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REVIEW ARTICLE

May-Thurner syndrome: an integrative review

Síndrome de May-Thurner: uma revisão integrativa

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ABSTRACT

Introduction: May-Thurner syndrome (MTS) is characterized by extrinsic compression of the left common iliac vein (LCVI). Diagnosis is made by combining clinical findings with non-invasive or invasive tests, and treatment is based on conservative or invasive measures, which can be open or endovascular surgery. **Objective:** To highlight the best diagnostic methods, as well as the positive and negative points of each method, and to demonstrate the superiority of endovascular treatment in comparison with conventional treatment. **Methods:** This is an integrative literature review, using the data portals LILACS, Google Scholar and PubMed. Twenty-six studies were used as a theoretical framework. **Results:** The searches resulted in 8 types of studies, with a predominance of case reports due to the scarcity of randomized clinical trials. These were conducted in 10 different countries. **Discussion:** MTS is characterized by signs and symptoms of chronic venous insufficiency (CVI) and deep vein thrombosis (DVT) and pulmonary thromboembolism (PTE). Ultrasound is the initial examination associated with contrast-enhanced CT, angiotomography, angioresonance or endovascular ultrasound (IVUS). Initial treatment is conservative and in resistant forms, conventional or endovascular surgical therapy is used. **Conclusion:** TMS is associated with cardiovascular alterations, mainly CVI, DVT and PTE. Some examples of diagnostic tests are CT, US and phlebography. After diagnosis, treatment should always be individualized depending on the patient's clinical condition.

Keywords: May-Thurner syndrome; Cockett syndrome; Endovascular procedures; Diagnosis.

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RESUMO

Introdução: A síndrome de May-Thurner (SMT) é caracterizada pela compressão extrínseca da veia ilíaca comum esquerda (VICE). O diagnóstico é feito pela associação da clínica com exames não invasivos ou invasivos e o tratamento baseia-se em medidas conservadoras ou invasivas, que podem ser por cirurgia aberta ou endovascular. **Objetivo:** Evidenciar os melhores métodos diagnósticos, assim como pontos positivos e negativos de cada método, e demonstrar a superioridade do tratamento endovascular em comparação com o tratamento convencional. **Métodos:** Trata-se de uma revisão integrativa de literatura, que utilizou os seguintes portais de dados: LILACS, Google Acadêmico e PubMed. Foram utilizados 26 estudos como arcabouço de referencial teórico. **Resultados:** O resultado das pesquisas resultaram em 8 tipos de estudos, com predomínio de relatos de casos devido à escassez de ensaisos clínicos randomizados. Esses foram realizados em 10 países diferentes. **Discussão:** A SMT cursa com sinais e sintomas caraterísticos de insuficiência venosa crônica (IVC) e trombose venosa profunda (TVP) e tromboembolismo pulmonar (TEP). A ultrassonografia é o exame inicial associada à TC com contraste, angiotomografia, angiorressonância ou ultrassonografia endovascular (IVUS). O tratamento incial é conservador e nas formas resistentes lança-se mão da terapêutica cirúrgica convecional ou endovascular. **Conclusão:** A SMT cursa com alterações cardiovasculares, principalmente IVC, TVP e TEP. Alguns exemplos de exames dignósticos são: a TC, USD e ou de flebografia. Após o diagnóstico, o tratamento sempre deve ser feito de forma individualizada a depender do quadro clínico apresentado pelo paciente.

Palavras-chave: Síndrome de May-Thurner; Síndrome de Cockett; Procedimentos endovasculares; Diagnóstico.

Introduction

May-Thurner Syndrome (MTS) or extrinsic compression of the left common iliac vein (LCIV), also known as Cockett Syndrome, Iliac Compression Syndrome or Iliac Vein Compression Syndrome (IVCS)[1,2], is characterized by the compression of the IACV by the right common iliac artery (RCA)[3] and was first described in the literature in 1956 by doctors May and Thurner, who examined 457 cadavers and observed IACV lesions in 22% of cases, classifying them as spurs[3,4]. In 1965, Cockett and Thomas classified the anatomical and clinical findings associated with TMS, in which compression of the IVC was associated with subsequent chronic venous insufficiency (CVI)[3].

MTS has an asymmetrical distribution between the sexes, being more prevalent in young women (around 72% of all cases), between the second and fifth decades of life (mean age at diagnosis 42 years)[5-7]. The prevalence is still unknown, but it is estimated that the condition affects 2 to 5% of patients with CVI[1,8].

This syndrome is essentially diagnosed by imaging tests. These can be subdivided into non-invasive, such as doppler ultrasound (USG), and invasive, such as the use of cross-sectional imaging with contrast, such as venography by computed tomography (CT) and magnetic resonance imaging (MRI), phlebography or intravascular ultrasound (IVUS)[9]. The main aim of these methods is to clarify the etiology of the disease, its severity and to locate possible anatomical alterations[10].

Paradoxically, despite the availability of these methods, there are no standardized and universally accepted imaging criteria for diagnosing the syndrome. In addition, there is significant variability in the degree of SVC compression, for the same patient, over short time intervals, using the same diagnostic means. Therefore, a single study may be insufficient to diagnose MTS, since there are variables, such as volume status, which significantly alter the degree of the vein compression[9].

The treatment for MTS can be conservative or through invasive procedures, namely venous decompression by

open or endovascular surgery. However, it must be always individualized, seeking the best therapeutic option for each patient's clinical condition. In the literature, there is no consensus regarding the need and type of treatment for asymptomatic patients, although it is agreed that they are more likely to develop thromboembolic phenomena. On the other hand, there is consensus on the need to treat symptomatic MTS[4].

Taking this into consideration, several studies have recently demonstrated the efficacy of endovascular treatment in patients with venous thrombosis associated with MTS. The main advantages of endovascular treatment are reversal of the obstructive component and preservation of valvular function. This is achieved by chemically dissolving the thrombus, which restores normal flow and therefore prevents the mentioned complications. Furthermore, it allows the mechanical obstruction caused by extrinsic compression to be corrected, reducing the risk of new events and shortening hospital stays, as well as allowing patients to return sooner to their normal work activities[8,11].

Based on this, there is a problem with the lack of standardization of diagnostic methods for TMS and the constant need to combine several tests in order to reach a full diagnosis, which is not very cost-effective for public health. In addition, there is still little access to endovascular treatment and a lack of reliable scientific evidence to support the greater effectiveness of this therapy. The goals of this study are, therefore, to highlight the best diagnostic methods for this comorbidity, as well as the positive and negative points of each method, and to demonstrate the superiority of endovascular treatment compared to conventional treatment. As a result of this study, there will be a change in the medical paradigm in relation to this comorbidity, with a new direction and better results in the diagnosis and treatment of MTS.

Methods

This is an integrative literature review aimed at synthesizing scientific knowledge on the subject so that clinical and surgical practice can be as effective and resolutive as possible. This study was built on the guiding question: "What are the main diagnostic and therapeutic methods for MTS?". The search for articles was guided by the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) from August to October 2023 in the Latin American and Caribbean Health Sciences Literature (LILACS), Google Scholar and Publisher Medline (PubMed) databases. The Health Sciences (DeCS) descriptors used were: "May-Thurner Syndrome", "Diagnosis", "Therapeutics" and "Endovascular Procedures" with their respective variations obtained through Medical Subject Headings (MeSH). The Boolean operators AND and OR were used.

The inclusion criteria for the studies chosen were: articles available free of charge as full text; studies of the following types: original articles, case reports, dissertations and review articles; time delimitation between 2008 and 2023; texts available in Portuguese, Spanish and English; studies that fell within the objective of this integrative review. The exclusion criteria were: studies published in languages other than Portuguese, Spanish and English, due to lack of mastery by the researchers; studies published before 2008 were also excluded; articles available only in abstracts, paid-for articles, studies published in sources that are not available electronically, such as books, monographs, commentaries and letters to the reader were disregarded; studies that did not correlate with the topic and other reviews were excluded.

By applying the keywords and Boolean operators, a total of 156 articles were identified, distributed as 124 in PubMed, 1 in LILACS and 31 in Google Scholar. After applying the inclusion and exclusion criteria, a total of 44 articles were found, 24 in PubMed, 1 in LILACS and 19 in Google Scholar. In order to avoid selection bias, this process was conducted by two researchers and the research results were then compared. When differences were found, they were discussed by all the researchers involved. After analyzing the titles and abstracts of these articles, 33 were selected to be read in full by all the authors, and then 26 articles were found suitable for the purpose of this integrative literature review and became part of the theoretical framework. The article selection process can be seen in Figure 1.

This article did not require the approval of the Research Ethics Committee (CEP), as it is a literature review article (Resolution No. 510 of April 2016 of the National Health Council and Ministry of Health).

Results

This study resulted in 27 articles which met the objectives and guiding question of this integrative literature review. These studies included 1 master's thesis (3.8%), 12 case reports (45%), 4 case-control studies (14,83%), 5 review articles (18,6%), 1 doctoral thesis (3.8%), 1 cross-sectional study (3.8%), 1 case series (3.8%) and 1 non-randomized clinical trial (7,5%). The search for articles to compose the theoretical framework of this review revealed that, because it is a rare disease and condition, there is a shortage of more robust literature, such as randomized clinical trials. It is therefore necessary for the scientific community to continue researching this comorbidity.

Additionally, the diversity of locations in which the studies were conducted shows that the disease can affect people of different nationalities and phenotypes. There were 3 studies in Portugal (11.12%), 9 in Brazil (33,5%), 2 in Turkey (7.40%), 3 in China (11.12%), 2 in the United States (7.40%), 1 in Singapore (3.8%), 2 in Argentina (7.40%), 2 in Spain (7.40%), 1 in Chile (3.8%) and 1 in England (3.8%) and 1 in Poland (3,8%).

As far as the aim of this study is concerned, it is possible to relate and compare the conclusions of the studies in relation to the main diagnostic methods, as shown in Table 1, and the conclusions in relation to the main therapeutic procedures, as shown in Table 2.

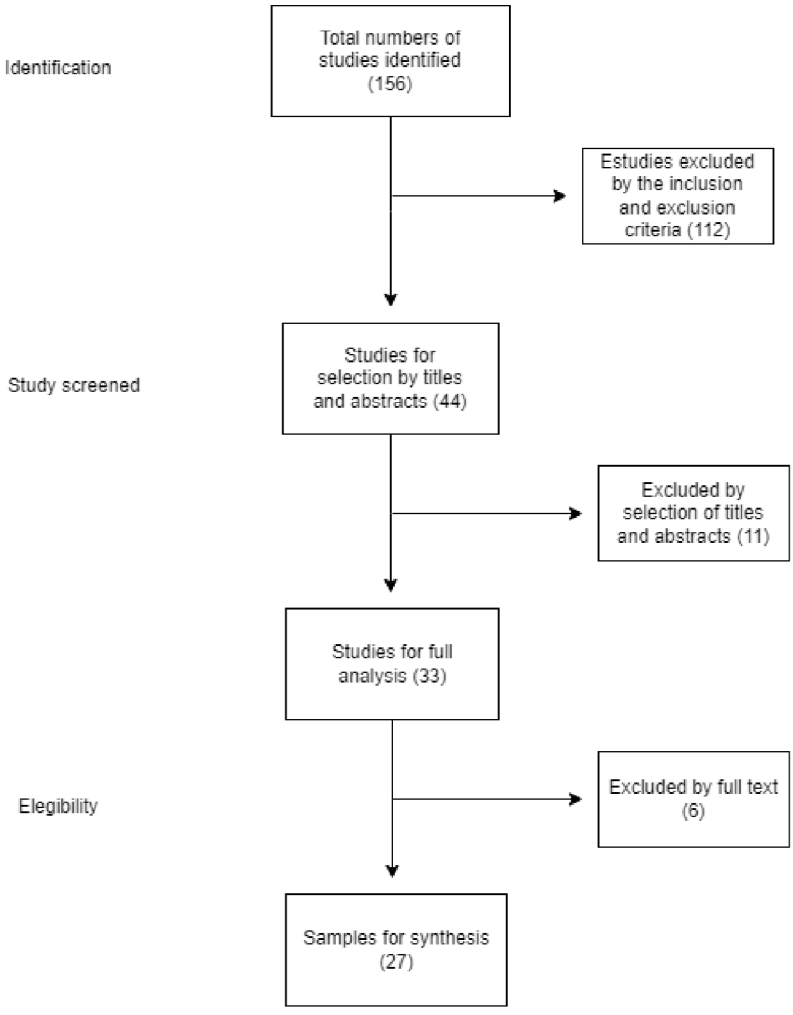

Figure 1. Article selection process.

Table 1. Articles that address diagnostic methods

Year	Authors	Country of origin	Results
2021	Morais JAS, et al.	Brazil	Non-invasive methods (color Doppler ultrasound) are reliable screening methods when performed specifically for the detection of this disease and by experienced examiners. However, ct angiography and MRI are more reliable tests.
2020	Rossi FH, et al.	Brazil	Endovascular ultrasound is considered the gold standard for diagnosis and has a sensitivity of 90% in detecting these obstructions, especially in patients with advanced CVI.
2020	Corrêa MP, et al.	Brazil	Intravascular ultrasound (IVUS), in addition to determining the degree of stenosis, is capable of calibrating the vessel before releasing the stent.
2019	Radaideh Q, et al.	United States	CT and MRI are acceptable diagnostic tools, but the gold standard remains intravascular ultrasound. Venography underestimates the presence of iliac vein compression.
2018	Chantre TFM	Portugual	Doppler ultrasound is an effective diagnostic method when performed by experienced examiners. However, CT and MRI are more dependable and are the method of choice for confirmation.

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Year	Authors	Country of origin	Results
2018	Machado M, et al.	Portugal	Doppler ultrasound has a sensitivity of 18% (with little use for diagnosis) and CT and MRI have similar sensitivities (80 and 75%). Phlebography confirmed in all patients and endovascular ultrasound is considered the best c-resence examination for the syndrome.
2016	Galang LD e Tulsidas H.	Singapore	Intravascular ultrasound provides direct visualization of iliac vein compression, effectively identifies mural abnormalities, and estimates vessel wall size.
2015	Nazzal M, et al.	United States	Computed tomography is effective in assessing the morphology of the iliac vein, iliac artery, and inferior vena cava.
2015	Cavalcante LP, et al.	Brazil	Noninvasive methods (color Doppler ultrasound) are reasonable screening methods when performed by experienced examiners with the aim of detecting this disease. However, angiotomography and angioresonance are more reliable exams and are still the method of choice for diagnostic confirmation, especially in our setting, where IVUS is not yet widely available, with multiple-view phlebography with pressure gradient measurements being elected as the most appropriate.
2011	Gurel K, et al.	Turkey	Contrast-enhanced MR venography appears to be an appropriate imaging technique for evaluating deep veins of the lower limb system.

Tabela 2. Articles that address therapeutic procedures

Year	Authors	Country of origin	Results
2021	Bashar K, et al.	United Kingdom	Patients with symptomatic iliac vein compression will likely benefit from a combination of intravenous treatment at the time of efinitive, including stenting to maintain efin patency and prevent recurrent deep vein thrombosis and/or postthrombotic syndrome.
2021	Morais JAS, et al.	Brazil	Endovascular treatment is more effective than conventional techniques, especially when combined with balloon angioplasty and stent placement.
2020	Rossi FH, et al.	Brazil	Endovascular treatment is currently considered the gold standard. It is performed with high technical success rates, low morbidity and mortality risks, high patency rates and therapeutic success, as long as the anatomical and pathophysiological characteristics that occur in the presence of these obstructions are considered.
2020	Bergantini Neto H, et al.	Brazil	Endovascular treatment, motivated by the worsening of the patient's symptoms after the conservative approach, was effective in the case described, carefully following the catheter-directed thrombolysis efinitive of our institution. The definitive treatment with angioplasty and self-expandable stent proved to be efficient and with low recurrence of new thrombotic events in short and medium term.
2018	Kong J, et al.	China	Endovascular treatment of recurrent varicose veins associated with iliac vein compression syndrome may improve symptoms and result in good long-term patency.
2018	Chantre TFM	Portugal	Endovascular intervention with thrombolysis and stenting remains the first choice for successful outcomes.

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Year	Authors	Country of origin	Results
2018	Machado M, et al.	Portugual	All cases in which simple angioplasty was performed required re-intervention with subsequent stent placement.
2018	Xu J, et al.	China	Endovascular treatment of Cockett Syndrome is safe and effective, is a good option for surgical treatment, and has beneficial effects in the medium and long term.
2017	Almeida BL	Brazil	Endovascular treatment with stent implantation in patients with significant iliac venous obstruction significantly decreased femoral pressure in the treated limbs
2015	Santos GTD	Brazil	Endovascular management of symptomatic patients represents a major advance in the treatment of this disease today, enabling hemodynamic restoration of the lesion, with satisfactory results.
2015	Cavalcante LP, et al.	Brazil	The endovascular approach has become the main therapeutic choice today, but treatment must still be individualized, seeking the best option for the individual characteristics and clinical condition of each patient.
2014	Martín ARG, et al.	Spain	The patient treated with thrombectomy associated with anticoagulant treatment evolved satisfactorily, similar to the patient treated with thrombectomy with surgical repair of the common iliac vein and subsequent placement of an endoprosthesis.
2012	Melo CCS, et al.	Brazil	Endovascular management enables hemodynamic restoration of the lesion, with satisfactory results in the short and medium term.
2011	Cunha Júnior JR, et al.	Brazil	Endovascular treatment in May-Thurner syndrome appears to be superior to conventional techniques and clinical treatment, and has been shown to be the treatment of choice in symptomatic patients.

Discussion

MTS presents with ileofemoral thrombosis and characteristic signs and symptoms of CVI and DVT, such as varicose veins, edema and pain in the left lower limb, trophic changes and ulcerations of the lower limb, and more serious complications such as pulmonary thromboembolism (PTE)[4,12-14]. Therefore, the treatment of symptomatic cases is imperative and must be individualized. The diagnosis of DVT should be suspected in any patient with the symptoms described above, and the Wells criteria help define this diagnosis. In addition, the anatomical variant that characterizes SMT is a variable that should be considered in these cases of suspected DVT[13,15]. In this respect, the May-Thurner Phenomenon (isolated anatomical anomaly) may correspond to the first stage of the disease, and its asymptomatic nature prevents us from knowing the comorbidity precise prevalence. This symptomless stage may remain until some event triggers the onset of the syndrome, such as pregnancy, prolonged immobilization or surgery[7,16].

The patterns of iliac vein compression in patients with CVI can be diverse, and the most common anomaly is compression by the right common iliac artery against the anterior border of the fifth lumbar vertebra (77.5%)[7,11], followed by the association between the right and left common iliac arteries (47.5%), and in third place compression of the left common iliac artery alone (18%)[7]. Because the most prevalent pattern is compression of the SIV by the LIA, symptoms tend to be asymmetrical and in the left lower limb (LLL)[11,17].

Diagnostic methods

Currently, the diagnosis is made by morphological analysis of the obstructions, since there is no hemodynamically dependable test[2]. In some imaging studies, compression of the IVC may appear as a normal variant rather than a pathological finding, so there is no need to treat asymptomatic compression. Therefore, imaging exams must be complemented by a compatible clinic of symptomatic patients in order to be more effective[18].

Intravascular ultrasound (IVUS)

Endovascular ultrasound (IVUS) is the most accurate diagnostic test. This method consists of a catheter with an ultrasound system at its distal end, which provides high-resolution imaging, which is positioned inside the vessel to be studied, and can determine the size of the vessels, the internal morphology, small trabeculae and beams and the degree of stenosis, and provide facilitation for stenting[7,9,10,16,18].

IVUS is more sensitive in detecting iliac vein compression than conventional venography, since in 304 symptomatic limbs venography was able to detect obstruction in 50% of cases compared to the 80% detection capacity of IVUS

in the same veins[18]. In addition, 36% of patients who had normal venograms after thrombolysis had an obstructive lesion with residual intraluminal thrombus visualized by IVUS[4].

However, despite its apparent superiority IVUS still its price against it, since it is expensive, and requires a lot of embedded technology for its use[2,12].

Doppler ultrasound

Doppler ultrasound is an available diagnostic method, especially for screening and initial assessment of Cockett's syndrome, as it is non-invasive, simple to perform and low risk[2,4]. The main changes that can be seen in this test are: compression of the IVC, changes in venous flow associated with respiratory function, turbulence and increased blood velocity when compared to the same test on the right lower limb[11]. In addition, it is highly accurate in detecting venous insufficiency and acute iliofemoral deep vein thrombosis, findings associated with compression of the IVC[2,4].

However, it is not a sufficiently sensitive test to detect compression of the IVCV or its intraluminal defects, since visualizations of the IVCV are often obscured due to its deep location, the presence of overlying intestinal gas, and being examiner-dependent, therefore it can fail in around 20% to 50% of cases[2,9,10,16,18]. This diagnostic method has a sensitivity of 79% in the external iliac vein and 47% in the common iliac vein[18].

When compared with IVUS, color Doppler US showed that a velocity ratio ≥2.5 through the point of greatest obstruction was the best parameter for diagnosing obstruction ≥50%. Thus, Doppler ultrasound showed an accuracy of 86.7%[2,4]. In addition, other signs that can be found on USG can indirectly indicate compression, such as: colored flow demonstrating mosaic flow, indicating post-stenotic turbulence due to proximal venous stenosis; absence of phasic blood flow; abnormal valsalva response with continuous flow during the maneuver[18].

AngioTC

CT angiography can assess both the venous and arterial territories, thus providing a more comprehensive evaluation. Axial section images are the best for visualizing the inferior vena cava and iliac veins[18]. Diagnostic performance has been significantly increased by the development of new contrast media that persist longer in the circulation, increasing the likelihood of the target vein being visualized[4].

The diagnosis of SMT can be facilitated by the use of computed tomography angiography (100% sensitivity and 98% specificity for detecting DVT) as it overcomes obstacles such as gas and abdominal fat in obese people by providing greater diagnostic accuracy. In addition, CT is able to help determine the point of greatest compression, the diameters and lengths of stent required, and also establish the best access route for treatment[2]. The use of CT angiography may have some additional advantage points, for instance the ability to exclude alternative causes of compression, such as pelvic masses and malignancy, and the analysis of collateral circulation which may corroborate the diagnostic hypothesis of iliac vein compression[18].

Compared to USG, CT has a shorter examination time, is not examiner-dependent and has better visualization of the pelvic veins, making it more accurate in identifying iliofemoral vein thrombosis. However, CT requires a large volume of contrast and cannot be performed during pregnancy or in individuals with altered kidney function. In addition, CT can show changes in diameter according to changes in breathing, the cardiac cycle and dorsal decubitus[7,18].

AngioMRI

This method has high sensitivity and specificity in confirming the diagnosis of iliac vein compression, it has the advantage of showing collateral veins and making it possible to assess retrograde flow in the ipsilateral iliac vein, as well as not emitting radiation. On the other hand, it is contraindicated in patients using older pacemakers and other metallic implants, and does not show the non-laminar venous flow that can be seen in patients with iliac vein obstruction[18].

MRI provides similar information to CT with better characterization of the pathology, as well as additional assessment of hemodynamic significance, demonstrating pelvic collaterals and reversal of flow[1,11]. Some cases of left iliofemoral venous thrombosis associated with compression of the left common iliac vein are not diagnosed due to the excessive use of non-invasive methods, since these techniques have their limitations, thus resulting in underdiagnosis of this pathology[19].

Angioresonance, however, needs more studies to be compared with other methods. The information in the literature comes only from the study by Massenburg et al.(2015)[20] who concluded, after evaluating 46 patients, that MRI compared to IVUS has a sensitivity of 100%, specificity of 22.7%, positive predictive value of 58.5% and negative predictive value of 100%[2].

Venography

Venography is an invasive diagnostic method and assesses the degree of hemodynamic repercussion of the lesion, compression of the IVC and the presence of coolater circulation[13,- 21,22,23]. This method was considered the gold standard for diagnosis for many years, but ends up failing in up to 1/3 of cases when compared to endovascular ultrasound[2].

Despite its previous status, venography is invasive and time-consuming, has an increased risk of bleeding, can only capture two-dimensional images and does not contribute significantly to extravascular information[18].

Treatment

The aim of treatment is to reverse the obstructive component and preserve valve function. This is done by chemically dissolving the thrombi, which restores normal flow and reduces the chance of post-operative complications,

reduces hospitalization time, as well as allowing patients to return to their normal work activities sooner[13]. The initial treatment for TMS is conservative, involving compressive therapy with elastic stockings or bandages, combined with phlebotomy, analgesic and/or anti-inflammatory drugs, depending on the need. For forms that are resistant to medical treatment and considerably interfere with the patient's quality of life, there is the possibility of surgical therapy, which is divided into conventional and endovascular, both aimed at reducing venous blood stasis in the LLM and preventing thromboembolic phenomena[12,16].

Historically, the use of anticoagulants and drug prophylaxis has been the chosen treatment for patients with TMS, but this therapeutic measure can be questioned, as anticoagulation does not eliminate existing thrombi and reversal of the anatomical variant of this syndrome is imperative[11,15]. An example of this issue is that 6 months after isolated anticoagulation, 88% of patients with iliofemoral DVT present moderate to severe venous obstruction[9]. Consequently, the patient is subject to complications related to post-thrombotic syndrome and recurrence of thrombi[13]. Clinical practice reveals excessive use of drug prophylaxis in low and moderate risk patients, which consequently reduces prophylactic efficiency and leads to iatrogenic anticoagulation, in addition to higher financial costs and risk of complications[22].

Regarding patients with MTS undergoing thrombolysis and stent placement, the ideal duration of anticoagulation is unclear. Guidelines state that in patients who have undergone any form of thrombus removal (thrombolytic or thrombectomy), anticoagulant therapy presents the same intensity and duration as in comparable patients who do not undergo thrombus removal[9].

Endovascular management is an effective treatment option and the main method, thus, presents itself as the gold standard of therapy, as it reverses the obstructive component and preserves valve function through the chemical dissolution of thrombi. This treatment method also has its biases, the main one being the recurrence of MTS, because even when combining treatment with anticoagulants, recent trauma, thrombotic disease, thrombophilia and stent placement below the inguinal ligament increase the risk of recurrence[2,13,23]. Endovascular treatment can aim at the resolution of acute or subacute venous thrombosis, the recanalization of occluded or stenotic venous segments and percutaneous transluminal angioplasty (PTA) with balloon and stent placement to ensure VICE patency[4].

Endovascular treatment is performed by placing self-expanding stents in the venous system, as they allow long distances to be covered and have adequate durability[4]. Thus, this technique, combined with balloon angioplasty and stent placement, provides excellent results in recanalizing the iliac venous system, subjecting the patient to minimal surgical trauma. Thus, endovascular treatment has proven to be superior to conventional techniques and clinical treatment, and has proven to be the treatment of choice for symptomatic patients, although there are still no long-term studies on the endovascular treatment of this syndrome[11,17,24].

Results regarding endovascular treatment in TMS corroborate its effectiveness, since in a group with acute DVT of VICE with a disease course of less than seven days there was a cure rate of 93.8%, in a follow-up period that varied from 3 months to 8 years, with a mean of 2.8 years. Furthermore, in a group with chronic obstruction of venous reflux with a disease course between 3 months and 14 years, there was a clinical cure rate of 100% in a follow-up period of 3 months to 8 years, with a mean of 2.2 years[25]. Additionally, in groups divided into non-thrombotic, acute thrombotic and chronic post-thrombotic venous obstruction, there was a similar success rate in endovascular treatment in the three groups (94%-96%). Primary and secondary patency rates were 96% and 99% in the non-thrombotic group, compared with 87% and 89% in the acute thrombotic group and 79% to 94% in the chronic post-thrombotic group[26].

In addition to directly resulting in VICE decompression, endovascular procedures have an impact on the consequences of TMS, such as pain and recurrent varicose veins in the lower limbs. There was improvement observed in all patients regarding the visual pain scale, a decrease in the venous clinical severity score, and all dermatitis and ulcerations were completely cured. Besides, no recurrent varicose veins were observed, and the patency of the iliac vein was 100% during the follow-up period[27,28].

Conclusion

Therefore, it can be seen from this integrative literature review that TMS involves cardiovascular changes that can affect various parts of the human body, mainly with CVI, DVT and PTE, in addition to other milder signs and symptoms that are quite common in average practice, which makes the knowledge about it extremely important for healthcare professionals. The disease can be diagnosed using non-invasive and invasive methods, each presenting its own advantages and disadvantages. Doppler ultrasound initially works as an excellent screening method, and in symptomatic patients with negative results, it is necessary to complement it with invasive methods, of which IVUS is the gold standard for diagnosing TMS. The main diagnostic method and, consequently, the gold standard, is endovascular ultrasonography, which allows determining the size of the vessels, the internal morphology, small trabeculae and trabeculae, and the degree of stenosis, and facilitates the placement of stenting. Treatment can be performed conservatively (compression therapy combined with phlebotonic, analgesic and/or anti-inflammatory drugs) or invasively (venous decompression by open or endovascular surgery). Regardless of the chosen method, treatment should always be evaluated and performed depending on the clinical condition presented by each patient. However, it is clear that, when endovascular management is chosen, the desired results are achieved satisfactorily in the short and medium term, since this method reverses the obstructive

component and preserves valve function through the chemical dissolution of thrombi, exposing the patient to minimal surgical risk.

Author's Contributions

We describe contributions to the papers using the taxonomy (CRediT) provided above:

Conceptualization, Investigation, Methodology, Visualization & Writing – review & editing: RROC; PBFO; HCS; TCAC. *Project administration, Supervision & Writing – original draft*: RROC; PRFO; HCS; TCAC; HCC. *Data curation & Formal Analysis*: RROC; PRFO; HCS; TCAC; HCC. *Participation in the approval of the final version of the manuscript:* RROC; PRFO; HCS; ThTCAC; HCC.

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