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May-Thurner syndrome: can it be diagnosed by a single MR venography study?

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PURPOSE
We aimed to evaluate the longitudinal stability of left common iliac vein (LCIV) compression by the right common iliac artery on magnetic resonance venography (MRV).

MATERIALS AND METHODS
This retrospective study included 214 patients diagnosed with May-Thurner syndrome by MRV. We identified a subset of patients who underwent contrast-enhanced cross-sectional imaging of the pelvis six months before or anytime after the MRV and did not undergo any interventional venous procedures between the two studies; 36 patients met these criteria. The degree of venous compression was calculated in both the index and comparison study.

RESULTS
On the index MRV, the mean compression of the LCIV was 62%. However, on the comparison study in the same patients, the mean compression was 39%. The mean change in degree of compression between the two studies was 23% ($P < 0.0001$), ranging from a 12% increase to 69% decrease in degree of compression on the comparison study.

CONCLUSION
The compressed LCIV on a single MRV study was not stable over time and thus may be insufficient to diagnose May-Thurner syndrome.

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Compression of the left iliac vein against the fifth lumbar vertebra by the overlying right common iliac artery is a well-known anatomic variant. It was first suggested by Virchow in 1851 who observed that iliofemoral deep vein thrombosis was five times more likely to occur in the left leg compared to the right one (1). Although formally reported in 1908 (2), it was not until 1957 when May and Thurner (3) brought attention to the anatomic variant responsible for this disparity. They found that the left common iliac vein (LCIV) had vascular thickening at the point where it was crossed by the overlying right common iliac artery in a substantial portion of examined cadavers (22% of 430 cadavers). The obstructing lesion was termed a venous "spur," and the observation led to postulation that chronic pulsations of the overlying iliac artery could lead to development of the "spur" in the vein, resulting in partial venous obstruction. This anatomic variant became widely recognized as May-Thurner syndrome. Autopsy rates in the early twentieth century reported "obstructing" lesions in the left common iliac vein in 22% to 32% of specimens (2–4).

May-Thurner syndrome most commonly presents as deep vein thrombosis (DVT). However, patients can also present with left-sided leg pain, swelling, fatigue, heaviness, venous claudication, and venous insufficiency (i.e., varicose veins) without thrombosis, presumably caused by spurs prior to the thrombosis, i.e. nonthrombotic iliac vein lesions, which occur less frequently (5, 6). Raju and Neglen (7) found a high prevalence of nonthrombotic iliac vein lesions in patients with chronic venous disease. Historically, contrast venography has been considered the gold standard for diagnosis of May-Thurner syndrome, but different imaging modalities, including magnetic resonance imaging (MRI), computed tomography (CT) scanning and intravascular ultrasonography, demonstrate the compression just as successfully (5, 6, 8–10). In some studies, intravascular ultrasonography has been shown to be more sensitive than venography in identifying compression (7, 11). To date, however, there is neither an accepted radiological definition for May-Thurner syndrome nor established diagnostic criteria to support the syndrome. Some authors have advocated endovascular intervention with venoplasty and stent placement upon diagnosis of compression along with the accompanying appropriate indications for revascularization (12–14).

The aim of this study was to evaluate the longitudinal stability of identifying left common iliac vein compression on a single magnetic resonance venogram (MRV).

Materials and methods

Study design

This retrospective study was compliant with The Health Insurance Portability and Accountability Act and approved by our institutional

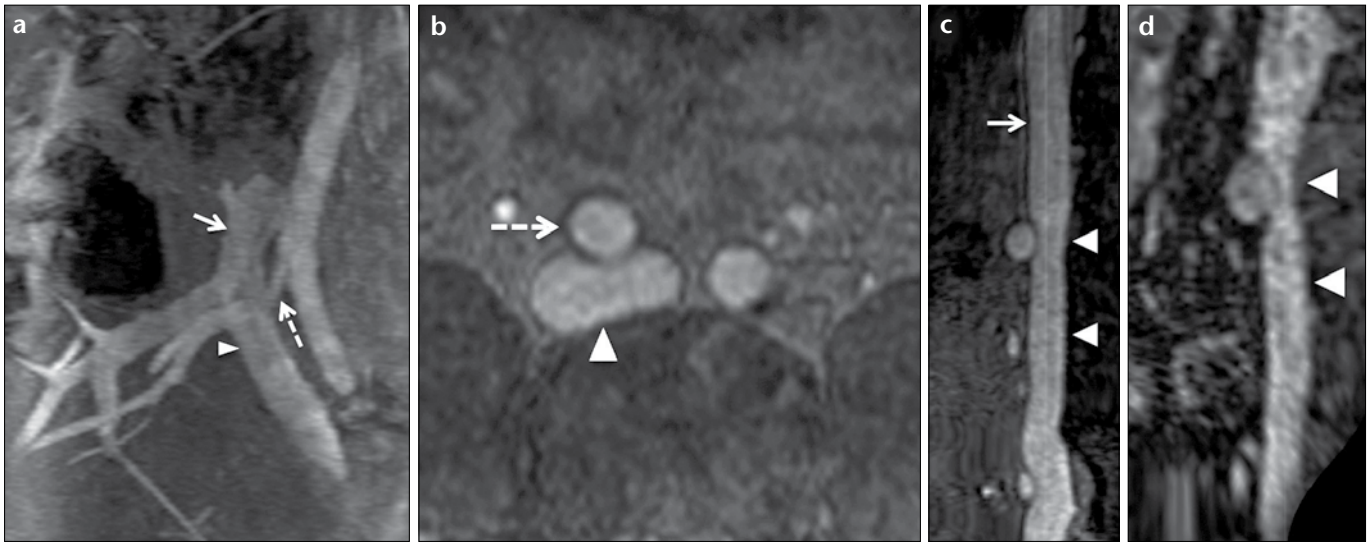

Figure 1. a–d. Magnetic resonance venography images following injection of the blood pool contrast agent, Ablavar, in a 46-year-old male **(a–c)**. A coronal MIP image **(a)** and axial image **(b)** show the inferior vena cava *(solid arrow)*, right common iliac artery (RCIA) *(dashed arrow)*, and left common iliac vein (LCIV) *(arrowhead)*. A curved reformatted image **(c)** shows the inferior vena cava *(solid arrow)* and the LCIV *(arrowheads)*. Measurements to calculate the degree of venous compression were taken where the LCIV is compressed by the overlying RCIA *(upper arrowhead)* and just caudal to this point *(lower arrowhead)*. In this case, there is no significant venous compression. A curved reformatted image **(d)** in a 32-year-old female demonstrated marked compression of the LCIV by the RCIA *(upper arrowhead)*.

review board with waiver of the need for informed consent. We used the term "May-Thurner" to perform a search of the radiology electronic database at our institution ("Render"), which contains over 11 million studies (15). The search was limited to a five-year period, from July 1, 2006, through June 30, 2011. This strategy identified all patients who were diagnosed with May-Thurner syndrome based on an MRV study. The patients' radiology records were reviewed to identify those who underwent another contrast-enhanced cross-sectional imaging study within six months prior to or anytime after the MRV. Patients who had any interventional procedure performed between the two studies were excluded from this study. The MRV was considered the "index study," and the other cross-sectional study was considered the "comparison study."

Study population

The study population included a total of 214 patients who were diagnosed with May-Thurner syndrome based on MRV findings. Thirty-six underwent at least one other contrast-enhanced cross-sectional imaging of the pelvis (CT or MRI) within six months preceding or following the MRV. Of the 36 patients, 27 were female and nine male; the mean age was 47 years, with a range from 22 to 82 years. The indications for the MRV were as follows: evaluation of patients with a patent foramen ovale with or without stroke (n=21), DVT (n=11), lower limb swelling or discomfort (n=3), and defining the etiology for pelvic varices (n = 1). Three patients had a DVT at the time the MRV was performed, and all three were in the left common femoral vein. Six had a history of prior DVT, diagnosed on average five years prior to the MRV (range, 1–15 years); three were in the right lower limb, and three in the left (one in the posterior tibial vein; two in the femoral vein).

The comparison study was CT venography in 32 cases and MRV in the remaining four cases. The mean time between the index and comparison study was 3.7 months, with a range of six months prior to and 22 months after MRV. The comparison study was before the MRV in nine cases.

Image analysis

MRI and CT measurements were made from axial DICOM images using a picture archiving and communication system workstation (IMPAX, Agfa Healthcare, Mortsel, Belgium). Images were enlarged to cover only the relevant anatomy, and digitally calibrated measurement tools were used. Anteroposterior measurements were recorded proximal and distal to the site of crossing of the right iliac artery over the left iliac vein, and at the site of crossing (Fig. 1). The degree of venous compression was calculated as the diameter of the common iliac vein at the site of maximal compression divided by the diameter of the uncompressed caudal segment of the iliac vein, as previously described and validated by Kibbe et al. (16).

Statistical analysis

Wilcoxon rank sum test was performed to determine whether the difference in degree of venous compression on the two studies was significant. A P value of less than 0.05 was used as the cut-off for statistical significance. Standard Bonferroni correction was used to avoid a Type I error (α/k, k=number of statistical tests performed on the data).

Results

In the index study, the mean anteroposterior diameter of the left common iliac vein at the axial level where it was crossed by the overlying right common iliac artery was 3.3 mm (range, 1.9–5.7 mm). The mean degree of venous compression was 63.4% (range, 40.5%–82.6%). All patients had >25% compression, with 29 patients showing >50% compression, and five patients showing >75% compression (Fig. 2).

In the comparison study, the mean anteroposterior diameter of the left

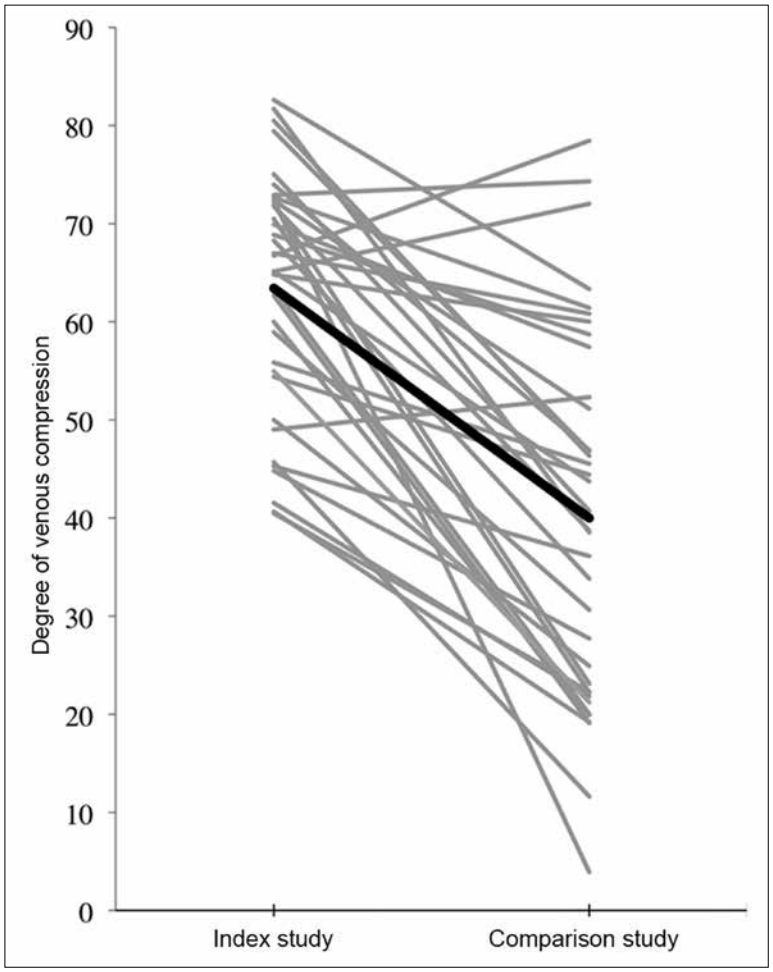

Figure 2. Line chart showing the change in the degree of venous compression between the index and comparison study of each patient. The solid black line represents the mean.

common iliac vein at the point where it was crossed by the right common iliac artery was 7 mm (range, 1.9–13.7 mm). The mean degree of venous compression was 40% (range, 3.9%–78.4%). Twenty-four patients had >25% compression, 11 had >50% compression, and only one had >75% compression.

The mean change in degree of venous compression between the index and the comparison study was 23.1% ($P < 0.0001$), with a range from an 11.7% increase to a 68.8% decrease in degree of compression (Fig. 2).

Discussion

Since the introduction of catheter-directed thrombolysis, the diagnosis of May-Thurner syndrome has increased considerably, suggesting that it was historically under-diagnosed or that it is now over-diagnosed.

There is no precise definition for the degree of compression that may render a person at high-risk for developing an iliofemoral DVT. Three studies have been published on the degree of compression of the LCIV in asymptomatic patients, with a mean compression of 28%–37.8% (range, -5.6%–74.8%) (16–18). These findings suggest that iliac vein compression is a common anatomical variant that may not necessarily be associated with chronic left-lower extremity venous congestion or iliofemoral DVT. Rather, this anatomical variant combined with other risk factors for venous thrombosis, such as immobility, pregnancy, use of oral-contraceptive pill, trauma, and cancer, may place patients at an increased risk of developing venous thrombosis.

To our knowledge, this is the first study to quantitatively analyze the degree of LCIV compression in the same patient at two different time points. As May-Thurner syndrome is a chronic process with development of permanent venous wall lesions and intraluminal spurs (2–4), the degree of stenosis should not change significantly over time, specifically between the index study and the comparison study. In our study, we found that the mean change in the degree of LCIV compression was 23.1%, which ranged from an 11.7% increase to a 68.8% decrease in degree of compression.

The change in the degree of venous compression between the two studies may be due to factors known to influence venous filling (cardiac output, degree of fluid hydration, valsalva) (Fig. 3). Unfortunately, the timing of the examination and hydration status of the patients at the time of the MRV was unknown, both of which may affect the diameter and distensibility of the vein; however, this is usually the case in everyday practice. It is also possible that patient position may influence the diameter of the iliac vein on cross sectional imaging. Given that May-Thurner syndrome is a permanent process, the luminal diameter of the iliac vein should not change with patient positioning. The recent development of blood pool contrast agents, such as gadofoseveset trisodium (Ablavar, Lantheus Medical Imaging, N. Billerica, Massachusetts, USA) (19), allows contrast MRV on patients in both the supine and prone position following a single dose of contrast injection to make the diagnosis of May-Thurner syndrome more specific on MRV. Fig. 4 demonstrates a case of MRV in which MTS was diagnosed in the supine position; however, images obtained from the prone position reveal a normal, widely patent left common iliac vein.

Our study has several limitations. The majority of the comparison studies were not dedicated studies for assessing the inferior vena cava and iliac veins; however, we felt that clear measurement of vessel diameter was still possible. The fact that some of the comparison studies were performed prior to the MRV may be another limitation. However, we only included patients who had imaging within six months of the MRV, and as May-Thurner syndrome is a chronic process with the development of intraluminal spurs, a new significant stenosis may likely not be able to develop over that short period of time. Another limitation in our study is that MRV and CT were compared in the majority of cases, which may potentially exaggerate the

Figure 3. a, b. Investigation of a 46-year-old male for recurrent deep venous thrombosis. Magnetic resonance venography **(a)** demonstrates 60% compression of the left common iliac vein *(arrowhead)* where it is crossed by the right common iliac artery *(arrow)*. CT of abdomen **(b)** performed three months later demonstrated only 5% compression of the left common iliac vein *(arrowhead)* by the right common iliac artery *(arrow)*.

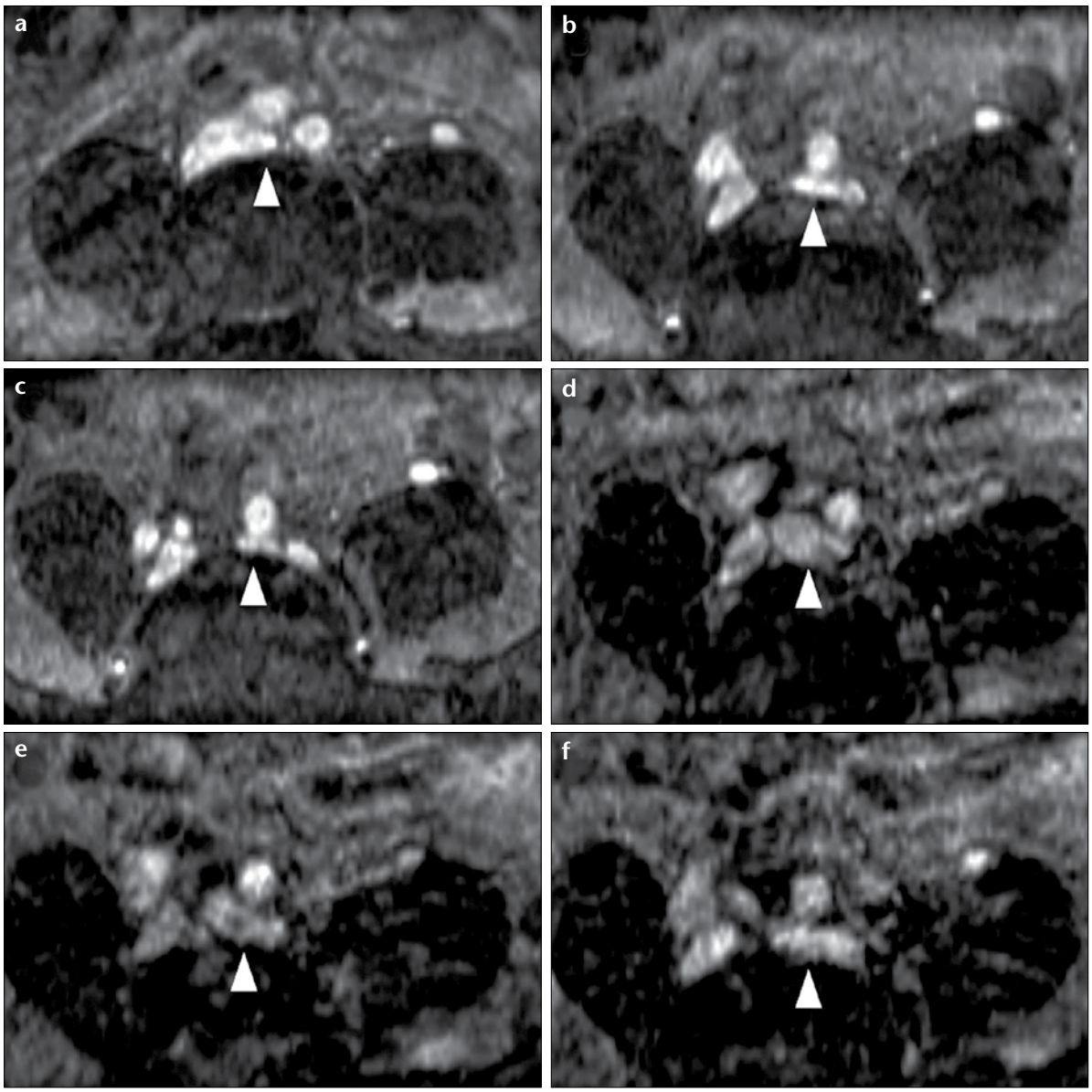

Figure 4. a–f. Investigation of venous compression in a 45-year-old female. Time of flight images with the patient in the supine **(a–c)** and prone **(d–f)** positions. There is a marked difference in the degree of compression of the left common iliac vein by the right common iliac artery between the two positions.

difference in degree of compression between the two studies. However, in the four cases where MRI was both the index and the comparison study, the mean change in degree of venous compression was 19.6%, with a range from 11.7% increase to 32.6% decrease in degree of compression, which is comparable to our overall results.

We used the method described by Kibbe et al. (16) to calculate the degree of iliac vein compression. This could potentially overestimate the degree of venous compression if there was prestenotic dilatation of the common iliac vein. However, none of the patients in our cohort had prestenotic dilatation. Furthermore, our cohort was identified based on the report of the index MRV and is therefore subject to referral bias based on the reporting radiologist's opinion on what defines May-Thurner syndrome. We purposely used this criterion to identify patients, as it is these patients who undergo further investigation, commence treatment or undergo procedures due to their diagnosis of May-Thurner syndrome.

In conclusion, the sole finding of a compressed left common iliac vein on a single MRV study may not be consistent over time in patients who do not undergo therapeutic procedures. This implies that anatomic narrowing by MRV alone may not be sufficient to confirm the diagnosis of May-Thurner syndrome and could possibly lead to unwarranted further investigations and interventions.

Conflict of interest disclosure

The authors declared no conflicts of interest.

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