ΤΜΗΜΑ ΙΑΤΡΙΚΗΣ

ΣΧΟΛΗ ΕΠΙΣΤΗΜΩΝ ΥΓΕΙΑΣ

ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΕΣΣΑΛΙΑΣ

ΜΕΤΑΠΤΥΧΙΑΚΟ ΠΡΟΓΡΑΜΜΑ ΣΠΟΥΔΩΝ

ΥΠΕΡΗΧΟΓΡΑΦΙΚΗ ΛΕΙΤΟΥΡΓΙΚΗ ΑΠΕΙΚΟΝΙΣΗ ΓΙΑ

ΤΗΝ ΠΡΟΛΗΨΗ ΚΑΙ ΔΙΑΓΝΩΣΗ ΤΩΝ ΑΓΓΕΙΑΚΩΝ ΠΑΘΗΣΕΩΝ

Μεταπτυχιακή Διπλωματική Εργασία

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υπό

ΑΝΔΡΙΩΤΗ ΠΕΤΡΟΠΟΥΛΟΥ ΝΕΦΕΛΗ

Ειδικευόμενη ακτινολογίας

Υπεβλήθη για την εκπλήρωση μέρους των

απαιτήσεων για την απόκτηση του

Διπλώματος Μεταπτυχιακών Σπουδών

«Υπερηχογραφική λειτουργική απεικόνιση για

την πρόληψη και διάγνωση των αγγειακών παθήσεων»

Λάρισα, 2023

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Τίτλος εργασίας στα αγγλικά:

"The role of ultrasound in the assessment of Pelvic Congestion Syndrome."

Acknowledgement

I am sincerely grateful to my supervisor, Professor Pitoulias Georgios, for his invaluable contribution to my thesis. Without his continuous support, motivation, and guidance, this accomplishment would not have been possible.

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Abstract

An important cause of chronic pelvic pain, which is a commonly referred symptom especially in young female patients, is the Pelvic Venous Congestion Syndrome (PVCS). Pelvic and ovarian venous insufficiency plays a significant role in developing this condition. The syndrome is characterized by long-standing symptoms such as position-dependent pelvic pain, a perineal sensation of heaviness, and pelvic pain after intercourse, which might be linked to vulvar, perineal varicose veins, and/or atypical varicose veins of the lower limbs. Although the exact pathogenesis of the syndrome is still unclear, it is considered multifactorial. Various factors are involved in developing pelvic venous insufficiency, such as hormonal factors, valvular impairment and venous thrombosis. A notable percentage of the global population is affected by PVCS. Early diagnosis and proper clinical management are essential for those patients to prevent a significant loss of their quality of living. The purpose of this thesis is to examine the importance of a well-structured ultrasound protocol and evaluate the accuracy and the diagnostic value of ultrasound compared to the diagnostic gold standard venography.

- **Keywords**: pelvic congestion syndrome, pelvic venous insufficiency, ovarian vein insufficiency, ultrasound diagnosis pelvic congestion syndrome

Περιληψη

Μια σημαντική αιτία του χρόνιου πυελικού πόνου, που αποτελεί ένα συχνά αναφερόμενο σύμπτωμα ιδιαίτερα σε νέες γυναίκες, είναι το σύνδρομο πυελικής φλεβικής συμφόρησης (PVCS). Η φλεβική ανεπάρκεια των πυελικών και των ωοθηκικών φλεβών παίζουν σημαντικό ρόλο στην δημιουργία αυτής της κατάστασης. Το σύνδρομο χαρακτηρίζεται από την παρουσία χρόνιων συμπτωμάτων όπως πυελικός πόνος εξαρτώμενος από τη στάση, αίσθημα βάρους στο περίνεο, πυελικός πόνος μετά τη συνουσία, ο οποίος μπορεί να σχετίζεται με αιδοιοκολπικούς, περινεϊκούς ή/και άτυπους κιρσούς των κάτω άκρων. Η ακριβής παθογένεια του συνδρόμου είναι ακόμη ασαφής, αλλά θεωρείται πολυπαραγοντική. Διάφοροι παράγοντες, όπως ορμονικοί παράγοντες, βαλβιδική δυσλειτουργία και φλεβική θρόμβωση, εμπλέκονται στην ανάπτυξη της πυελικής φλεβικής ανεπάρκειας. Υπάρχει ένα σημαντικό ποσοστό του παγκόσμιου πληθυσμού που πάσχει από PVCS, επομένως είναι σημαντικό οι ασθενείς αυτοί να διαγιγνώσκονται έγκαιρα καθώς και να αντιμετωπίζονται κατάλληλα για να αποφευχθεί σημαντική απώλεια της ποιότητας ζωής. Ως εκ τούτου, στόχος της παρούσας εργασίαςς είναι να εξετάσει τη σημασία ενός καλά δομημένου διαγνωστικού πρωτοκόλλου υπερήχου και να αξιολογήσει την ακρίβεια και τη διαγνωστική αξία του υπερήχου σε σύγκριση με τη φλεβογραφία.

- **Λέξεις κλειδιά**: σύνδρομο πυελικής συμφόρησης, πυελική φλεβική ανεπάρκεια, ανεπάρκεια ωοθηκικής φλέβας, υπερηχογραφική διάγνωση σύνδρομο πυελικής συμφόρησης

1. Introduction

1.1 Chronic Venous Disease-Venous Insufficiency

Chronic venous disease (CVD) is a common process often overlooked in clinical practice. CVD accounts for a broad spectrum of venous abnormalities and chronic venous insufficiency (CVI) refers to the most severe manifestations of CVD. Pelvic Venous Insufficiency (PVI) and Pelvic Congestion Syndrome (PCS) are clinical forms of CVD where the valves in pelvic veins are affected (1),(2) Blood return abnormalities have a significant impact on the pathogenesis of all of them. There is a wide range of signs and symptoms of venous insufficiency, depending on the location of the insufficiency. Pressure and heaviness of the extremity, especially in the calves, is the most common complaint among patients (3),(4). It is well observed that the venous circulation of the lower extremities is often the most vulnerable. Varicose veins (VVs) are the most common clinical manifestations of CVD. However, clinical signs may affect any vein in the body. As well as in Pelvic venous congestion syndrome, the underlying mechanisms of the disease poorly understood and considered to be a combination of genetic and environmental factors. Although they are both medical problems that have a tremendous socioeconomic and psychological impact, they are often underdiagnosed (4),(5).

2. Epidemiology

Chronic venous disease causes significant morbidity and afflicts a great percentage of the global population. The socioeconomic impact is significant for both individuals and the healthcare system. Depending on the degree and the progression of the disease, some patients may experience a substantial loss in the quality of life (1). According to studies about the international prevalence of CVD, with CVI and VVs being the most common manifestations, there is notable diversity worldwide. The lowest probability of having CVD was noted in Asia, while Eastern Europe, followed by Western Europe, had the highest percentage. Underdiagnosis and a sedentary way of living are two more factors that will soon alter the percentages of the literature (5),(6), (7) (Epidemiology and Classification of venous disease, Eberhard Rabe,Felizitas Pannier,2018).

2.1 Risk Factors

Numerous risk factors play a crucial role in developing CVD, with varicose veins being the prevailing expression of the disease. However, there is heterogeneity in the prevalence of CVD, which differ from region to region, as obesity, lifestyle and other factors do.

Many clinical studies have shown that female genre and older age are two of the most important predisposing factors, increasing the probability of having VVs (5),(7). According to a survey published in July of 2022, the prevalence of VVs in women reaches 73%, while in men is approximately 56% (8). Moreover, the Framingham Study suggests that the risk factors do not contribute equally in both genres. For example, obesity and a sedentary lifestyle are risk factors that significantly impact women, while smoking does the same for men. The same research indicates that women have higher rates of CVD in the age range of 40 to 49 years and men in the age range of 70 to 79 years (3).

Pregnancy is highly associated with the development of VVs which results from a complex interplay of multiple factors such as multiparity, hormonal and physiological factors. Changes can occur even from the first pregnancy, with 40% of them having VVs, while the incidence and severity stage rises with increasing parity (9). Regarding the hormonal factors, a study conducted by Ciardullo et al. in 2000 indicates a correlation between elevated sex hormones and increased venous distension.

Another risk factor that is considered to contribute to the development of CVD and VVs, is obesity. Overweight patients experience multiple concurrent processes, including inflammation and increased pressure due to subcutaneous adipose tissue accumulation. This can lead to venous insufficiency by compressing the venous system (5),(11).

Prolonged standing and heredity are significant factors linked to the development of varicose veins (11). Lower extremity trauma, regular smoking, and prior deep venous thrombosis (DVT) are also believed to be important risk factors. Contrarily, physical activity was related to lower CVD risk and a crucial method to prevent its progression (5),(6).

3. Pelvic Congestion Syndrome-Chronic pelvic pain

Pelvic congestion syndrome (PCS) refers to venous insufficiency of the gonadal and internal iliac veins in the lower pelvis. The term was first described by Louis Alfred Richet in 1857 as a condition in females characterized by dull, non-cyclical pelvic pain and heaviness greater than a 6-month duration (12). When ovarian point tenderness on bimanual pelvic examination coexists with the symptoms mentioned above, the diagnosis of PCS has 94% sensitivity and 77% specificity. Other symptoms, such as pain after or during intercourse (dyspareunia), dysuria or urinary urgency, may coexist (2). Evidentially, symptoms are magnified with the menstrual cycle, extended periods of standing and activities that raise abdominal pressure(12). A 2003 publication by The American College of Obstetricians and Gynecologists reported that Chronic Pelvic Pain (CPP), where chronic applies to pain lasting more than six months, is a pretty common complaint among women aged 15-73.

Moreover, the same study indicates that CPP accounts for 10% of gynecologic referrals, 12% of hysterectomies, and 40% of laparoscopies(2). Approximately 16–31% of those cases of chronic pain account for pelvic venous insufficiency (PVI). Chronic pelvic pain is a common, not-specific symptom in many pathologies of different systems, such as gynecological, urological, gastrointestinal, musculoskeletal, or even psychoneurological systems. Therefore, PCS is often overlooked in the differential diagnosis(14).

Although men can experience pelvic pain as well, the term “chronic pelvic pain” (CPP) is used exclusively for women(15). Varicocele in men is similar to pelvic congestion syndrome (PCS) in women. However, since pelvic varicosities are not externally visible like varicocele, PCS can be easily misdiagnosed.For those reasons and a lack of methodological consistency and adequate evidence, it is not easy to find a well-defined diagnostic algorithm for PCS(12).

In addition to physical consequences, the socioeconomic impact is more than notable, having a health care cost of €3.8 billion per annum concerning European patients, £158 million in the UK, and U$881.5 million per annum in the US, according to a recent study published in 2017(15). Moreover, it cannot be overlooked that 15% of women suffering from CPP report missing work, and 45% experience declined work performance (2).

3.1 Anatomy

Venous drainage of the pelvic organs is achieved through the gonadal veins (ovarian veins in women and testicular veins in men) and the internal iliac veins, two distinct but connected venous pathways.

The uterus is drained mainly through four veins. Blood from the superior segment of the uterus is directed through the uterine or the gonadal plexus (pampiniform plexus) to the gonadal veins. The inferior part of the uterus is drained through the right and left internal iliac vessels (IIV). IIV is drained to the common iliac vessel and the inferior vena cava (IVC) on each side. IIV can occasionally be drained direct to IVC(Figure 1).

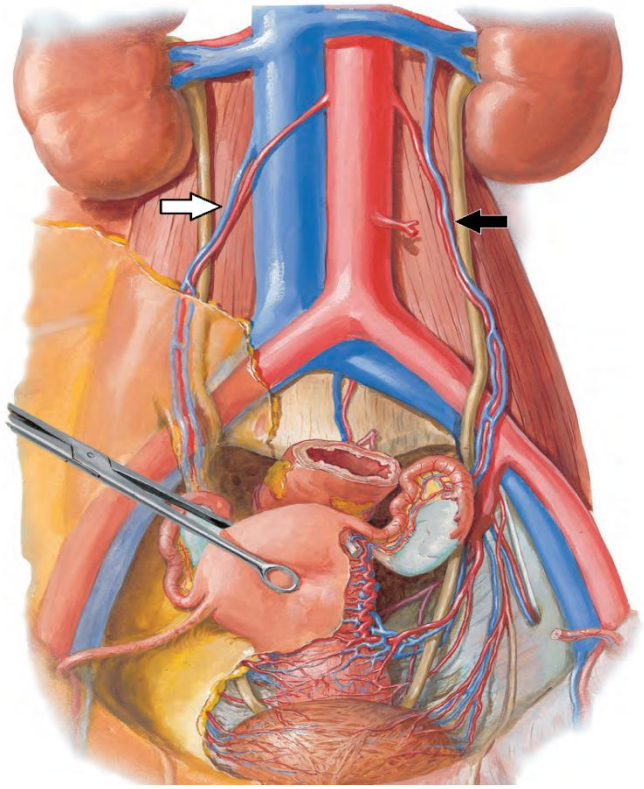


Figure 1: Anatomy of ovarian and renal vein and artery (Atlas of Human Anatomy 6th Edition, Frank Netter)

The ovarian venous plexus is created by the merging of vessels emerging from the parenchyma of the ovary and courses within the ovarian ligament. The right ovarian vein drains into the IVC at an acute angle in 90% of cases, and the remaining 10% drains into the right renal vein. The left ovarian vein drains into the mid-segment of the ipsilateral renal vein at an angle of 90˚ (Figure 2). Additionally, there is a left-side prevalence of PCS which some anatomical features can explain. The length of the left ovarian vein (LOV) is greater than that of the right ovarian vein (ROV) which, due to gravity, might render drainage more difficult in the erect position. The sigmoid colon,

also found on the left side, may compress the LOV during constipation. Depending on the area they drain, numerous pelvis veins classified as visceral branches and parietal are directed to the internal iliac vein. Visceral tributaries are the middle hemorrhoidal, internal pudendal, and vesicoprostatic plexuses in men, while the gonadal, uterine, and vesicovaginal plexuses are found in women.

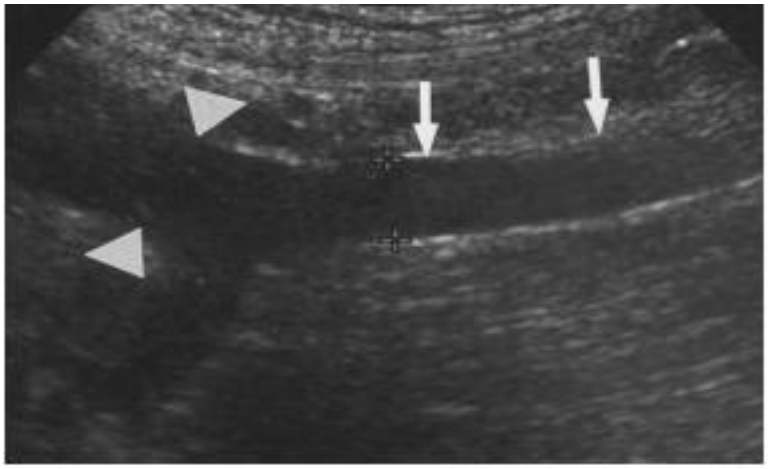


Figure 2:Dilated left ovarian vein (arrows) drains into left renal vein (arrow heads)

There are many interconnections between the superficial veins, pelvic veins, perineal superficial veins, and veins of the leg. The venous network of the lower limbs is affected by pelvic venous hypertension which is transmitted through specific points calles Pelvic leak points (PLP) or Pelvic escape points (PEP). Therefore, it is common for patients with PCS to develope atypical varicose veins such as vulvar (Figure 3), which are the most common, suprapubic, perineal and gluteal (16)(17)(18).

Figure 3: Vulvar and vaginal varicosities (The Whiteley Clinic)

3.2 Pelvic Leak Points (PLP)

Claude Franceschi was the first to describe three pelvic leak points in his study in 2005, where he analyzed varicosities of the lower extremity developed during pregnancy. Those are the perineal points (PP), inguinal points (IP) and clitoridian (or clitoris) points (CP). There are superior and inferior gluteal points (GP) and obturatorian points (OP) as well(19). Those are demonstrated in Figure 4.

The perineal point(PP) is located at the level of the labia majora of the vulva connecting the system of internal and external pudendal veins. Reflux through PP may occur in case of the incompetence of the internal pudental vein.

The inguinal point (IP) is the superficial round ligament of the inguinal canal where the round ligament vein connects wth the superficial veins. Reflux through IP is noticed in the incompetence of any vein of the pelvis, especially in case of varicose veins in the parauterine.

The clitoris point (C) can be found medially to the Sapheno Femoral Junction (SFJ) towards the clitoris. Reflux through this point may occur in case of incompetence of the internal pudendal vein.

The gluteal points (GI) are located in the intrapelvic part of the gluteal veins, at the level of the greater sciatic notch, above and below the pyriformis muscle.

The obturatorian point (OP) is located in the intrapelvic part of the obturator vein at the level of the homonymous foramen. It connects the deep veins of the muscles of the medial part of the surface of the thigh with the internal iliac vein (20).

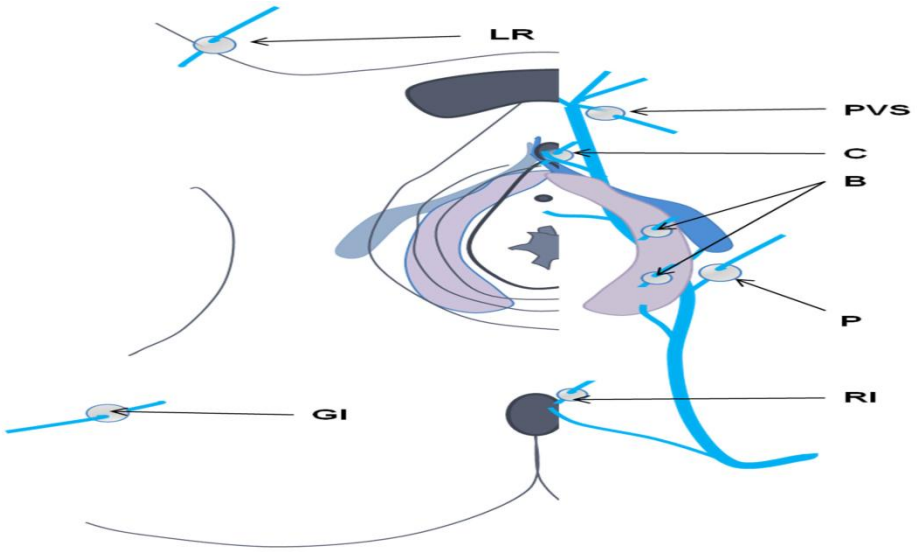


Figure 4: Pelvic Leak Points. LR: round ligament-IP, PVS: venous plexus of Santorini, C:cliroris point, B:bulbar or IP, P: perineal or PP and GI:lower gluteal(13)

Valves are usually found in the main trunks of the ovarian veins in 80%-90%, at the point where main trunks connect with the renal veins or inferior vena cava, while infrequently encountered in the IIVs (10% of the cases). Furthermore, in 15% of women, the ovarian vein valves appear absent and, typically, on the left ovarian vein. When they do exist, they are often incompetent on the left side rather than on the right (40% and 35%, respectively) (17).

3.4 Pathophysiology and classification

According to numerous older and recent studies, a combination of factors contributes to the pathogenesis of PCS, mainly through reflux of blood and venous obstruction. Pelvic venous insufficiency leading to PCS can be broadly classified as primary, usually referred to as venous reflux of the ovarian veins, and secondary, which involves venous occlusion of either the ovarian or internal iliac vein.

Primary PVI and PCS are gradually deteriorating processes involving venous valves or the venous wall, which will initially cause the dilation and weakening of the vein and eventually reverse blood flow.

Although the genetic predisposition of PCS remains unclear, several reports of premenopausal women with no risk factors suffer from the syndrome. According to studies, there is a strong family history among patients with VVs, with up to half of them having some genetic background. Mutations in several genes such as FOXC2, TIE2, NOTCH3, thrombomodulin, and the type 2 transforming growth factor–β receptor are associated with the development of VVs, suggesting that inherited predisposition may have an essential role in venous disease associated with PCS (21). Anatomical abnormalities that affect wall and valve integrity may also exist such as congenital deficiency of the ovarian venous valves. Another theory relates the existence of polycystic ovaries to the disease, although there is still insufficient evidence(16).

On the other hand, hormones and genes seem to play an essential role in the etiology of primary PVI. After several experiments in 2003, Stones et al. proved that gonadal and uterine veins are sensitive to ovary-produced hormones as opposed to femoral and iliac veins or vena cava. Stones found that this can increase the caliber of ovarian and uterine veins through the secretion of nitric oxide. Moreover, Progesterone is associated with SMC relaxation, vein dilation and weakening of the valves(5). Stone's theory is supported primarily by the fact that there is a decline in symptoms of PVI with menopause and by the broadly accepted pharmacological treatment of PVI, ovarian suppression (22).

Evidence suggests that pregnancy has the most vital etiological relationship to PCS. According to surveys and sources, nonparturient women over 40 have a 20% possibility of developing VVs, as a manifestation of CVD, versus multiparous women with a 40% or even up to 65% in case of 5 or more gestations (5). Palmer et al. proved that there is a raised volume of circulation and flow in the ovarian and pelvic veins during pregnancy (15). The capacity of those vessels may increase up to 60%. Additional intrauterine pressure in the pelvis, caused by the gravid uterus and increased weight, further the strain on those veins' valves and aggravate blood reflux. Multiple gestations and the lack of elastic recoil in the veins may also result in irreversible dilation and valve damage (15),(16).

Secondary PCS is referred to venous outflow obstruction of the ovarian or internal iliac vein. The most prevalent cause of secondary PCS is Deep Vein Thrombosis (DVT), with Virchow's triad summarizing the risk factors favoring clot formation. Vascular compression syndromes such as May-Thurner syndrome and Nutcracker syndrome have also been reported to cause secondary PCS. In both cases, the increase in venous endovascular pressure is the primary factor, leading to gradual venous dilatation and valvular insufficiency. Subsequently, prolonged dilation is followed by wall inflammation and, gradually, by the formation of multiple varicose veins in the pelvis. Moreover, dilation will trigger specific receptors of the wall, and blood stasis will cause local hypoxia, stimulating pain. Other possible molecular pathways lead to pain sensation such as the release of calcitonin gene-related peptide (CGRP) and substance P (16).

Primary and secondary PCS are different conditions, and thus, they are treated differently (15).

3.5 Classification of Pelvic Venous Disorders and Venous Compression Syndromes

Recent studies have established the term Pelvic venous disorders (PeVD) to describe women with chronic symptoms such as chronic pelvic pain (CPP), perineal heaviness and postcoital pain, along with the presence of atypical varices such as vulvar, perineal and varices of the upper thigh. The term includes several disorders like Pelvic Congestion Syndrome, May-Thurner syndrome, and Nutcracker syndrome that often overlap (23). These disorders were vastly underdiagnosed until recent years, making introducing more explicit criteria and classification essential. Therefore, the American Vein and Lymphatic Society developed 2018 the Symptoms-Varice-Pathophysiology (SVP) classification instrument for PeVD. This instrument includes three main domains. These are Symptoms(S), Varices (V), and Pathophysiology (P).

Table 1. Symptoms(S)

S_0	**No symptoms of a PeVD (no renal, pelvic, or extrapelvic symptoms)**
S_1	Renal symptoms of venous origin
S_2	Chronic pelvic pain of venous origin
S_3	Extrapelvic symptoms of venous origin
a	Localized symptoms (pain, discomfort, tenderness, itching, bleeding, and superficial venous thrombosis) associated with veins of the external genitalia (vulva and scrotum)
b	Localized symptoms associated with pelvic origin nonsaphenous veins of the leg. These include those related to pelvic origin varices of the posteromedial thigh (pain, discomfort, tenderness, itching, superficial venous thrombosis) and those related to sciatic/tibial nerve varices (pain, paresthesias). More generalized lower extremity symptoms and signs, such as heaviness and swelling, are classified with CEAP, not SVP.
c	Venous claudication

(24)

Clinical manifestations and varices of PeVD occur in four different anatomical zones demonstrated in Figure 5.zone 1 includes the left renal vein; zone 2 includes the gonadal, internal iliac, and pelvis veins; zone 3 vulvar varices, perineal varices, and varices of pelvic origin and zone 4 include the lower extremity veins. The latter is referred to as the superficial and deep vein network of the lower limbs with their tributaries, and it is classified with a different system, the CEAP classification system (clinical- etiological-anatomical-pathophysiological) (23),(24).

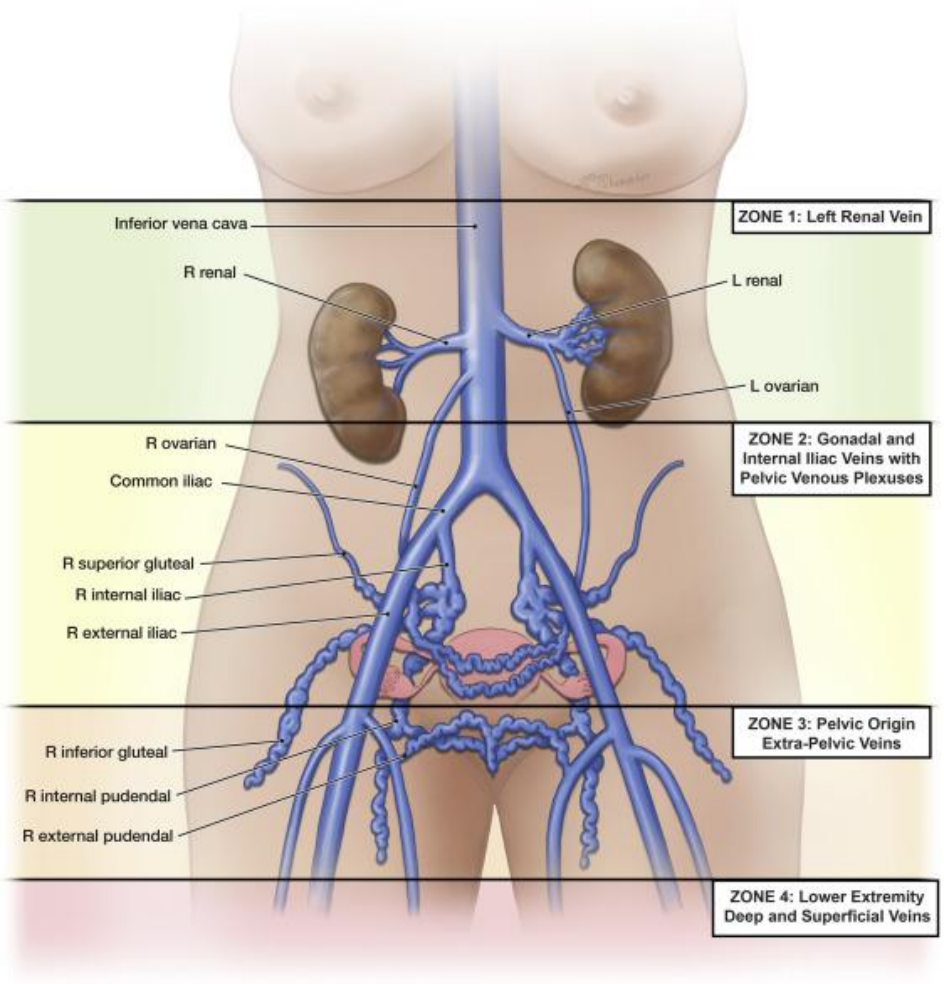


Figure 5 :Anatomical Zones (24)

Symptoms (S) are categorized from 0 to 3, corresponding to the descending anatomic zones, from renal symptoms to extrapelvic symptoms of venous origin, as presented in the **Table 1**.

Varices (V) may develop in three different areas of the pelvis. 1st on the renal pedicle, 2nd on the pelvic vascular plexuses, or 3rd on extrapelvic veins with pelvic origin. Varices of the lower limb may also occur and communicate with the latter group of extrapelvic varices. The therapeutic aim in these cases is to decrease the pressure in those reservoirs. The venous reservoirs are presented in **Table 2** (24).

Table 2. Varices (V)

V_0	**No abdominal, pelvic, or pelvic origin extrapelvic varices on clinical or imaging examination**
V_1	Renal hilar varices
V_2	Pelvic varices
V_3	Pelvic origin extrapelvic varices.
a	Genital varices (vulvar varices and varicocele)
b	Pelvic origin lower extremity varicose veins arise from the pelvic escape points and extend into the thigh. Includes visible varicosities, typically over the posteromedial thigh, as well as sciatic varices and other refluxing veins transitioning the pelvic floor, which are visualized only with ultrasound.*
c	Venous claudication

* CEAP classification must be included for complete characterization of lower limbs varices (24).

Pathophysiology (P) includes the anatomic (A), hemodynamic (H), and etiologic (E) subdomains seen in **Table 3**. Hemodynamic (H) abnormalities include Reflux (R), obstruction (O), or both (R, O). Obstruction may be thrombotic or non-thrombotic. When hemodynamic abnormalities are due to some congenital malformation rather than reflux or obstruction, the H subdomain should be omitted. Lastly, etiology (E) is characterized as thrombotic (T), non thrombotic (NT), or congenital (C) (**Table 4)**.

Table 1. Anatomy (A)

Abbreviation	**Expansions**
IVC	Inferior vena cava
LRV	Left renal vein
GV	Gonadal (testicular, ovarian) veins
LGV	Left gonadal vein
RGV	Right gonadal vein
BGV	Bilateral gonadal veins
CIV	Common iliac veins
LCIV	Left common iliac vein
RCIV	Right common iliac vein
BCIV	Bilateral common iliac veins
EIV	External iliac veins
LEIV	Left external iliac vein
REIV	Right external iliac vein
BEIV	Bilateral external iliac veins
IIV	Internal iliac veins
LIIV	Left internal iliac vein and tributaries
RIIV	Right internal iliac vein and tributaries
BIIV	Bilateral internal iliac veins and tributaries
PELV	Pelvic escape veins22 (“escape points”); inguinal, obturator, pudendal, and/or gluteal

(24)

Table 4. Etiology (E)

Thrombotic (T)	Venous reflux or obstruction arising from a previous episode of DVT
Nonthrombotic (NT)	Reflux arising from a degenerative process of the vein wall or proximal obstruction; Obstruction arising from extrinsic compression
Congenital (C)	Congenital venous or mixed vascular malformations

DVT (Deep vein thrombosis) (24).

For example, Nutcracker syndrome with flank pain and hematuria could be defined as S2V2PBGV, R, NT, and May-Thurner syndrome with left lower extremity edema as S0V0PLCIV, O, NT

4. Diagnosis of Pelvic Congestion Syndrome

The diagnosis of pelvic venous congestion syndrome is still considered a challenging task which first requires the exclusion of other, more common causes of chronic pelvic pain. Further imaging assessment is needed on clinical suspicion of PCS based on medical history and physical examination. According to current literature, several diagnostic tools are invasive and non-invasive to assess PCS. Transcatheter ovarian phlebography is an invasive imaging procedure that remains the gold standard in diagnosing PCS.

Doppler Ultrasound (DUS) is the first-line imaging modality in evaluating the syndrome. Among the non-invasive imaging, it is low-priced, widely available, and, unlike other modalities, has neither ionizing radiation exposure nor the need for a contrast agent. It provides anatomic and hemodynamic information, determining the direction and speed of blood flow with B-mode and Color Doppler ultrasound, respectively. However, a considerable disadvantage of ultrasound imaging is that it is an exclusively operator-dependent method. Therefore, a thorough knowledge of anatomy and pathology is required for a correct diagnosis of the pelvic veins and appropriate training in the use of ultrasound and the interpretation of its findings.

Moreover, the use of transabdominal (TAUS) and transvaginal (TVUS) ultrasound allows to exclude other pelvic pathologies, confirms the existence of pelvic venous insufficiency, to determine the anatomical level of the pathology and thus allows the classification of the syndrome, which is crucial for further diagnostic and therapeutic assessment. TVUS is considered superior to TAUS, according to most authors, since the pelvic venous plexus is better visualized, it does not require the patient's cooperation, and the examination is not affected by bowel gas or the BMI of the patient. Usually, patients referred from the vascular surgery department have been screened with transabdominal ultrasound and those referred from the gynecology department with transvaginal ultrasound. According to a survey conducted in 2017,Labropoulos et al. demonstrated that the most remarkable feature of sonography is that it provides real-time images and permits blood flow evaluation. The pelvic venous system is visualized in different positions of the patient, standing and supine, and during Valsalva maneuvers that increase diagnostic sensitivity. Standing position and Valsalva maneuvers will raise venous pressure in the pelvis, leading to dilation of the vessels and thus revealing even subtle reflux. Those features render Doppler Ultrasound (DUS) a unique diagnostic tool for the pelvis's venous incompetence and/or varicose veins. Although CT and MRI are essential diagnostic tools, the patient's obligatory supine position is restricted during the examination(25).

There are four regions of interest considering Pelvic Venous Pathology, and thus in case of clinical suspicion of PCS, those areas should be examined:

Renal Region:

DUS is highly important for assessing this area. The left renal vein can be compressed between the aorta and superior mesenteric artery (Figure 6) (Nutcracker syndrome) and this can be demonstrated by measuring peak systolic velocity (PSV) in the compression area (Figure 7). PSV there is higher than the velocity in the hilum (26). When ratios range from 4.0:1 to 5.0:1, there is a strong possibility of nutcracker syndrome. The transabdominal approach includes the measurement of the aortomesenteric angle (< 45˚ in favor of nutcracker syndrome) and demonstrating possible pre-stenotic dilatation of the left renal vein. Vessel diameter and the superior mesenteric angle can also be measured with CT and MRI. However, venous pressure measurements are more specific and thus, venography is preferred for assessing renal venous hypertension (27).

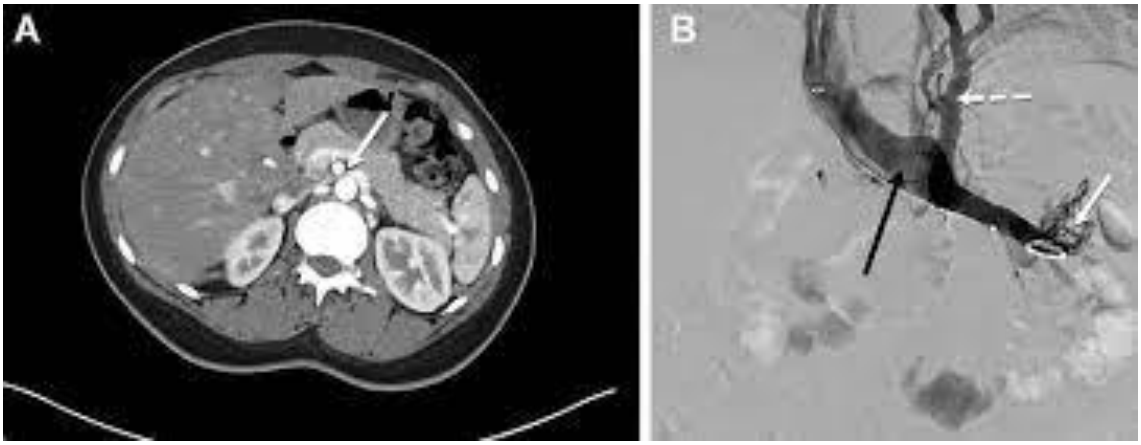


Figure 6: Compression of the left renal vein A: on the celiac artery and B: renal varices and collaterals due to compression of the left renal veiin (24).

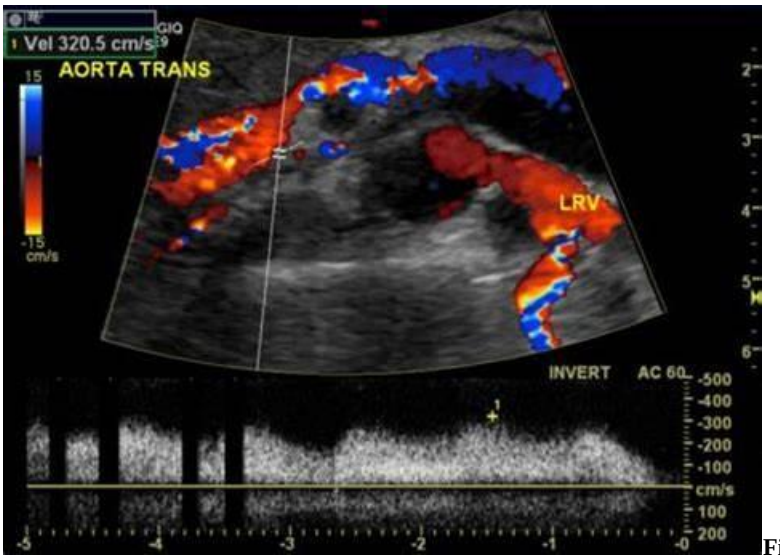


Figure 7: Doppler ultrasound demonstrating increased velocity in the compression area of left renal vein between aorta and superior mesenteric artery

Ovarian Veins, Pelvic Venous Plexus and Iliac Vein:

TAUS and TVUS are first-line modalities in pelvic screening for venous dilation, venous reflux and visualization of other pelvic varicosities. TVUS is better than TAUS as it provides better anatomical information. The possible presence of tortuous, dilated periuterine and perivaginal veins (trunk diameter ≥5 mm) or mild dilated venous plexuses communicating via transuterine veins should be examined as well (Figure 8) (28). Spontaneous or induced reflux with the Valsalva maneuver or by mild and prolonged compression of the abdomen can be demonstrated with DUS in the ovarian veins, which is a critical ultrasound criterion, or in the internal iliac veins and their tributaries (Figure 9). Slow flow velocity <3cm/sec or reversed caudal flow and spontaneous or induced reflux in the pelvic varices are also essential . CT and MRI are also helpful tools for identifying dilated vessels, while venography can indicate reflux(29). According to Park et al., pelvic varicosities up o 6mm and tortuous appearance of the ovarian veins are two more finings indicating PCS(30). Retrogate caudal flow in the gonadal veins can be detected with TAUS, TVUS, time-resolved MR angiography, phase-contrast MRI, or conventional venography(31).

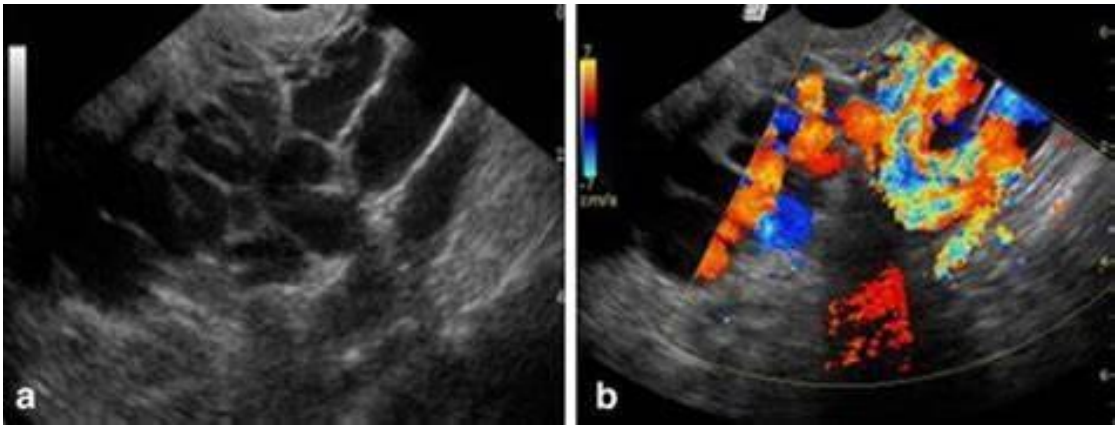


Figure 8: Dilated tortuous veins surrounding on TVUS of left ovary on B-mode (**a**) and Color Doppler(**b**) (30)

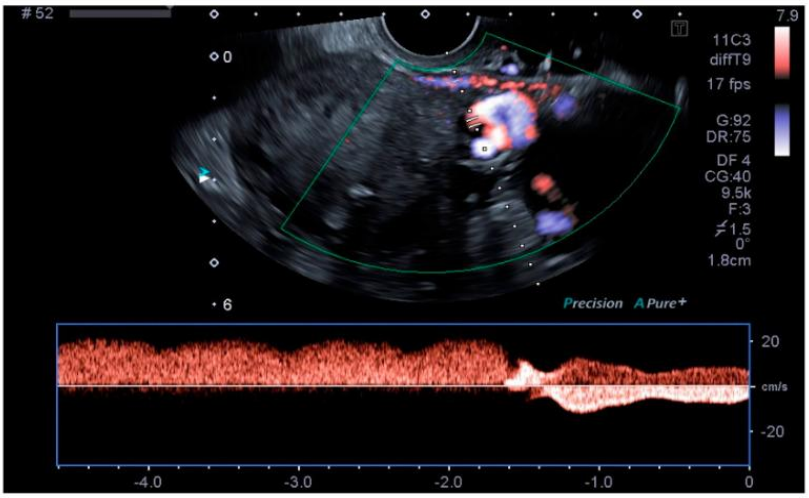


Figure 9: Blood reflux in pelvic varices during Valsalva maneuver(41).

Iliac veins are also examined for anatomical and hemodynamic findings suggesting external pressure, intra-lumen obstruction, or thrombosis, mainly with TAUS. However, TVUS provides excellent anatomical information on the internal iliac veins. May - Thurner syndrome is the most common iliac vein compression syndrome. It is characterized by the compression of the left common iliac vein from the right iliac artery on the sacrum or the fifth lumbar vertebra (32). The anatomical stenosis is revealed by calculating the diameter of the common iliac vein. At the same time, the symptomatic compression is confirmed by hemodynamic criteria. The loss of flow phasicity in the periphery(Figure 10), the reduction of flow in the left common and internal iliac vein and the inversion of flow in the unilateral internal iliac vein are some of them (33).

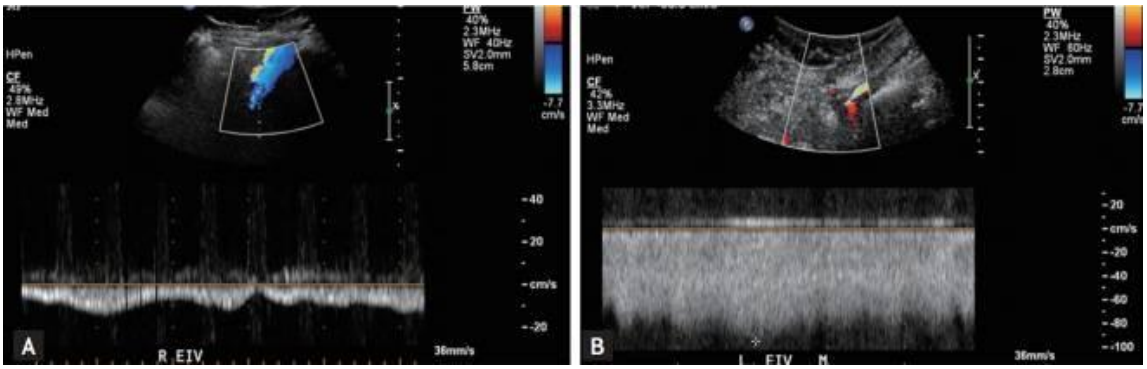


Figure 10:Right and left iliac veins in a patient with non-thrombotic stenosis. (A) Blood flow with normal respiratory response at the right external iliac vein (EIV). (B) Augmented blood velocity at the left EIV.(Πηγή: Ortega MA, Fraile-Martínez O, García-Montero C, Álvarez-Mon MA, Chaowen C, Ruiz-Grande F, et al. Understanding chronic venous disease: A critical overview of its pathophysiology and medical management. J Clin Med. 2021;10(15):1–42.)

Inferior Vena Cava

The inferior Vena Cava is scanned from the xiphoid process to the umbilicus for possible congenital anomalies such as duplication, aplasia or hypoplasia, obstruction, compression, or the development of collateral circulation(25).

Pelvic leak points (PLP)

The perineal area is screened with DUS for posterior vulvar and para vulvar varicose veins. When observed, the obturator, pudendal, and gluteal veins should be checked for leakage (20).

Other sonographic findings

According to Park et al., another common finding in these women is cystic changes in the ovaries. However, hair growth and amenorrhea are not commonly reported in patients with PCS, as is expected in patients with classic polycystic ovary syndrome. The sonographic findings varied from the typical polycystic appearance to groups of four to six cysts with a 5-15mm diameter in bilaterally enlarged ovaries (30).

4.1 Diagnostic algorithm of Pelvic Congestion Syndrome

In case the clinical suspicion, in combination with the ultrasound findings of TAUS and/or TVUS, suggests a diagnosis of PCS, further imaging assessment is needed **Figure 1**. There are two main options when pelvic varicosities are found in the US. When a slow, phasic venous flow increases with the Valsalva maneuver, venous insufficiency is considered a more possible diagnosis and venography is necessary. When it is continuous and increased flow at rest, and the flow is not altered by the Valsalva maneuver, venous compression syndrome is considered a possible diagnosis. Thus CT or MRI angiography or/and venography is recommended (34).

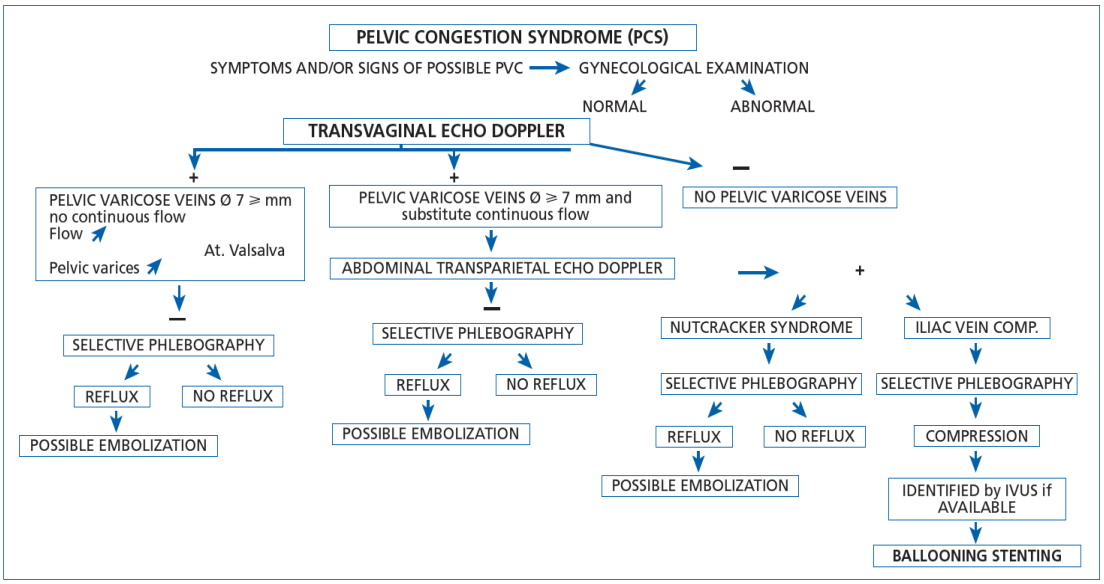


Figure 1.

5. Objective

The number of patients diagnosed with pelvic congestion syndrome has increased rapidly in the last decades. Despite the significant development of diagnostic imaging tools in recent years, invasive selective venography is still considered the examination of choice. The primary drawback of venography is its invasive nature and the use of ionizing radiation, which is harmful both for the patient and the doctor. Nevertheless, it provides the possibility of diagnosis and endovascular therapeutic intervention simultaneously in the presence of pathological findings. The use of non-invasive methods, such as color Doppler ultrasound, CT, and MRI - angiography in the evaluation of pelvic venous congestion syndrome, is of great importance as well. Nevertheless, the diagnostic efficacy of these imaging techniques is still uncertain.

This review aims to provide enlightenment on the role of ultrasound in diagnosing Pelvic Congestion Syndrome compared to venography. A secondary objective is to examine the accuracy of the ultrasound diagnosis.

5.1 Materials and Methods

5.1.1 Search strategy

The systematic review included original studies reporting the use of ultrasound in diagnosing Pelvic Congestion Syndrome. Data were collected from the literature database PubMed. A list of used keywords as well as a combination of them, are presented below

- Ultrasound or ultrasonography or sonography Pelvic Congestion Syndrome
- Diagnosis Pelvic Congestion Syndrome
- Ultrasound or ultrasonography or sonography pelvic varicies
- Sensitivity and specificity ultrasound pelvic congestion syndrome

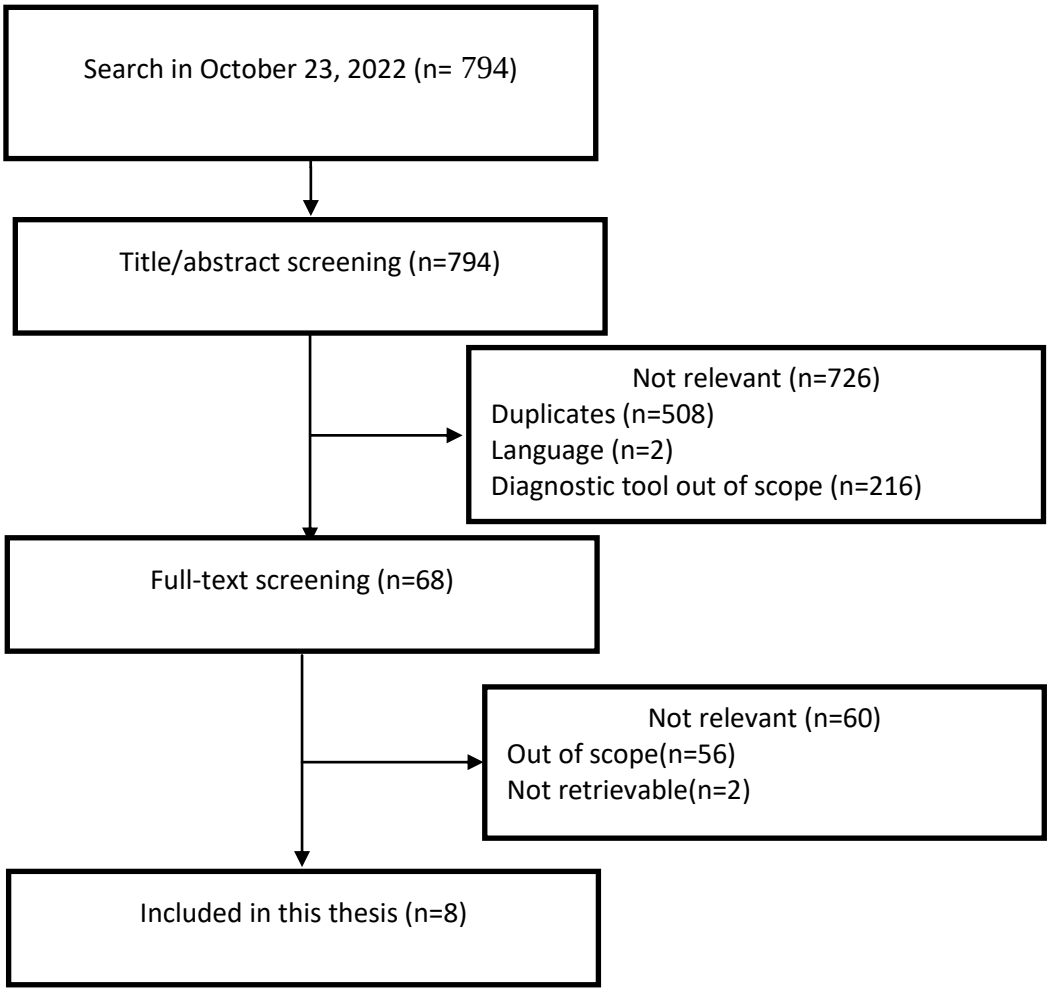
The search was restricted to English or Greek articles examining female patients. In addition, screening of the literature references of the selected articles was carried out to search for additional studies.

5.1.2 Study selection and Data collection

The search included studies comparing ultrasound with the gold standard diagnostic tool in patient assessment with suspicion of pelvic congestion syndrome. The articles' title and abstract were used as the two primary criteria, and the second selection was based on the full text of the publications. The literature search in Pubmed for relevant articles was performed on 23rd December 2023 and resulted in the screening of 794 articles. Both abstract and full-text screening has been reviewed based on PICO (Patient, Intervention, Comparison, Outcome) criteria. Taking for granted that the search is taking place in all available data basis applying the most relevant keywords, the PICO framework is usually adopted to identify these variables. PICO criteria are proved helpful in including or excluding studies.

- **P**atients: Females with clinical suspicion of Pelvic Congestion Syndrome
- **I**ntervention: Ultrasonography (TAUS or TVUS)
- **C**omparison: venography (transuterin or selective)
- **O**utcome: Diagnosis of Pelvic Congestion Syndrome

The systematic literature review process is presented in the flowchart below, resulting in 8 articles.



6. Results

6.1 Patients Characteristics

In all studies, the vast majority of the patients were women of reproductive age, while the information on the race and the number of children of participants was insufficient. The overall mean age across all studies was 39, and race was reported only in Malgor et al. 2013. All studies examined the supine position, and in four of them, the examination was performed in a semi-erect or upright position. The mean number of childbirths in the study by Malgor et al., 2013 was three, and Gavrilov et al., 2020 reported a range of 1-3 children per patient. Valve insufficiency of the left gonadal vein was more prevalent in all patients. Valero et al. supported the multifactoral theory of PCS and included this cohort in their analysis, contrasting with the other seven studies that excluded menopausal women. The prevalence of the disease in menopausal women was found to be 7,69%.

In the majority of the studies (six out of eight), the inclusion criteria included the presence of pelvic pain. The studies of Halligan et al. 2000 and Campell et al. 2003 were the only ones in which exclusion criteria were not mentioned.

Gavrilov et al. 2020 performed a critical subject selection and detailed all excluded criteria. The authors excluded patients with venous insufficiency of the lower extremities to avoid the possibility that chronic venous disease of the lower extremities creates symptoms involved in pelvic venous insufficiency. In that way, the presence of vulvar varicosities, which he used as inclusion criteria, can be safely linked to pelvic venous insufficiency.

Table 5.2.1 Key patient characteristics of the studies included.

Study	**Age group (years)**	**Race**	**Symptoms and Signs/ Indications**	**Parity/Mean number of children**	**Patient Position**
Park et al. 2004	26-64	Missing information	Persistent pelvic pain lasting more than 6 months and ovarian point tenderness	All subjects / Missing information	Supine
Campell et al. 2003	22-52	Missing information	Non-cyclical pelvic pain of at least 6 months' duration	Missing information	Supine
Halligan et al. 2000	22-44	Missing information	Diagnosis of PC.	Missing information	Supine
Giacchetto et al. 1990	16-53	Missing information	Non-cyclical pelvic pain and no dysmenorrhea	16/35 / Missing information	Supine & Upright
Malgor et al 2013	32-52	Caucasian (60%) Hispanic (38%) Asia (2%)	Presence of vulvar varicosities, PVV with their valvular incompetence	40/48 /3*	Supine & Upright
Hansrani et al 2016	23-51	Missing information	Vulvar varices, posterior thigh or buttock varices, and recurrent varicose veins of the leg	Missing Information	Supine & Semi-erect
Gavrilov et al 2020	32.6-42	Missing information	Pelvic pain, dyspareunia, dysuria, or dilated veins of the external genital organs.	All subjects/1-3**	Supine & semi-erect
Valero et al, 2021	34.4-50	Missing information	Non-cyclical pelvic pain for 6 months or longer	40/51	Supine

*Mean number of pregnancies **Range was reported

Table 5.2.3 Inclusion/exclusion criteria of the studies included.

Study	**Inclusion Criteria**	**Exclusion Criteria**
Park et al. 2004	Persistent pelvic pain lasting more than 6 months and ovarian point tenderness	Other pelvic diseases including endometriosis, uterine myoma, and uterine adenomyosis.
Campell et al. 2003	Non-cyclical pelvic pain of at least 6 months' duration	Not mentioned
Halligan et al. 2000	Pelvic pain, and a diagnosis of PC	Not mentioned
Giacchetto et al. 1990	Persistent pelvic pain lasting more than 6 months and ovarian point tenderness	Other pelvic diseases (endometriosis, uterine myoma, and uterine adenomyosis)
Malgor et al.	Pelvic pain or heaviness Dyspareunia Dysuria With or without varicose veins (region: pubis, labia, perineum, or buttocks)	• Pastvenous interventions or presence of venous disease in the lower extremities • Patients with anatomic compression, such as renal or iliac veins
Hansrani et al. 2016	Aged between 18 and 55 and premenopausal	• Post-menopausal • Pregnant or within 12 months of pregnancy • History of venous thromboembolism • Ischaemic heart disease or stroke • Hysterectomy • BMI>40 • Unable to give informed consent
Gavrilov et al. 2020	Age 18 to 50 years	Pregnancy

	Presence of vulvar varicosities, PVV with their valvular incompetence.	• Menopause • Presence of varicosities in the legs • Absence of abnormalities of valvular apparatus of the pelvic veins according to DUS • Venous incompetence of the great and/or small saphenous veins, according to the DUS
Valero et al., 2021	Presenting non-cyclical pelvic pain for 6 months or longer.	Patient's refusal to undergo a venography.

Table 5.2.2 Key study characteristics of the studies included.

Study	Method	Evaluated tool(s)/ GS	Diagnostic US Criteria	Primary Objective	Sensitivity/Specificity Results	Subjects (N)
Park et al. 2004	Prospective (Case-control)	TAUS & TVUS / Venography	1)Diameter of left ovarian vein (5 or 6 or 7mm with different positive value) 2)Pelvic Varicocele (tortuous and dilated vein > 5 mm) 3)Flow direction of the left ovarian vein 4)Presence of arcuate vein in the myometrium > 5mm, 5)Change of the duplex waveform during the Valsalva's maneuver	To assess transabdominal and transvaginal US findings of PCV and to contrast them with those of healthy participants.	TVUS: Pelvic Varicocele 100% / 83%* Vein > 5 mm crossing uterine body: 25% / 91%* TAUS: Reversed caudal flow in ovarian vein:100% / 75%*	74
Campell et al. 2003	Prospective (Cohort)	TVUS/ Venography	1)Number of veins (0-2:score 1, 3-6:score2, 7+:score3) 2)Diameter of the largest vein(2mm:score 1,2-5mm:score2,>5mm:score 3)Evaluation of pelvic congestion (normal:score 1, moderate:score 2, severe: score 3) Total score range between 3 (normal) and 9 (severe)	To compare TVUS findings with those of venographic congestion score	Non Applicable	42

Halligan et al. 2000	Prospective (Case-control)	TVUS/ Venography	1)Number of veins (0-2:score 1, 3-6:score2, 7+:score3) 2)Diameter of the largest vein(2mm:score 1,2-5mm:score2,>5mm:score 3)Assessment of pelvic congestion (normal:score 1, moderate:score 2, severe: score 3) Total score range between 3 (normal) and 9 (severe)	To assess power Doppler findings and ovarian US in PCS	Non Applicable	36
Giacchetto et al. 1990	Prospective (Cohort)	TVUS/ Venography	Circular or linear anechogenic structures with a diam- eter >5 mm in the parauterine –Confirmation of vascular nature of those structures with Valsal- va's maneuver or/and in the upright position	To propose a diagnostic protocole for PCS with the use of TVUS	TVUS Pelvic varicocele 100% / 83-100%	35
Malgor et al 2013	Retrospective Review	TAUS/ Venography	1)≥4 tortuous parauterine veins with >4mm in diameter in the supine position (upright position and/or Valslava maneurer if needed) 2) Ovarian vein diameter >6mm 3)ovarian or PVR	Assess the accuracy of duplex ultrasound (DU) in the diagnosis of PCS	Detection of dilated: - LOV:100% / 57% - ROV:67% / 90%	48
Hansrani et al 2016	Prospective (Cohort)	TVUS/ Venography	Sustained reverse flow >0.5 s in the ovarian or internal iliac on both (induced or not)	To propose a diagnostic protocol with the use of TVUS, widely accepted and compared with the current gold standard.	Non Applicable	50
Gavrilov et al 2020	Prospective (Cohort)	TAUS & TVUS/ Venography	1) Pelvic vein reflux > 1.0 sec, associated with the vein's dilation > 5 mm. 2)Retrograde blood flow in the vulvar veins	To assess the diagnostic efficacy and validity of ovarian and pelvic venography with pelvic varicose veins (PVV) and vulvar varicosities (VV).	Not applicable	62
Valero et al,	Prospective	TVUS/	Diameter of the largest pelvic venous	To conclude if TVU is an	TVUS: 92.3% / 75%	51

2021	(Observational-Cross-sectional)	Venography	vessel >8mm	accurate and valid diagnostic tool for PCS		

- Based on Steenbeek at al. 2018. TAUS: Transabdominal Ultrasound; TVUS: Transvaginal Ultrasound ; GS: Gold Standard

6.2 Study Characteristics

An overview of study characteristics is presented in Table 5.2.2. Of the eight included studies, only one is a retrospective review (Malgor et al. 2013), while the rest are prospective studies. Four of the studies included are cohort studies (Campell et al. 2003, Giacchetto et al. 1990, Hansrani et al. 2016, Gavrilov et al. 2020), two case-control (Park et al. 2004, Halligan et al. 2000) and one Observational- Cross-sectional (Valero et al. 2021).

In all studies, TVUS or both TVUS and TAUS were used except for the study of Malgor et al. 2013 who used only TAUS. The most widely applied diagnostic criterion was the diameter of the most prominent pelvic vein, with a range from 4mm to 8mm. Other criteria to be mentioned were the diameter of the left ovarian vein with a range >5mm or >6mm, retrograde flow in the left ovarian or iliac or vulvar veins, or a dilated pelvic vein >5mm.

Most of the patients were women of reproductive age, while the information on the race and the number of children of participants was insufficient.

Park et al. conducted a prospective patient-healthy control subjects study with 32 patients and 35 healthy volunteers. They used a combination of color and duplex Doppler transabdominal and transvaginal ultrasound to study patients with PCS in the supine position compared to healthy subjects. He noted that pelvic varices were present in most patients and that in 8 of 32 patients and 3 healthy witnesses, there was dilatation of the uterine arcuate vein > 5mm. Furthermore, dilatation of the left ovarian vein was detected in the patients by transabdominal ultrasound with a mean ovarian vein diameter of 7.9 ± 2.3 mm in the patient sample and 0.49 ± 0.15 mm in the healthy volunteer sample. The positive predictive value was 71.2%, with a normal limit of ovarian vein diameter up to 5mm and 83.3% at an upper limit of 6mm. The palindromic contrast agent flow in selective venography corresponded to a reversal of flow in the left ovary vein during Doppler transabdominal ultrasound in all patients with PCS (30).

Campell and colleagues (35) compared power Doppler transvaginal ultrasound and transutrinel venography using an ultrasound pelvic congestion scoring system based on the number and diameter of pelvic veins and subjective assessment of pelvic congestion. The venographic pelvic scoring system used had a venographic congestion score ≥6. Of the 42 women with clinically suspected PCS, 35 were diagnosed with this condition (83%). A poor positive correlation was found between ultrasound and venographic pelvic congestion score.

Halligan and colleagues (36), using the same venographic and ultrasound scoring system for pelvic congestion as Campbell's study, compared the ultrasound pelvic congestion score with a venographic congestion score of ≥6 in patients diagnosed with PCS by venography. The comparison was made between 36 diagnosed patients and 19 healthy subjects who did not undergo venography and concluded that the

overall ultrasound pelvic congestion score showed no difference between the patient sample and the healthy group. In addition, the distinction between patients with pelvic congestion syndrome and healthy volunteers was also made impossible by Power Doppler testing of the pelvic veins.

Giacchetto and colleagues (37)described a prospective cohort study of 35 women with non-cyclic pelvic pain who underwent transvaginal ultrasound in the supine and upright positions, with no mention of the percentage of pelvic varices found. In 16 of the 35 women, blood reflux in the homolateral ovarian vein was found after venography, and in 3 of those 16 women, reflux in both ovarian veins was observed. The mean diameter of the normal left ovarian vein was 3.6mm, and on inadequacy, 10.7mm.

Malgor et al. (38)conducted a retrospective review in which 48 women with chronic venous disease, pelvic pain or heaviness, dyspareunia and dysuria were assessed. All women underwent transabdominal ultrasound in a supine and/or upright position where the presence of reflux in the right and left ovarian veins was examined, their diameter was measured, and the possible presence of 4 or more tortuous parauterin veins with a diameter of >4 mm was examined. The left ovarian vein diameter in these women was significantly larger than the right one. Additionally, all women with a left vein diameter >6mm were found to have coexisting pelvic varicies, which was also demonstrated by CV. Malgor et al. compared DU with CV and CTV and concluded that the specificity and sensitivity of ultrasound for detecting a left ovarian vein >6mm were 100% and 54%, respectively. The value for the sensitivity of DU for the right ovarian vein was significantly lower (67%) than the specificity (90%).

Hansrani et al. (39) described a prospective cohort study of 50 women with abnormal veins in the lower extremity indicative of pelvic venous communication, who underwent transvaginal ultrasound in a supine, semi-sedentary position at rest, with Valsalva maneuver and with two-handed thigh compression and release. The ovarian veins, internal iliac and >0.5sec was defined as pelvic venous insufficiency. During the ultrasound, in the supine position, all veins could be demonstrated in 38 of 50 women (76%) compared to 32 of 50 (64%) in the semi-sitting position. Also, in the semi-sitting position, the vessel caliber increased, as well as the ability to demonstrate pelvic venous insufficiency (34 of 50 (68%) in the supine position, and 38 of 50 (76%) in the semi-standing). A correlation between vessel caliber and duration of vein reflux was also shown only for the ovarian veins bilaterally (39).

According to a sonographic assessment, Gavrilov et al. (40) conducted a prospective cohort study in which they studied 62 women with pelvic pain who had pelvic and vulvar varicosities with valvular insufficiency. He had as an exclusion criterion the presence of varicose veins in the lower extremities. He divided the sample of subjects into two groups, one with PCS symptoms and one without. All patients underwent transabdominal and transvaginal ultrasounds in sitting and semi-sitting positions, where pelvic, extra-genital and lower extremity veins were examined. He considered

as a pathological finding the presence of retrograde venous flow >1sec in a dilated pelvic vein >5mm and the change of flow from blue to red after the Valsalva maneuver to evaluate all veins. In the first group, simultaneous blood reflux in ovarian, parametrial, and uterine veins was found in 70% of women and was considered a pathognomonic sign. All patients had ovarian vein insufficiency and blood reflux in the parametrial veins, 70% were found with uterine vein reflux and 83,3% had a left-side prevalence in contrast to a 16,7% on the right side. In the second group, only 9,4% of women had left ovarian vein insufficiency. All patients were identified with retrograde blood flow in parametrial veins and only 3,1% in the uterine veins. Gavrilov et al. concluded that sonographic assessment is indicated only for patients with vulvar and pelvic varicosities but without symptoms of PCS.

Valero et al. 2021 (41) conducted an observational, cross-sectional study of 51 women with a single inclusion criterion of non-cyclic pelvic pain lasting 6 months or more and a single exclusion criterion of refusal to undergo phlebography. The women first underwent TVUS, where the volume of the uterus and ovaries were measured, the presence of crossing veins in the myometrium was examined, the most prominent pelvic vein and the pelvic venous plexus were identified and assessed for possible retrograde flow with color and spectral Doppler during the Valsalva maneuver, bilaterally. The cut-off point for diagnosing PCS was set as the presence of a pelvic vein of >8 mm diameter. A comparison was then made with the venographic findings. The ultrasound imaging test, according to the criteria set by Valro et al., had a sensitivity and specificity of 92.31% and 75%, respectively.

7. Discussion

In the present literature review, an attempt was made to verify the diagnostic potential of ultrasound imaging in screening the Pelvic Congestion Syndrome. Due to the limited number of available articles on pelvic venous insufficiency and the non-reported randomized clinical trials conducted to date, it is challenging to draw adequate and safe conclusions on specific points concerning the diagnosis of pelvic congestion syndrome.

According to all eight studies, invasive diagnostic phlebography remains the gold standard. As a non-invasive diagnostic method, ultrasound was used in all studies, and specifically, in seven of the eight studies, transvaginal ultrasound was preferred as superior, according to the authors.

The sensitivity and specificity of ultrasound diagnosis are reported only by Malgor et al. and Valero et al.. Of the eight studies, five advocates using ultrasound as a diagnostic tool in the study of pelvic congestion syndrome (Giacchetto, Malgor, Hansrani, Valero, Park), and one supports the ultrasound study of pelvic veins only in patients without symptoms of pelvic congestion (Gavrilov). Two studies reject ultrasound as diagnostically adequate for this syndrome (Halligan et al. 2000 and Campell et al. 2003).

There is no agreement on diagnostic criteria in ultrasound imaging between the eight studies (except those of Halligan et al .2000 and Campell et al. 2003) and the current literature. The protocols followed differ from study to study and essential information, such as the anatomical areas to be examined or which specific vessel is assessed, is often not clarified. The lack of consistency of criteria used depending on the study does not encourage an explicit and practical protocol for the ultrasonographic diagnosis of PCS to be developed. Moreover, there are insufficient statistical studies on the sensitivity and specificity of ultrasound in diagnosing PCS in the contemporary literature. A widely acceptable ultrasound protocol is the central pillar for improving diagnostic accuracy and thus for providing the appropriate treatment and enhancing the patient’s quality of life.

Another limitation that occurs in four of the eight studies (Park et al. 2004, Campell et al. 2003, Halligan et al. 2000, and Valero et al. 2021) is the assessment of patients in a supine position which may underestimate the diameter of the pelvic veins as well as the presence of retrograde flow, especially in moderate pelvic venous insufficiency.

A rather interesting approach was made by Valero, who used as the only exclusion criteria for her study the patient's refusal to undergo phlebography. In contrast, she studied a group of women with only the inclusion criterion of non-cyclical pelvic pain for 6 months or longer. As the ultrasound findings were directly compared with the venography findings, it was possible to draw meaningful conclusions. These included the diagnostic accuracy of sonography on PCS diagnosis and the confirmation of previous observations, such as, for example, the increased prevalence of the disease in

multiparous women and the decreased prevalence in menopausal women. Due to the discrepancy of criteria in modern studies of the diameter of a dilated vein in the pelvis, Valero decided to use the threshold of 8 mm, which is defined as a severe dilatation of the vessel. This choice served initially to facilitate the detection of the dilated vein and to create a well-accepted technique that is easy to apply. Another critical point was the attempt to enhance the sensitivity and specificity of the TVUS compared to the 5-6mm threshold used in previous studies, which corresponded to smaller percentages.

Another interesting study was that of Steenbeek et al. (42). He calculated the sensitivity and specificity of ultrasound in diagnosing PCS from studies that already existed based on the data of each study. He reports that the detection of varices within the pelvis by TVUS, according to Giacchetto et al. and Park et al. has a sensitivity and specificity of 100% and 83-100%. The authors noted that according to Park et al., communication between pelvic veins located bilaterally via transuterine veins >5mm has a sensitivity of 91%, ovarian vein diameter >5mm or >6mm has a sensitivity of 71.2% and 83.3%, respectively and retrograde caudal flow in ovarian vein has a 100% sensitivity. Furthermore, as Campbell et al. and Halligan et al. had already stated in their research, Steenbeek reported that it was not possible to distinguish women with PCS from the control group. The authors also collected data from all the studies he reviewed and came to some further conclusions. He calculated that women with PCS have considerably more and smaller ovaries, smaller uterine volumes, and thinner endometrium (42).

The possibility of invasive venography being replaced as an ultrasound diagnostic method could be highly increased when an overall protocol is in place. The non-invasive, widely available, and low-cost diagnostic nature of sonography renders ultrasound a broadly acceptable diagnostic tool. The remarkably lower cost of this non-invasive technique should not be ignored as well. As a result, venography could be restricted in cases of non-inclusive diagnosis or treatment (16).

8. Conclusion

Pelvic venous congestion syndrome is frequently misdiagnosed multifactorial clinical entity that affects a significant proportion of the world's female population. Although it is a prevalent source of chronic pelvic pain, a well-defined diagnostic approach must be established. Nowadays, venography is considered the gold standard test for diagnosis.

Several references in the current literature support using ultrasound, an especially transvaginal ultrasound, as a first-line diagnostic tool for evaluating pelvic congestion syndrome. However, there are currently no diagnostic criteria and protocols that are universally applicable and accepted, which renders it difficult to draw safe conclusions according to the diagnosis of the syndrome. Furthermore, the sensitivity and specificity of ultrasound diagnosis of the disease have been insufficiently studied to allow a reliable comparison of this tool with venography.

Therefore, it is requisite to conduct further studies, emphasize randomized clinical trials to estimate the diagnostic accuracy, and define a protocol and the appropriate diagnostic criteria for patients with suspected pelvic congestion syndrome.

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