (LRV) results in greater and more clinically significant variations than in its right counterpart. The retro-aortic left renal vein (RLRV) is a malformation characterized by the presence of a vessel that drains the left renal blood up to the inferior vena cava (IVC) crossing behind the aortic artery. RLRV is a relatively frequent venous variation with a reported incidence of 0.5%–3.7% [1–5].

Varicocele is defined as the venous dilation of the pampiniform plexus. It has been reported that 15% of married couples are infertile, and varicocele is supposed to be responsible for 20%–40% of the cases, making it one of the most common surgically correctable causes of infertility [6]. Some aetiological factors have been suggested, such as valvular incompetency in the internal spermatic vein and hydrostatic over-pressure of the LRV. Mostly, the left side is affected, since these veins drain into the renal vein at a right angle [6, 7]. RLRV has not been considered as a possible aetiological factor to date, and we did not encounter any previous study on the subject.

The purpose of the study was to estimate the prevalence of RLRV in an adult population by abdominal computed tomography (CT) and the rate of varicocele in the affected men.

Materials and methods

Between February 2003 and May 2004 abdominal CT images of 1,125 consecutive patients were examined for the presence of RLRV. The indications from CT examinations were of a large spectrum of abdominal complaints. All CT data were obtained with a four-channel multi-detector row CT scanner (Somatom Sensation 4, Siemens Medical Systems, Erlangen, Germany). CT scans were performed in venous phase while the patients held their breath, after the intravenous administration of 100 ml non-ionic contrast medium at a flow rate of 2.5 ml/s and a 70 s delay time. The acquisition time was 15–20 s. The parameters included a detector array of 2.5×4 mm, slice thickness of 3 mm, a table speed of 12.5 mm per rotation and a reconstruction increment of 2.5 mm at 367 mA, and 120 kVp.

The male patients with RLRV were examined by scrotal Doppler ultrasonography (US) for the presence of varicocele after informed consent had been obtained. Doppler US was performed with a 7.5 mHz superficial linear-array probe (Toshiba SSA-270 A, Tokyo, Japan). All were performed by the same radiologist while the patients were in upright and supine positions, and also by Valsalva manoeuvre. Classical criteria for varicocele were applied in the diagnosis i.e. a venous diameter of plexus pampiniformis larger than 2 mm and reverse flow duration of more than 1 s on Valsalva's manoeuvre on spectral Doppler analysis, regardless of amplitude in the same vein [8].

Results

Of the 1,125 patients (573 men and 552 women), a RLRV was found in nine women (1.6%) and ten men (1.7%). Mean age of the male patients with varicocele was 43.5±1.8 years. One of the male patients refused Doppler US, and of the remaining nine men, seven (77%) were diagnosed with varicocele by Doppler US (Fig. 1). The varicocele was left-sided in four patients and bilateral in three. In the left-sided varicocele the venous diameter was 2–3 mm in two cases and 3–4 mm in the other two. In the bilateral varicocele, the venous diameter was 2–3 mm in one case, 3–4 mm in one and over 4 mm in another, on the left side, and 2–3 mm in one case, 3–4 mm in two, on the right side (Table 1). A significant association was found between the RLRV and varicocele.

Table 1 Distribution and score of varicocele in patients with RLRV

Varicocele	Patients									
	1	2	3	4	5	6	7	8	9	10
Left	+	+	-	++	-	+	*	++	+++	++
Right	-	-	-	-	-	+	*	++	++	-

+ 2–3 mm, ++ 3–4 mm, +++ 4 mm or more than 4 mm
*Refused US

Discussion

After the development of cross-sectional imaging, congenital anomalies of the IVC and its tributaries have become more frequently identified in asymptomatic patients. Vascular structures can readily be identified on contrast-enhanced CT scans of the abdomen. Three-dimensional ultrasound enables one to determine the course of renal vessels and anatomical relationships [9]. Venous variations are frequently encountered, and one of the important variations is the RLRV. These are frequently observed as three types. In the first type the ventral pre-aortic limb of the LRV is obliterated, but the dorsal retro-aortic limb persists and joins the IVC in an orthotopic position. In type II, the ventral pre-aortic limb of the LRV is obliterated, and the remaining dorsal limb becomes retro-aortic. However, this lies lower, often at the level of L4–L5, and joins the gonadal and ascending lumbar veins before joining the IVC. The third

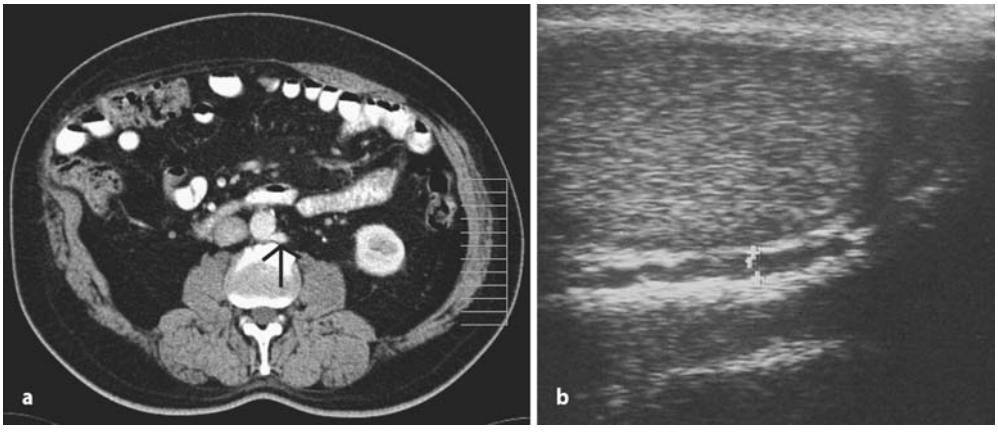

Fig. 1 RLRV in a 35-year-old man. **a** CT scan shows the left renal vein (*arrow*) descending to cross the posterior to the aorta. **b** Colour Doppler US image shows varicocele

group of congenital venous abnormalities is the circumaortic LRV or venous collar. This type is due to the persistence of the supracardinal and intersupracardinal anastomoses and the dorsal limb of the LRV [10]. RLRV was reported as having an incidence of 0.5%–3.7% [1–5, 10]. Our result is similar to these ratios, which were 1.7% in men and 1.6% in women. There was no difference in incidence of RLRV with regard to gender. All our patients had type 1 RLRV, and neither type 2 nor circumaortic renal veins was detected in our study.

There are numerous studies in the literature, which implies the clinical significance of RLRV and, especially, the underlying importance of preoperative recognition of the anomaly [11, 12–14]. Other reported clinical entities that are related to the RLRV are haematuria, pain, thrombosis and left renal vein hypertension because of the pullback pressure [15–20]. None of these studies proposed a relationship between varicocele and RLRV except one, which was performed with retrograde phlebograms of the left testicular vein [21].

Approximately one-third of infertile men have varicocele, while the incidence among the male general public is approximately 15% [22]. However, we found that the incidence of varicocele is 77% in the cases with RLRV in our study. The presence of RLRV considerably increased the rate of RLRV, which suggests an aetiological link in-between. In fact, the pathophysiology of varicocele is still unknown in great part. Several current theories are suggested as the possible aetiology. Increased blood flow, causing an elevated intratesticular temperature, is one of them [23, 24]. The other is elongated left spermatic vein with right-angle insertion into the LRV and/or absence of valves, which results in a higher hydrostatic pressure in the left spermatic vein and subsequent dilatation. The possibility of arterial compression of the left renal vein, probably by the superior mesenteric artery—the nutcracker phenomenon or aorto-mesenteric left renal vein entrapment syndrome—is another suggested mechanism. This results in left renal venous hypertension, which leads to varicocele. The third part of the duodenum may also add to the pincer effect on the LRV [17–20, 25]. Varicocele occurs in the left hemiscrotum in most of the cases. The reason for the left-side predominance may be explained anatomically. The left spermatic vein is one of the longest veins in the body, entering the left renal vein at a perpendicular angle. The intravascular pressure in the left renal vein is higher than that on the right, as it is compressed between the aorta and the superior mesenteric artery. This phenomenon causes increased pressure in the left gonadal vein, which can dilate and cause incompetence of the valve leaflets, leading to retrograde flow of blood toward the testis in the erect position. Among all these, the most commonly accepted mechanism is the elevated hydrostatic pressure of the left renal and spermatic veins. RLRV probably causes a higher pressure in the spermatic vein and dilated pampiniform plexus.

There are some limitations to our study. First of all, the left spermatic vein could be drained by another vein, such as the IVC or the iliac vein, other than the left renal vein. We could not assess all the patients in terms of drainage, and we accepted that all spermatic veins drain to the left renal vein. Secondly, most of the patients had various abdominal pathological conditions, such as malignancy and other serious diseases. All these diseases can cause a high intra-abdominal pressure that affects the different vascular systems, which may interfere with the spermatic vein pressure and lead to varicocele. Another disadvantage is that the number of patients in our study group was relatively small for a disease with that incidence. For these reasons, a larger group, consisting of normal cases without any abdominal pathological conditions and cases with verified drainage to the renal vein, should be studied for further determination of the relationship between RLRV and varicocele. One of the important problems in our result is right-side varicocele, which could not explain with RLRV. These three patients were older than 60 years. The long-term high pressure of the left side could have affected the right side as well, or some other unidentified pathological condition might have played a role.

In conclusion, we suggest that RLRV may be one of the possible reasons for varicocele. Abdominal contrast-enhanced CT is useful and essential for establishment of the presence RLRV, and it should be taken into consideration for assessment of the abdominal radiological examination. The RLRV should be noticed in the abdominal CT report. Men with RLRV should be examined by scrotal Doppler US for varicocele.

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