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Lumbar overlordosis — towards the better understanding of the May-Thurner syndrome pathogenesis

Funkcjonalna hiperlordoza kręgosłupa lędźwiowego — nowy element w patogenezie zespołu May-Thurnera

Katarzyna Kościelna-Buczek, Ewa Mędoń, Michał Widuch, Bartosz Kończyk, Wacław Kuczmik, Tomasz Urbanek

Department of General Surgery, Vascular Surgery, Angiology and Phlebology, Medical University of Silesia, Katowice (Katedra i Klinika Chirurgii Ogólnej, Chirurgii Naczyń Angiologii i Flebologii Śląskiego Uniwersytetu Medycznego w Katowicach)

Abstract

Introduction: May-Thurner Syndrome (MTS) is a condition in which the left common iliac vein is compressed by the right common iliac artery, which together with intraluminal vein changes can lead to clinically symptomatic venous outflow obstruction. Patients having such pathology may suffer from symptoms of venous hypertension as well as lower leg deep venous thrombosis. In most of the MTS cases, static and continuous compression is observed which can also lead to the intraluminal spur formation. According to the literature, among the factors which can influence the severity of iliac vein compression, lumbar spinal degeneration can also be mentioned. Considering the aortic bifurcation anatomical conditions, also other, non — degenerative changes of the lumbar vertebral column segment can be taken into consideration.

Aim: This study aimed to reveal the prevalence of the left common iliac vein compression in young healthy individuals as well as to assess the severity of the left iliac vein compression provoked by lumbar hyperlordosis.

Material and methods: The study was performed on a group of 207 volunteers of both sexes, aged 21–27 yrs. using ultrasound examination to measure the diameter of the right common iliac vein as well as the diameter of the left common iliac vein in the area of the possible compression by the right iliac artery. In all the patients the measurements were performed in the supine position as well as in the provoked lumbar hyperlordosis position. In all the individuals the presence of the symptoms and signs of the lower leg chronic venous disease were investigated.

Results: The mean anterior-posterior diameter of the right common iliac vein in the standard supine position in the whole study group was 5.71 mm (± 0.6 mm). The mean diameter of the left common iliac vein in a normal horizontal position was 4.87 mm (± 0.6 mm) with a range from 3.8 mm to 6.2 mm. In most of the cases, the difference between the left and iliac common vein diameter (when measured in the place of the right iliac artery crossing) did not exceed 20%. In 15.9% of the study subjects, the right and left iliac vein diameter difference ranges between 20–30% and in 2.41% only, the diameter difference over 30% was noticed (in none of the cases the stenosis exceeding 40% of the vein diameter was found). Looking for the effect of the overlordosis on the proclivity to decrease left iliac vein diameter, in the provoked hyperlordosis position the changes of the iliac vein diameter in the range of 21–30% were observed in 15.9% and over 30% in 2.4% of the study subjects. Hyperlordosis presence was also responsible for the shift towards lower left iliac vein diameter — in 36.2% of the patients, the left iliac vein diameter below 4 mm was noticed including 1.9% of individuals with a diameter not exceeding 3 mm. In the analysis, there was no statistically significant correlation between the presence of the reported CVD symptoms in the left leg and the reported diameter reduction between the right and left iliac veins in the population of the studied young individuals.

Conclusions. Left common iliac vein compression may be anatomically conditioned at least in some of the young population individuals. Lumbar hyperlordosis influence on the left common iliac vein diameter suggests that also in healthily individuals, an incorrect spinal position can promote the occurrence of the left iliac vein compression. Further studies are needed to assess the haemodynamic influence of these findings on the lower leg venous outflow.

Key words: May-Thurner syndrome, iliac veins, compression syndrome, hiperlordosis

Streszczenie

Wstęp. Zespół May-Thurnera koresponduje z anatomicznie istotnym uciskiem lewej żyły biodrowej wspólnej przez prawą tętnicę biodrową wspólną. Sytuacja ta w połączeniu ze zmianami wewnątrz światła żył może prowadzić do klinicznie objawowej obturacji odpływu żylnego. U pacjentów z taką patologią mogą występować objawy nadciśnienia żylnego oraz zakrzepicy żył głębokich kończyn dolnych. W większości przypadków MTS obserwuje się statyczny i ciągły ucisk, który może prowadzić do powstania miejscowego przerostu błony wewnętrznej („ostrogi") w świetle naczynia. Według piśmiennictwa wśród czynników mogących wpływać na stopień ucisku żyły biodrowej można wymienić zwyrodnienie odcinka lędźwiowego kręgosłupa oraz biorąc pod uwagę warunki anatomiczne rozwidlenia aorty inne, niezwyrodnieniowe zmiany tego odcinka.
Cel pracy. Celem pracy było wykazanie częstości występowania ucisku lewej żyły biodrowej wspólnej u młodych i zdrowych osób oraz ocena nasilenia ucisku lewej żyły biodrowej wywołanego hiperlordozą lędźwiowego odcinka kręgosłupa.
Materiał i metody. Badanie przeprowadzono w grupie 207 ochotników obu płci w wieku 21–27 lat. Za pomocą badania ultrasonograficznego oceniano średnicę prawej żyły biodrowej wspólnej oraz średnicę lewej żyły biodrowej wspólnej w okolicy możliwego ucisku przez prawą tętnicę biodrową. U wszystkich pacjentów pomiar wykonywano w pozycji leżącej oraz w pozycji wywołanej hiperlordozy lędźwiowej. U wszystkich pacjentów badano obecność objawów i oznaki przewlekłej choroby żylnej podudzi.
Wyniki. W całej badanej grupie średnia przednio-tylna średnica prawej żyły biodrowej wspólnej w standardowym ułożeniu na plecach wynosiła 5,71 mm (±0,6 mm). W tej grupie średnia średnica lewej żyły biodrowej wspólnej w prawidłowej pozycji leżącej wynosiła 4,87 mm (±0,6 mm), pozostając w zakresie 3.8–6.2 mm. W większości przypadków różnica pomiędzy średnicą żyły biodrowej lewej i żyły biodrowej wspólnej mierzonej w miejscu przecięcia prawej tętnicy biodrowej nie przekraczała 20%. U 15,9% badanych różnica średnicy żyły biodrowej prawej i lewej wahała się w granicach 20–30%, a tylko u 2,41% stwierdzono różnicę średnicy powyżej 30% (w żadnym przypadku zwężenie nie przekraczało 40% średnicy żyły). Poszukując wpływu prowokowanej pozycji hiperlordozy na redukcję średnicy żyły biodrowej lewej, zaobserwowano zmiany wymiaru średnicy naczynia w zakresie 21–30% u 15,9% i ponad 30% u 2,4% badanych. Obecność hiperlordozy była również odpowiedzialna za przesunięcie wartości pomiarów średnicy żyły biodrowej lewej w kierunku wartości niższych — u 36,2% pacjentów stwierdzono średnicę żyły biodrowej lewej poniżej 4 mm, w tym 1,9% osoby o średnicy nieprzekraczającej 3 mm. W analizie nie stwierdzono istotnej statystycznie korelacji między występowaniem zgłaszanych objawów przewlekłej choroby żylnej w kończynie dolnej lewej a obserwowanym zmniejszeniem średnicy między żyłą biodrową prawą i lewą w populacji badanych młodych osób.
Wnioski. Widoczny w badaniach i uwarunkowany anatomicznie ucisk żyły biodrowej wspólnej lewej jest rozpoznawany przynajmniej u części osób w populacji młodych ludzi. Wpływ hiperlordozy lędźwiowej na średnicę lewej żyły biodrowej wspólnej sugeruje, że u osób zdrowych nieprawidłowa pozycja kręgosłupa może również sprzyjać wystąpieniu ucisku lewej żyły biodrowej. Potrzebne są dalsze badania, aby ocenić wpływ powyższych obserwacji na potencjalne zaburzenia odpływu krwi z kończyn dolnych.

Słowa kluczowe: zespół May-Thurnera, żyły biodrowe, zespół uciskowy, hiperlordoza

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Introduction

May-Thurner syndrome (MTS) belongs to the vascular compression syndromes and can potentially lead to a significant level of venous outflow obstruction as well as its clinical consequences. Historically, in 1908 Mc Murrich based on the cadaver study discovered the presence of the left iliac vein obstructive changes in several examined subjects (29.9%) suggesting the relationship between these findings and left-leg DVT [1]. The next significant step towards the comprehensive understanding of the iliac vein compression pathology came with the study of May and Thurner, from whom the syndrome is named. According to their research, published in 1957 and performed on 430 cadavers, lesions in the left common iliac veins were found in 22% of the studied cases. The authors of the research postulated that the observed changes, described as intraluminal "spurs" were related to the chronic compression of the left common iliac vein by the right iliac artery [2].

Cockett and Thomas in 1965, investigated 29 patients with proximal lower leg DVT documented the left iliac vein stenosis presence and suggested the possible clinical link between its occurrence and iliofemoral DVT. The authors of the study also documented that due to the nature of the stricture/stenosis, the simple decompression does not recanalize the affected vein [3].

The left iliac vein compression is observed in several asymptomatic patients undergoing imaging studies of the region of aortic bifurcation and iliac vein confluence which can also suggest that at least in some patients the presence of the non-significant left iliac vein compression is a normal anatomical condition related to the local anatomy [4–6]. Most of the cases of iliac vein compression noticed in imaging studies remain clinically silent. The true incidence of the left iliac vein compression symptomatic cases (which correspond with the May-Turner syndrome definition) remains unknown. Among symptomatic patients, both acute cases (with acute proximal DVT), as well as chronic ones (with chronic venous disease — CVD, symptoms and signs), can be found [7–9]. In the latter group, the symptoms related to venous hypertension including leg pain, heaviness, a sensation of swelling, venous claudication, as well as signs of the CVD such as leg oedema, trophic changes or venous leg ulcers can be observed. Considering the high prevalence of CVD in the community, in many cases, it is difficult to confirm the real relationship between iliac vein compression and CVD development as well as its severity. The multifactorial aetiology of CVD as well as the lack of the proper criteria for the haemodynamically significant venous stenosis, at least for now does not allow to define the degree of the stenosis which became critical in terms of symptoms and signs occurrence [10, 11]. In most of the studies focus on the invasive treatment of this pathology (left iliac vein compression) the criteria of stenosis exceeding 50% stenosis are used [12, 13].

According to recent observations and suggestions, the presence of iliac vein obstruction can be an important compound leading to pelvic venous disorders related to venous hypertension [14, 15]. In patients with the presence of the iliac vein obstructive changes in not only the lower leg but also pelvic venous symptoms can be observed. Additionally, the presence of venous hypertension in the pelvic venous circulation can lead to the development of the lower leg varicose veins of the pelvic origin. In the recently published SVP (Symptoms, Varicose vein, Pathology) classification, compression syndromes are listed among important factors related to the pathogenesis of pelvic venous hypertension occurrence [16].

As mentioned above, the presence of iliac vein compression can increase the risk of the proximal, iliofemoral DVT. The estimated prevalence of the MTS related DVT (mostly iliofemoral DVT) in the whole DVT population is relatively low: 2–3% [17, 18], however, much higher in the patients with left leg proximal iliofemoral DVT. This observation is linking the iliac vein compression and its intraluminal abnormalities with the obstructive compound of the Virchow triad [19, 20]. According to several authors, in patients with proximal iliofemoral DVT in approximately 50–70% of the patients, some levels of compression and/or the presence of intraluminal changes in the left iliac vein can be found [21–23]. Despite the fact of the relatively low prevalence of the massive iliofemoral DVT in the general population, it should be emphasized that the clinical symptoms as well as consequences of deep vein thrombosis in this location remain significant.

MTS affects both, female and male populations, with a higher prevalence among middle-aged women [24, 25]. Looking for the factors which can be potentially related to the left iliac vein haemodynamically significant stenosis development leading to the MTS occurrence, not only anatomical but also haemodynamic factors should be taken into consideration. Except for the iliac vein anatomical compression, the chronic pulsatile compression of the left common iliac vein by the right common iliac artery results in the formation of the fibrotic adhesions leading to partial or complete iliac vein obstruction. Chronic irritation of the vascular endothelium, as well as the venous wall, led to the accumulation of collagen and elastin as well as the formation of venous "spurs" — which is described as the replacement of the normal intima-media of the vein by well organized connective tissue often covered with endothelium and increasing the level of venous obstruction [26].

Besides compression location as well as chronic iliac artery pulsation on the left iliac vein, another possible factor which can potentially influence the severity of the outflow obstruction and vein compression can be the presence of degenerative changes in the lumbar vertebral column. Ou-Yang et al. suggested categorizing the patients with iliac vein compression into 3 groups including traditional MTS, those with lumbar degeneration as well as the third group with MTS being related to other causes [27]. When comparing the group characteristics, the median age of the patients with lumbar degenerated MTS was significantly higher than in the rest of the MTS subjects (61.5 ± 10.6 years vs 42.3 ± 6.5 years). Several changes related to the lumbar degeneration-related MTS could be identified including forward bulging or protruding of the intervertebral disc, osteophytes and spondylothesis [27]. In the literature, several case reports concerning the potential influence of vertebral degeneration changes or spinal/vertebral surgery on the symptomatic course of MTS can be identified, in most of the cases concerning significant vertebral column pathology [28–32].

In most of the available reports concerning the clinical significance of the changes related to the vertebral column pathological, degenerative or traumatic conditions of the lumbar vertebras are mentioned [28–35]. This is in accordance with the fact of limited prevalence of MTS in a very young patient population where this pathology is very rarely observed. However, also in these young individuals, the potential vertebral column abnormalities can be observed leading not only to the postural changes but also venous outflow disturbances influencing both lower leg as well as pelvic venous systems. In the presented study the importance of the lumbar vertebra overlordosis in young individuals was investigated. The prevalence and the severity of the iliac vein compression in the normal supine position as well as in the hyperlordosis position in young individuals were investigated.

Material and methods

The study was performed on 207 volunteers of both sexes aged 21–27 years (median age 24 years) including 131 women (63.4%) and 76 men (36.7%). According to the CEAP evaluation in 11 women and 1 man C1 pathology (spider veins) was recognized. No cases of C2 and more advanced CVD signs were recognized. Clinical symptoms of CVD including leg heaviness, pain, a sensation of swelling and night cramps have been reported in 23 women (17.6%) and 12 men (15.8%). In most of the patients (77% — 27 pts.) of the symptomatic group bilateral symptoms were found, in the remaining 8 subjects, in 5 cases the complaints were reported in the left leg in 3 cases in the right one. In all the patients the presence of the previous or current deep or superficial vein thrombosis was excluded. Another exclusion criteria were previous vertebral or pelvic fractures or trauma as well as previous vertebra stabilization surgery or recognized discopathy.

In all the patients an ultrasound examination of the lower limb venous system was performed to exclude the DVT presence or the presence of post-thrombotic changes and to confirm the patency of the deep vein system. The US study of the proximal part of the lower leg vein system was performed in the supine position using SIEMENS Acuson X300 Machine and a 2.5–5 MHz probe. In each patient, the measurements in two positions (both supine) were performed: 1 — standard horizontal supine position, 2 — in supine position with hyperlordosis.

During the first measurement, after visualization of the iliac vein confluence, both common iliac veins and arteries the diameter of the left and the right common iliac veins was measured. The measurement of the left iliac vein diameter (anterior-posterior) was performed at the level of the right iliac artery crossing the left iliac common vein. The right iliac artery diameter was measured at the same distance from the iliac vein confluence as on the left side. The measurement of the diameter of the iliac veins in the selected points was performed on the top of the inspiration phase — in each patient and each position the 3 measurements were performed in each patient and the mean value was used for further analysis. The secondary measurements were performed in the hyperlordosis position with the 12 cm high roller positioned under the patient's lumbar spine (Fig. 1). During all measurements, the compression of the vein lumen by the probe was strictly avoided.

In the analysis of the results the differences between the right and left iliac vein diameter were evaluated in the normal and hyperlordosis position including the diameter changes in the place of the right iliac artery crossing the left iliac vein. In the statistical analysis, the Statistica version 13.3 program (StatSoft Poland) was used. In the statistical analysis, initially, the distribution of the results was evaluated. In the analysis of the results Kolmogorov-Smirnov, as well as Shapiro-Wilk tests, were implemented. The differences between the diameters were compared in the whole group as well as in the groups according to the patient's gender. T-student as well as the Mann-Whitney test were also applied. The statistic value of $p < 0.05$ was taken as statistically significant. All the patients were volunteers and the project was approved by the local institutional review Board.

Figure 1. Ultrasound measurement of the iliac vein diameters performed in the hyperlordosis position

Results

The mean anterior-posterior diameter of the right common iliac vein in the standard supine position in the whole study group was 5.71 mm (± 0.6 mm). The mean diameter of the left common iliac vein in a normal horizontal position was 4.87 mm (± 0.6 mm). The minimum and maximum right common iliac vein diameter in the study population and US evaluation were 4.4 mm and 7.5 mm. The respective values for the left iliac vein diameter were from 3.8 mm to 6.2 mm. The results of the US measurements in the individual patients are presented in Figure 2. According to the statistical analysis, some gender differences in the initial measurements were also noticed between male and female populations concerning the size of the studied veins — the mean diameters of women's left and right common iliac veins are smaller than men's — concerning the right common iliac vein, this difference was statistically significant (Table I).

Table I. Gender-related differences of the left and right iliac vein diameter between female and male populations

Vein	Women	Men	Statics value of the diameter difference (T-student test)
Right common iliac vein diameter	5.48 ± 0.6	5.48 ± 0.6	$p < 0.05$
Left common iliac vein diameter in the place of the right iliac artery crossing	4.7 ± 0.55	5.14 ± 0.6	$p > 0.05$

Despite the fact of the relatively low difference between the main diameter of the right and left common iliac vein in the whole study group, the important differences were noticed in the individual cases. In most of the cases, the difference between the left and iliac common vein diameter (when measured in the place of the right iliac artery crossing) did not exceed 20%. In 15.9% of the study subjects the right and left iliac vein diameter difference was between 20–30% and in 2.41% only, a diameter difference of over 30% was noticed (Fig. 3).

In none of the cases the stenosis exceeding 40% of the vein diameter was observed.

Comparing normal supine position with iliac vein diameter measurement in hyperlordosis in the whole study group, both, right and left iliac veins changed their diameters by a mean of 0.71 (± 0.34) for the right and mean of 0.68 (± 0.29) for left common iliac vein, however, according to the statistical analysis these differences were not statistically significant ($p > 0.05$; T-student test). Looking for the effect of the lumbar hyperlordosis on the proclivity to decrease iliac vein diameter according to the patient gender, an influence of this position in males and females was also investigated. In the male population right CIV diameter decreased by 0.73 mm (± 0.4 mm) in the hyperlordosis position and this difference was statistically significant ($p < 0.05$; T-student test). On the left side, a statistically non-significant CIV diameter decrease of 0.53 mm (± 0.23 mm) was observed. In the female patients, hyperlordosis decreased the right common iliac vein diameter mean by 0.7 mm (± 0.3 mm) and the left

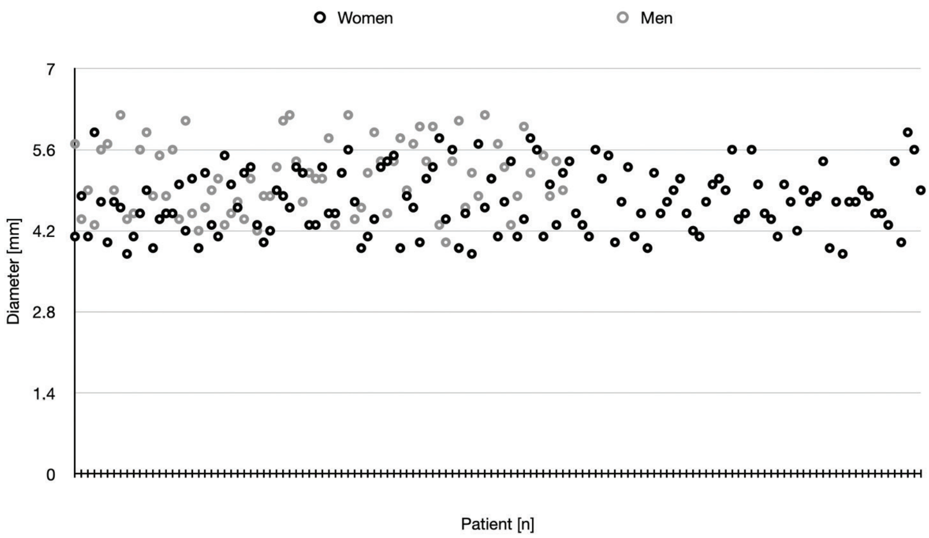


Figure 2. The diameter of the left common iliac vein in the studied population measured in a supine position — individual subject results including the patient gender

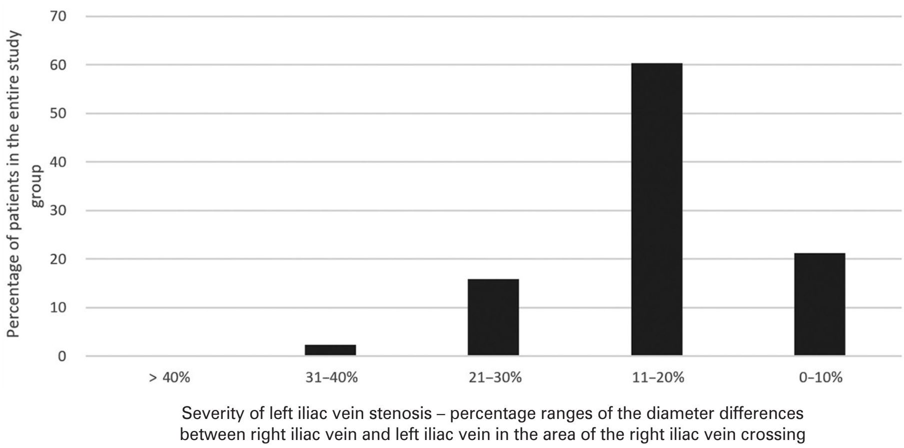


Figure 3. The percentage range of the difference in diameter between the right and left iliac veins in the study population

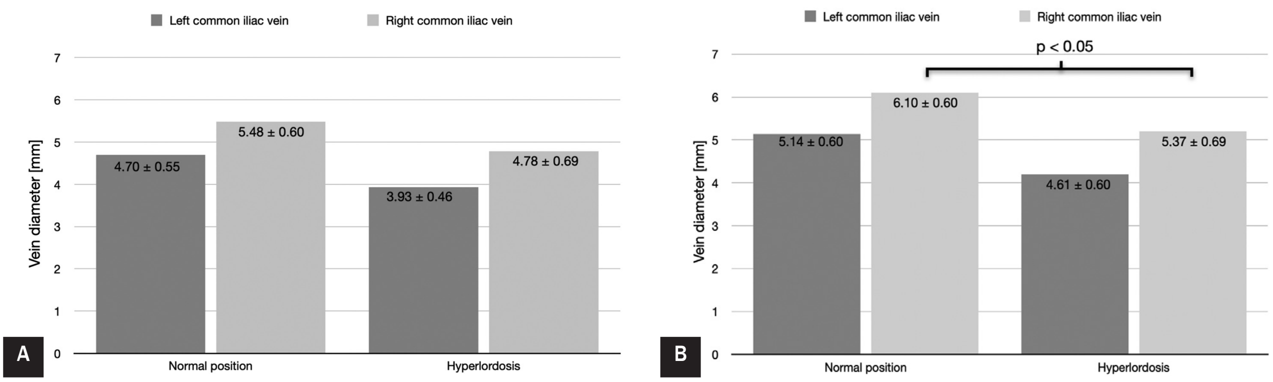


Figure 4. Comparison of right and left common iliac vein's diameter in two positions: normal supine and hyperlordosis among women (4A) and men (4B)

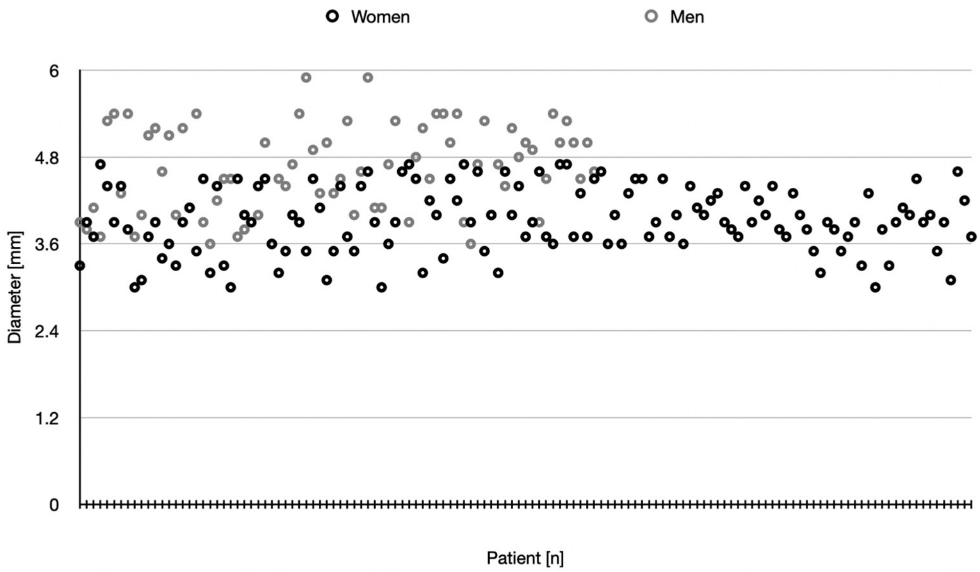


Figure 5. The diameter of the left common iliac vein in the studied population measured in the lumbar hyperlordosis position — individual subject results including the patient gender

CIV by 0.78 mm (± 0.27 mm), however, these differences were not statistically significant (Fig. 4).

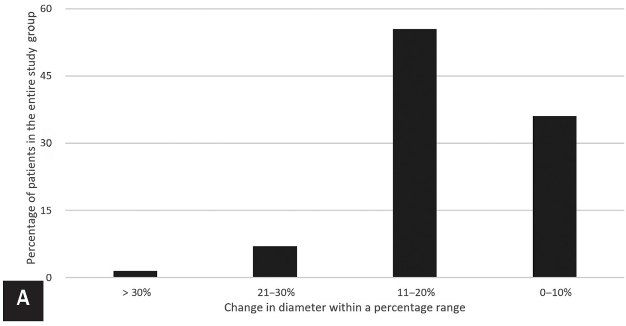
Considering the distribution of the results of the vein diameter measurements in the hyperlordosis position (Fig. 5), the analysis of the range of diameter changes in the study population was performed (presented in Figures 6a and 6b for right and left iliac veins, respectively).

According to the performed analysis in the hyperlordosis position changes of the left iliac vein diameter in the range of 21–30% were observed in 13.5% and over 30% in 0.9%. On the right side, the respective values were 7% and 1.5%. An interesting observation concerns the analysis of the diameter of the left common iliac vein in individual patients. As presented in Figure 7, despite the previously presented lack of this vein statistically significant mean diameter reduction in the whole study group in the lumbar hyperlordosis position, the shift towards low left iliac vein diameter in a significant number of patients was noticed.

The last step of the analysis concerned the comparison between the group of asymptomatic and symptomatic patients (positive for at least one symptom potentially related to the CVD occurrence as mentioned in the methods). As described in the material and methods — most of the symptomatic patients declared the presence of bilateral symptoms in the lower legs. In the analysis, there was no statistically significant correlation between the presence of the reported symptoms in the left leg and the diameter reduction between the right and left iliac veins.

Discussion

According to the available literature, there is very limited knowledge about the prevalence of left iliac vein compression as well as May-Thurner syndrome in the young and very young population. Considering the onset of the clinical symptoms and signs of the May-Thurner syndrome, in most of the studies and reported ca-



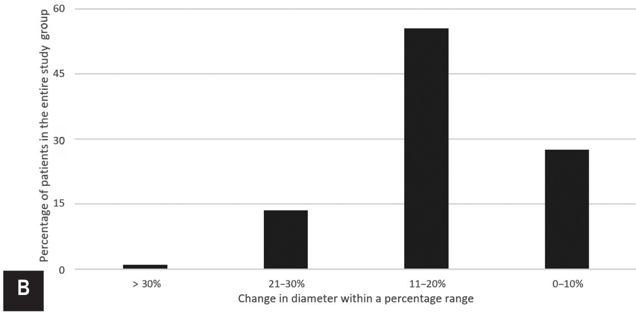


Figure 6. Percentage change in the diameter of the right common iliac vein (6A) and left common iliac vein (6B) in the hyperlordosis position compared to supine position measurements (baseline)

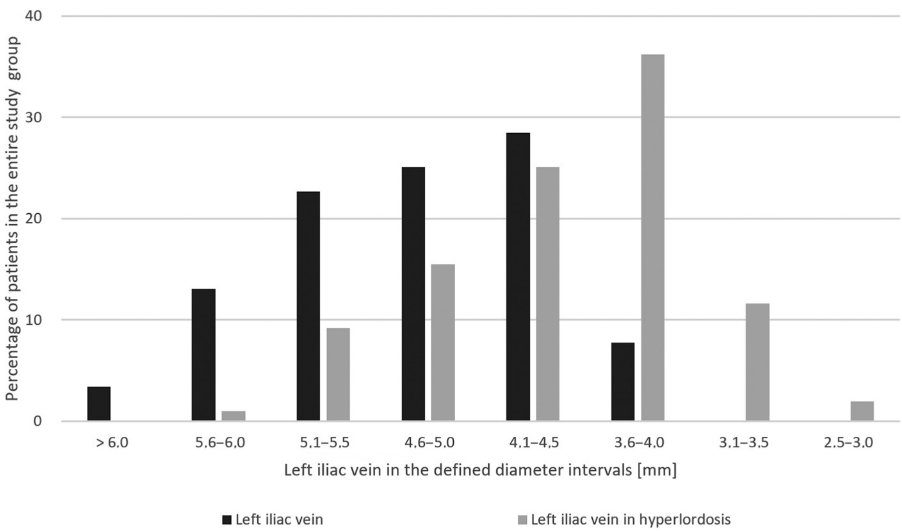


Figure 7. The per cent of the patients in the specified intervals concerning the diameter of the left common iliac vein measured in the supine position or supine position with hyperlordosis

ses, the older patient population is investigated. Also, in the studies based on the CT and MR evaluation, mostly older than in the present study subjects were examined. In the retrospective study published by Kibbe and co-workers focused on the CT result analysis, the prevalence of the asymptomatic left iliac vein compression was 24% and the mean age of the population was 40 years (range 19–85 years). The mean compression of the left iliac vein was 35.5% in the range from 5.6–74.8% and in 66% of the study subjects, compression greater than 25% was observed (in 24% compression greater than 50% was described) [4]. Correa and co-workers on the base of 590 CT examination results found left iliac vein compression presence in 14.74% of the cases. The mean age of the patients with recognized compression was 41.4 years with the range of the vein diameter in the compression point from 2.67 mm to 4.97 mm [5]. In some studies, the prevalence of significant left iliac vein compression was higher. A cross-sectional study carried out by Nazzal et al. on unselected population revealed that over 70% compression within the left iliac vein was present in 59 (19.6%) patients out of all 300 asymptomatic subjects. Compression over 50% was present in 44.7% of the studied patients [21]. In the present study population, the prevalence, as well as the severity of the left iliac vein stenosis, was relatively low with the biggest number of patients presenting compression not exceeding 20%. In 15.9% of the patients, a 21–30% diameter decrease was noticed and only in 2.4% the diameter reduction over 30% (but not exceeding 40%) was found. None of the patients presented stenosis over 50%. The low rate of potentially significant stenosis in the present study in male and female populations can correspond with the young patient age as well as relatively limited symptomatology noticed (no C3–C6 patients, no patients with venous claudication or DVT cases in the group). According to epidemiological studies, the ageing of the population can significantly increase the rate of CVD prevalence [36]. In terms of May-Turner syndrome and left iliac vein compression presence, the potential age-related anatomical condition changes should also be taken into consideration. As mentioned before, according to the literature, the highest prevalence of MTS is observed in the middle-aged female population and does not increase in the very old population.

It is still difficult to establish the level of the iliac vein compression/stenosis which can be directly related to the CVD symptom and sign occurrence. Also, the exact prevalence of May-Thurner syndrome remains still the subject of discussion and is estimated to vary between 2 to 24% of people with lower leg venous symptoms [8]. In the available literature, contradictory reports can be found. In the study published by Giacon Costa and co-workers, based on the assessment of the presence and severity of the iliac vein compression by MR imaging, no statistically significant correlation between CVD symptoms and the presence of the left iliac vein compression was found [37]. Opposite results were presented by Liu and co-workers. Based on the CT evaluation, the reported rate of iliac vein compression was higher in the CVD patients (53.3%) than in the control group (22.1%) ($p < 0.001$). Also, the duration of CVD was positively associated with the iliac vein compression severity and additionally left iliac vein compression was an important factor corresponding with varicose vein recurrence [38]. Another cohort study by Raju and Neglen confirmed, on a group of 4026 patients with CVD that 896 of them (22%) had iliac venous obstructive lesions [39]. In the series of de Wolf [40] and co-workers 36 cases (57.1%) of MTS from 63 patients with either venous claudication or venous disease were identified [41].

Such observations concerning both, the prevalence as well as the severity of the compression, were not confirmed in the present study material. The bilateral lower leg complaints (symptoms) concerning most of the symptomatic patients in the study cohort suggest the role of the other, not related to the left iliac vein compression, factors in CVD development. Another factor which should be taken into consideration in the result evaluation is a relatively low prevalence of CVD in the study group as well as the exclusion criteria used in the patient qualification (no DVT as well as postthrombotic patient included).

Following Virchov's triad principles, venous obstruction itself is just one of the factors influencing thrombosis occurrence. Coagulation cascade activation (hypercoagulability) as well as endothelial cell activation/injury can be related to several known as well as undiagnosed conditions influencing the other triad compound presence [42]. The presence of comorbidities applied to treatments as well as other patient-dependent factors should be always taken into consideration in the DVT risk assessment.

The acute symptoms of MTS are one of the most visible clinical presentations of the iliac vein compression and concomitant intraluminal spur presence. According to the literature, the prevalence of iliac vein compression as well as other kinds of iliac venous obstruction in patients with proximal, iliofemoral DVT remains high. Choi et al. confirmed the presence of the left common iliac vein compression in 137 out of 201 patients (68.1%) with symptomatic DVT, who underwent endovascular treatment [22]. Another study by Chung et al. [17] based on the cohort of patients with iliofemoral DVT documented among patients of the left side DVT 61.3% cases of the left common iliac vein compression by the right common iliac artery [23]. Chen and co-workers comparing CT examination results of 60 proximal left iliofemoral DVT patients, 19 right side iliofemoral DVT as well as 218 control subjects, found significantly higher left iliac vein compression levels in the patients with left leg DVT (77%) than other groups [43]. Narayan and co-workers suggest the possible association of the proximal DVT presence and > 70% left iliac vein stenosis [44]. In the populations of the present study, the diameter of the right common iliac vein ranges from 4.4 mm to 7.5 mm. The respective value for the left common iliac veins was from 4 mm to 6.2 mm in males and 3.8 mm to 5.9 mm in the female population. In most of the patients, a diameter over 4 mm in the standard supine position was noticed. Only in 7.73% of subjects, the left iliac vein diameter below 4 mm was observed but none of the patients had a left iliac vein diameter below 3.5 mm in the standard supine position. The use of the provoked hyperlordosis manoeuvre, as described in the protocol, increased the rate of the patients with iliac vein diameter below 4 mm, as well as with the diagnosis of the cases with lower left iliac vein diameter in the region of the right iliac artery crossing (11.6% of the cases with diameter 3.1–3.5 mm and 1.9% of the cases of the diameter 2.5–3.0 mm). None of the patients presented complete iliac vein lumen obstruction, however, due to the imaging study technique used the authors could not verify the presence of additional intraluminal spurs in the studied veins.

The complexity of the anatomy of the aortic bifurcation as well as the relationship between iliac vein confluence and the spine in this region suggest the possible influence of the musculoskeletal abnormalities on the local condition and level of the potential iliac vein compression. According to the exclusion criteria, the patient with lumbar degeneration as well as known vertebral pathology in this segment was excluded from the present study. One of the possible conditions, which can influence the anatomical relationship in this location is also lumbar hyperlordosis. Hyperlordosis can be related to spinal pathology but also other physiological factors such as pregnancy, type of physical exercises, the position of working or being overweight. In the study performed on the volunteers without known vertebral column pathology, lumber hyperlordosis was provoked by the standard roller positioned under the patient's lumbar spine. Despite the fact of the lack of statistically significant differences concerning the size of the left iliac vein in the entire group of study patients, the rate of the reduction of the vein size differs between the patients from 0 to more than 30%. As mentioned above lumbar hyperlordosis resulted also in the narrowing of the left common iliac vein in the place of the right iliac artery crossing to the lower diameters, in some of the patients not exceeding 2.5 or 3 mm. Since in the present study only the iliac vein diameter was measured, the haemodynamic significance of these observations should be further investigated. In terms of DVT occurrence, according to the retrospective study results presented by Carr and co-workers, each 1 mm reduction of left common iliac vein diameter increased the risk of lower leg DVT occurrence by a factor of 1.68, and in DVT patients [45]. Also, in CVD patients these observations seem to be of potential clinical importance especially in terms of the high prevalence of CVD in obese patients as well as due to the possibility of the influence of pregnancy-related hyperlordosis on the lower leg venous outflow. The iliac vein obstruction, including both, stenosis and occlusion are also potentially important factors leading to pelvic venous hypertension in patients with symptomatic pelvic venous disorders. In the recently published SVP classification focusing on pelvic vein disease, the obstructive compounds including left renal vein compression and also iliac vein stenosis/obstruction have been included [16].

Some limitations of this study should be mentioned. The limited accuracy of US diagnostics as well as the lack of the possibility of the correct intraluminal spur evaluation can for sure influence the results including the potential iliac vein obstruction prevalence and severity. According to the VIDIO study results, implementation of intravascular ultrasound (IVUS) in patients with suspicion of iliac vein obstructive changes can significantly increase the rate of the positive diagnosis for intra- and extraluminal pathology leading to proximal venous obstruction [46]. Several other studies as well as current guidelines confirmed the utility of IVUS in iliac vein stenosis/obstruction diagnostics and treatment. The young, limited age of the population as well as the lack of the haemodynamic assessment of the reported iliac vein diameter changes should also be mentioned. None of the patients underwent also imaging studies of the vertebral column to exclude possible asymptomatic changes as well as to assess their physiological lordosis.

Conclusions

Left common iliac vein compression may be anatomically conditioned at least in some of the young population individuals. Lumbar hyperlordosis influence on the left common iliac vein diameter suggests that also in healthily individuals, an incorrect spinal position can promote the occurrence of the left iliac vein compression. Further studies are needed to assess the haemodynamic influence of these findings on the lower leg venous outflow.

Conflict of interest

None declared

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Address for correspondence:
Lek. Ewa Mędoń
Department of General Surgery, Vascular Surgery, Angiology and Phlebology,
Medical University of Silesia,
Ziołowa 45/47, 40–635 Katowice, Poland
phone: (32) 359 81 98
e-mail: ewamedon95@gmail.com

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