Computed tomography findings in 10 cases of iliac vein compression (May–Thurner) syndrome

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Abstract

Objective: To present the computed tomography (CT) findings for the iliac veins of 10 patients who had left-sided lower extremity deep vein thrombosis due to iliac vein compression syndrome.

Materials and methods: The CT findings for 10 cases of left-sided acute or chronic deep vein thrombosis caused by iliac vein compression syndrome were retrospectively evaluated. The patients were five women and five men (mean age ± S.D., 49.9 ± 15.6 years). In each patient with iliac vein compression syndrome, the diagnosis of the compression was established by venography performed during endovascular treatment. Diameter of the left common iliac vein was also measured in 14 control subjects without any lower extremity venous disease for comparison.

Results: In all 10 cases, CT images in the transverse plane demonstrated the left common iliac vein being compressed by the overlying right common iliac artery. The mean diameter at the origin of the left common iliac vein (3.5 mm) in patients group was much smaller than the mean diameter of the same vein (11.5 mm) in the control group (p < 0.01). The mean percent stenosis of the left common iliac vein due to compression by the artery was 68%.

Conclusion: Pelvic CT images in the transverse plane are useful for detecting iliac vein compression by the overlying right common iliac artery in patients with left-sided deep vein thrombosis. Radiologists should be aware of this imaging finding of iliac vein compression by the artery where the inferior vena cava bifurcates into the common iliac veins.

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1. Introduction

Iliac vein compression syndrome (IVCS, also known as May–Thurner syndrome) is symptomatic compression of the left common iliac vein between the overlying right common iliac artery and the lumbar vertebrae. This syndrome was first noticed by Virchow in 1851, and was explained later through detailed anatomic dissections and histological studies performed by May and Thurner [1,2]. Iliac vein compression syndrome occurs predominantly in young to middle-aged women, and DVT is three to eight times more frequent on the left than on the right [1–3]. In the past, IVCS was thought to be rare, but the frequency of this condition has risen with the emergence of catheter-directed endovascular treatment of lower extremity DVT [4]. The likely reason for this is better visualization of the iliac veins with venography studies performed via vascular sheaths placed in more central veins. The reported prevalence rates of IVCS in patients with left-sided lower extremity DVT range from 18 to 49% [5,6].

Until recently, computed tomography (CT) findings of IVCS had been reported in only a few cases. However, a report published in 2004 describes the detection of iliac vein...
compression by CT venography in 27 of 44 patients with left-sided lower extremity DVT [7]. In this study, we present the CT findings for 10 patients with IVCS. In all cases, the diagnosis was confirmed by venography performed during catheter-directed endovascular treatment.

2. Materials and methods

We retrospectively analyzed the pelvic CT findings for 10 patients with IVCS (five women and five men; mean age ± S.D., 49.9 ± 15.6 years; age range, 25–77 years), all of whom had DVT. The thrombosis was acute (≤4 weeks) in three cases, chronic (>4 weeks) in five cases, and acute superimposed on chronic in two cases. All the patients had one or more short- or long-term complaints of leg swelling, venous claudication, and/or varicose veins. All 10 individuals were initially diagnosed with acute or chronic DVT on the basis of clinical findings and color Doppler ultrasound (CDUS) findings. The latter revealed DVT in all cases; however, no iliac vein compression was detected on CDUS. All 10 patients underwent catheter-directed endovascular treatment. Venography examination performed via the vascular sheath in the ipsilateral femoral or popliteal vein during endovascular treatment was considered the reference standard for diagnosis of iliac vein compression. Fourteen subjects (seven women and seven men; age range 26–67; mean age, 51.3) who were referred for a CT examination unrelated to any venous disease or any disease that could influence patency of the abdominal veins were selected as control group.

Each CT study was performed with a four-detector CT scanner (Sensation 4, Siemens, Erlangen, Germany). Seven patients underwent CT to exclude a pelvic mass or to define the limit of DVT extension into the iliac veins. The other three underwent CT for investigation of central vein stenosis and planning of endovascular treatment. In the aforementioned seven cases, the protocol for CT was scanning with 5 mm X-ray collimation and 5 mm reconstruction interval during the venous phase after infusion of 120 ml of non-ionic contrast medium (Ultravist, Schering, Berlin, Germany). Collimation was 1–3 mm in the remaining three cases. Five of the 10 patients also underwent preliminary pelvic CT without contrast injection. Computed tomography examination of all control subjects were performed with 5 mm collimation and 2.5 or 5 mm reconstruction interval during the venous phase after infusion of 120 ml of non-ionic contrast material.

In each CT study, the examiner assessed for compression of the left common iliac vein with scanning in the transverse plane. The anteroposterior diameter of the left common iliac vein was measured at its origin. Tortuosity or calcification of the distal aorta and iliac arteries, and degenerative changes of the lumbar vertebrae were also noted. Mann–Whitney U-test was used for comparison of the means. A p value of < 0.05 was accepted as significant.

3. Results

In all 10 cases, CT showed that the right common iliac artery was compressing the left common iliac vein (Fig. 1).
Fig. 2. A transverse computed tomography image from one of the cases shows the left common iliac vein compressed mainly by the right common iliac artery. Note the small osteophyte (arrow) also contributing to the compression.

The mean diameter at the origin of the left common iliac vein was 3.5 mm (range, 1–8.5 mm) in patients with IVCS, whereas the mean diameter of the left common iliac vein at the same level was 11.5 mm (range, 6.3–16.1 mm) in control subjects. The difference was statistically significant ($p < 0.01$). The mean percent stenosis of the left common iliac vein due to compression by the right common iliac artery was 68% (range, 40–92%). The mean distance from the posterior border of the right common iliac artery to the nearest lumbar vertebra was 4.5 mm (range, 2.6–8.4 mm). Marked tortuosity of the aortoiliac arteries was noted in one case. Five patients exhibited calcified foci in the walls of the iliac arteries and/or the aorta. In one of these five cases, chronic occlusion of the left common iliac vein was attributed to dense circumferential calcification of the right common iliac artery at the point of compression. Atherosclerotic changes in the aorta and the iliac arteries were not responsible for the compression in the other four cases. Four patients showed mild to moderate degenerative changes in the lumbar vertebrae. A small osteophyte contributed slightly to the compression in only one of these four cases (Fig. 2).

4. Discussion

Computed tomography for diagnosing lower extremity DVT has been introduced into clinical practice for evaluation of suspected pulmonary thromboembolism with the combination of pulmonary CT angiography and indirect CT venography [8]. Computed tomographic venography has proven to be almost as accurate as CDUS for detecting DVT below the inguinal ligament, and is more accurate than CDUS for identifying thrombus extension into the pelvic veins and inferior vena cava [8,9]. The value of CT for diagnosing IVCS has been recognized only recently. Some authors have recommended CT venography as a means of providing useful information when extrinsic compression is causing the obstruction [10,11]. In a recent study involving CT venography with three-dimensional reconstruction, Chung and coworkers found that 37 of 44 patients with left lower extremity DVT had an underlying anatomic abnormality that caused significant stenosis or obstruction of the iliofemoral veins or the inferior vena cava [7]. Of the 37 patients with an anatomic abnormality, 27 had IVCS. Multi-detector CTs with 2.5–3.2 mm X-ray beam collimation and 1.25–2 mm reconstruction interval with reformatted images were used in the same study. In all 10 of the patients with DVT in our study, CT images in the transverse plane showed compression of the iliac vein by the overlying artery. Our CT parameters were routine pelvic CT parameters with 5 mm collimation in seven of our patients. Computed tomographic venography with three-dimensional reconstruction was performed in only three cases, and these images added useful information for planning endovascular treatment. In its normal anatomic position, the inferior vena cava is on the right side of the vertebrae. The right common iliac vein branches off with little lateral deviation at its origin, whereas the left common iliac vein deviates laterally at a sharper angle that can even approach 90°. The left common iliac vein crosses the midline where the natural convexity of the lumbar vertebrae is most prominent. This was the site of left common iliac vein com-
pression in all 10 of our patients. This vessel was more than 50% stenosed in nine of the 10 cases.

May and Thurner [2] suggested that IVCS results from intimal injury caused by compression of the vessel and additional repetitive trauma from arterial pulsations. They proposed that intimal injury, in turn, leads to formation of obstructing bands or spurs in the vein lumen, rendering the individual prone to lower extremity DVT. Although compression of the left common iliac vein has been identified in studies of anatomic dissections, and more recently, investigations involving cross-sectional imaging methods, it is not known at what stage the changes due to intimal injury cause compression severe enough to cause symptomatic DVT.

Color Doppler ultrasonography is the method of choice for screening patients with DVT due to its widespread availability and ease of use for bed-side examination, but this technique is not 100% sensitive and specific in the detection of lower extremity DVT. The sensitivity and specificity of CDUS for diagnosing lower extremity DVT are higher in symptomatic patients than in asymptomatic patients [12]. The value of CDUS for diagnosing IVCS has not been investigated to date. Conventional venography is considered the reference standard for evaluating DVT, but this method has potential disadvantages including, and inadequate examination due to poor opacification of the central veins. The advantages of CT venography over CDUS or conventional venography are short examination time, lack of operator dependency, and better visualization of the pelvic veins. However, CT venography requires a large volume of contrast medium and cannot be used during pregnancy or in patients with impaired renal function. Investigation has shown that magnetic resonance venography is also more accurate than CDUS or conventional venography for detecting pelvic extension of DVT [13,14]. In two different studies, intravascular ultrasound demonstrated compression of the left common iliac vein in all patients who were evaluated for suspected IVCS [15,16].

Until recently, there has been no real need to know the detailed anatomy and extension of thrombosis to the pelvic veins because DVT has been managed with systemic anticoagulation. Catheter-directed endovascular treatment has recently been accepted as a safe and effective treatment for lower extremity DVT [5]. When a patient undergoes interventional treatment for acute or chronic lower extremity DVT, it is important to know the precise venous anatomy, and the distribution and extension of the acute clot or chronic involvement. Presence or absence of iliac vein stenosis is of particular importance in the management of DVT, because patients with extrinsic causes of obstruction (such as pelvic malignancies and IVCS) usually require stent placement and tend to respond poorly to balloon angioplasty alone [16].

This study has a number of limitations. Due to the small number of patients and the retrospective nature of the investigation, it is not possible to conclude whether iliac vein compression can be accurately diagnosed on transverse CT images in all patients. Prospective analysis of this subject with larger study groups is needed to define the value of CT for diagnosing IVCS. However, we feel it is noteworthy that our data suggest this modality is useful in this patient group.

5. Conclusion
Iliac vein compression syndrome is being encountered more frequently due to wider use of catheter-directed endovascular treatment. Radiologists should be aware that CT images can be valuable for diagnosing IVCS as a potential cause of lower extremity DVT. Computed tomography in the transverse plane appears to demonstrate compression of the iliac vein by the overlying artery accurately in this patient group.

References
