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Role of Transvaginal Color Doppler Ultrasound in the Diagnosis of Pelvic Congestion Syndrome

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Abstract: Pelvic Congestion Syndrome (PCS) is a known cause of chronic pelvic pain in women, secondary to pelvic venous insufficiency and varicosities. Diagnosis is still not easy and delayed, due to the non-specific clinical picture. Transvaginal color Doppler ultrasound has proven to be a useful, non-invasive imaging technique for the evaluation of pelvic venous abnormalities. In this study, the authors sought to determine the ability of transvaginal color Doppler ultrasound to diagnose Pelvic Congestion Syndrome in women with chronic pelvic pain. The study was carried out as a prospective cross-sectional study at Tikrit Teaching Hospital, Iraq from Sep. 2023 to Sep. 2024. Ninety women with clinical suspicion of PCS aged 35-55 years were included. Comprehensive clinical assessment was done for all the participants followed by transvaginal grayscale and color Doppler ultrasound examination. Ovarian vein diameter, parametrial vein diameter, venous reflux during the Valsalva maneuver, venous flow velocity and pelvic varicosities were sonographic parameters. Data was analysed using SPSS version 26.0 and a p value of < 0.5 was deemed to be statistically significant. The ages of the subjects were ranged between 40 and 46 years; the average age was 44.3 ± 5.6 years. All patients complained of chronic pelvic pain and pelvic heaviness (80.0%), dyspareunia (64.4%), and post-coital pain (54.4%) were common associated symptoms. Sixteen of the women (67.8%) had been diagnosed with Pelvic Congestion Syndrome. The most common sonographic findings were dilated parametrial veins (66.7%), ovarian vein diameter greater than 6 mm (64.4%), venous reflux during the Valsalva maneuver (67.8%), and slow venous flow velocity < 3 cm/s (63.3%). The diagnostic performance of TV-CDU was excellent, with a sensitivity of 91.8%, a specificity of 86.2%, a positive predictive value of 90.2%, a negative predictive value of 88.0%, and an overall diagnostic accuracy of 90.0%. There was significant correlation between ovarian vein diameter, venous reflux duration and pain severity ($p<0.001$). Transvaginal color Doppler ultrasound is an effective, accurate, and non-invasive imaging modality for diagnosis of Pelvic Congestion Syndrome. Because it is able to analyze the anatomic and hemodynamic aspects of pelvic venous insufficiency, it is a good first-line diagnostic test in women suffering from chronic pelvic pain and allows early diagnosis and adequate clinical management.

Keywords: Pelvic Congestion Syndrome, Transvaginal Ultrasound, Color Doppler Ultrasonography, Chronic Pelvic Pain, Pelvic Venous Insufficiency

Introduction

Chronic pelvic pain in women can have many etiologies, one of which is Pelvic Congestion Syndrome (PCS) which is an important cause but often overlooked [1]. This is caused by pelvic venous insufficiency, which can be attributed to either the incompetence of the pelvic veins or an obstruction or hormonal effects that cause dilatation of the ovarian and pelvic veins [2]. Chronic venous hypertension causes varicosities in the pelvis, which can cause chronic pain and other debilitating symptoms, greatly affecting the quality of life. Despite its growing recognition in the last few decades, PCS is difficult to diagnose owing to its clinical resemblance to a number of gynecological, gastrointestinal and urological diseases [3].

Chronic pelvic pain is typically defined as non-cyclic pain that persists for >6 months and is estimated to affect around 15-26% of women globally [4]. After ruling out other pelvic pathologies, up to 1/3 of chronic pelvic pain is believed to be due to pelvic congestion syndrome. It is commonly seen in premenopausal women between the age of 30 and 50 years, especially in multiparous women [5]. As the pregnancy progresses, the hormones cause the pelvic veins to be more incompetent, increase blood flow through the veins, and cause the veins to become varicose. A further physiological factor is the relaxation of the venous walls induced by estrogen, which leads to venous dilatation and reflux, hence an increased incidence of PCS in women of reproductive age [6].

The clinical signs of PCS are non-specific and variable. Patients often present with a chronic dull pain in the pelvis which becomes more severe with long periods of standing, walking, exercise, or sexual intercourse, but is eased by lying down [7]. Some of the associated symptoms are dyspareunia, post-coital pain, a sensation of heaviness in the pelvis, dysmenorrhea, lower back pain, varicosities of the vulva or lower limbs, and urinary urgency. The symptoms are also often seen in other pelvic disorders, and therefore a clinical assessment alone is not enough to establish the

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diagnosis, which is therefore confirmed by imaging investigations [8,9].

There have been various imaging modalities used to assess PCS, such as transabdominal ultrasound, transvaginal ultrasound, computed tomography (CT), magnetic resonance imaging (MRI), magnetic resonance venography (MRV), and conventional catheter venography [10]. Catheter venography has been used as a standard for diagnosis but is invasive, costly and carries risks from the contrast media and from ionizing radiation. In recent years, the role of non-invasive imaging techniques has grown in importance in the diagnostic approach to women with a suspected PCS [11].

Transvaginal color Doppler ultrasound has proven to be a useful first-line imaging tool because it offers good visualization of the pelvic venous plexus as well as good venous hemodynamics [12]. During the exam, the venous diameter in the ovary and parametrium, venous reflux during the Valsalva maneuver, assessment of velocity of venous blood flow and the presence of tortuous pelvic veins are measured and assessed. Moreover, transvaginal ultrasound is widely accessible, less expensive, and non-ionizing, is well tolerated by patients, and is especially well suited for routine clinical use and repeated follow-up examinations [13].

Recent developments in Doppler technology have increased the sensitivity of ultrasound for detecting slow venous flow and subtle hemodynamic changes and thus the diagnostic value. Many studies have demonstrated the reliability of Doppler ultrasound as a reliable screening and diagnostic tool for pelvic venous insufficiency, and high correlation between Doppler ultrasound findings and severity of PVI. The different criteria to diagnose, however, and the differences in data collection across the regions, also call for further research to achieve uniformity in the use of ultrasound for diagnoses, and to improve the accuracy of the diagnosis in different groups of patients [14,15]. The present study therefore aimed to assess the effectiveness of transvaginal color Doppler sonography in the diagnosis of Pelvic Congestion Syndrome in women with chronic pelvic pain at Tikrit Teaching Hospital and its characteristic sonographic appearances with emphasis on accuracy of diagnosis.

Materials and Methods

Study Design

This study was conducted as a prospective cross sectional diagnostic study to assess the usefulness of TVCUS in diagnosis of Pelvic Congestion Syndrome (PCS) in women of chronic pelvic pain. The purpose of this study was to evaluate the diagnostic accuracy of transvaginal color Doppler ultrasound in terms of the detection of characteristic venous abnormalities found in PCS and the comparison of the imaging results with the clinical findings.

Study Setting and Duration

This study was carried out in the Department of Radiology and Gynecology in Tikrit Teaching Hospital, Salah Al-Din, Iraq. The recruitment of patients and data collection was done for a period of one and half years from Sep. 2023 to Sep. 2024. All ultrasonographic examinations were conducted in a single department of radiology by highly experienced radiologists who had special interest in gynecologic ultrasound with standardized imaging protocols.

Study Population

During the study period, 90 women were consecutively enrolled. The age range of the participants was 35–55 years and they were referred from the gynecology outpatient clinics for their symptoms suggestive of Pelvic Congestion Syndrome and especially chronic pelvic pain of more than six months duration. Demographics data such as age, body mass index (BMI), parity, menopausal status, occupation, and pertinent medical and surgical history was collected on a structured data collection form.

Inclusion Criteria

Patients were included if they were between the ages of 35 and 55 years old, and had chronic non-cyclic pelvic pain for more than six months. Patients who had symptoms such as dyspareunia, post coital pain, pelvic heaviness, lower back pain, varicosities of vulva/lower limb and tenderness on pelvic examination were included. Written informed consent was obtained prior to participation by all participants.

Exclusion Criteria

Women who were pregnant, had pelvic inflammatory disease, uterine fibroids >5 cm, ovarian tumors, endometriosis, adenomyosis, congenital uterine anomaly, previous pelvic vein embolization or pelvic vascular surgery, active malignancy or severe systemic illness, or inadequate ultrasound visualization were excluded from the study. Patients who refused to participate or had incomplete clinical data were excluded.

Clinical Assessment

A detailed clinical assessment was made by a consultant gynecologist on each participant. The history included a detailed description of the characteristics, duration and severity of the pelvic pain, aggravating and relieving factors,

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menstrual history, obstetric history, previous pelvic surgery, and associated symptoms. Visual Analog Scale (VAS) 0-10 was used to rate the severity of pain. A physical examination of the pelvis was conducted to assess for any tenderness on cervical manipulation, any adnexal tenderness, any pelvic fullness, and any visible vulvar engorgement (varicosities).

Ultrasound Equipment

All examinations were conducted on a high-resolution ultrasound machine with transvaginal grayscale imaging and color and spectral Doppler. All exams were performed using a 5–9 MHz endocavitary transvaginal probe. The ultrasound system was calibrated regularly to ensure good image quality over the study period as per the manufacturer's guidelines.

Transvaginal Gray-Scale Ultrasound Examination

Initially, transvaginal grayscale ultrasound was performed to examine the uterus, cervix, endometrium, ovary, adnexa and pouch of Douglas. Structural gynecological abnormalities which may contribute to chronic pelvic pain were not examined. Special emphasis was placed on the detection of dilated parauterine, parametrial, ovarian and arcuate veins. The venous diameter was measured at its widest extent in the quiet respiration in millimeters.

Color Doppler Ultrasound Examination

After the assessment by grayscale imaging, color Doppler imaging was used to assess the pelvic venous circulation. A low pulse repetition frequency (PRF) and a high color gain were used to maximize Doppler sensitivity for slow venous blood flow. The following veins were evaluated longitudinally and transversely: ovarian veins and parametrial venous plexuses. The exam assessed the size of the veins, the direction of blood flow, the speed of flow, spontaneous reflux and the presence of tortuous pelvic veins. Dynamic assessment was carried out both at rest and during the Valsalva maneuver, to demonstrate venous reflux and venous distensibility.

Spectral Doppler Evaluation

The largest visualized pelvic veins were examined using spectral Doppler analysis. Peak venous velocity, duration of venous reflux, waveform characteristics and flow direction were measured. It was deemed abnormal if reflux was documented for more than one second during Valsalva. Slow venous flow velocity and prolonged retrograde flow were noted as imaging features possibly indicative of pelvic venous insufficiency.

Diagnostic Criteria for Pelvic Congestion Syndrome

Diagnosis of Pelvic Congestion Syndrome was confirmed when the typical sonographic features were seen with appropriate clinical symptoms. The ultrasound diagnosis criteria were as follows: diameter of the ovarian veins > 6 mm, dilated parametrial veins ≥ 5 mm, multiple tortuous pelvic veins, slow velocity of venous blood flow < 3 cm/s, venous reflux by diagnostic ultrasound during Valsalva maneuver or spontaneously, and congestion of the pelvic venous plexus. The diagnosis of PCS was made in patients who met both clinical and ultrasonographic criteria.

Data Collection

Standardized case report forms were used to collect clinical, demographic and imaging data. These variables which were collected were patient age, BMI, parity, duration of symptoms, a pain score, ultrasound measurements of ovarian and pelvic veins, venous reflux, blood flow velocity, laterality of venous involvement, and any associated pelvic abnormalities. All ultrasound images and Doppler measurements were stored on the computer for later review and quality assurance.

Statistical Analysis

Data was entered and analyzed by the Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Data for continuous variables were presented as mean ± SD and for categorical variables as frequencies and percentage. All continuous variables were compared between women diagnosed with PCS and women without PCS using the independent sample t-test. For categorical variables (where appropriate) the Chi-square test or Fisher's exact test was used. The receiver operating characteristic (ROC) curve analysis was used to select optimal values of ovarian vein diameter and Doppler parameters for diagnosing PCS. Sensitivity, specificity, positive and negative predictive values and the overall diagnostic accuracy were computed. The relationship between ultrasound findings and pain severity as assessed by the Visual Analog Scale was assessed using Pearson's correlation coefficient. A p value less than 0.05 was deemed to be statistically significant.

Results

Baseline Characteristics of the Study Population

A total of 90 women were included in the present study. The mean age was 44.3 ± 5.6 years (range: 35–55 years). The majority of participants in the study were multiparous women and obesity and overweight status were prevalent.

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Table 1. Demographic and clinical characteristics of the study population

Variable	Value
Number of patients	90
Age (years), Mean ± SD	44.3 ± 5.6
Age range	35–55
BMI (kg/m²), Mean ± SD	29.7 ± 4.5
Multiparous women	63 (70.0%)
Grand multiparous	19 (21.1%)
Premenopausal	73 (81.1%)
Postmenopausal	17 (18.9%)
Previous pelvic surgery	15 (16.7%)
Family history of varicose veins	20 (22.2%)

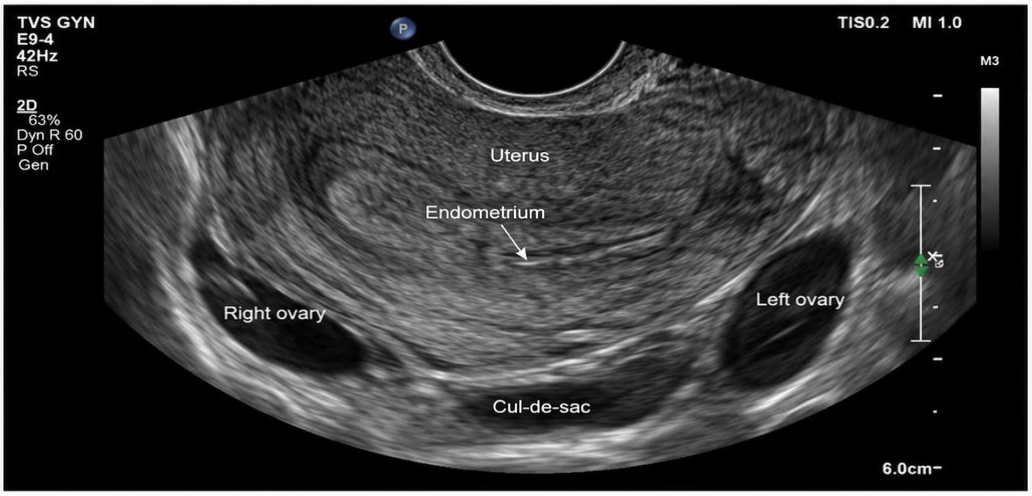

Figure 1. Transvaginal grayscale ultrasound demonstrating normal female pelvic anatomy before Doppler assessment.

Clinical Presentation

All women had chief complaint of chronic pelvic pain. Heaviness of the pelvis, dyspareunia and post-coital pain were common (Table 2).

Table 2. Clinical manifestations of the studied patients

Clinical symptom	n	%
Chronic pelvic pain	90	100
Pelvic heaviness	72	80.0
Dyspareunia	58	64.4
Post-coital pain	49	54.4
Lower back pain	43	47.8
Vulvar varicosities	27	30.0
Lower limb varicosities	35	38.9
Dysmenorrhea	39	43.3

Pain Severity

The severity of pain was rated on the Visual Analog Scale (VAS) and the majority of patients had moderate to severe pain (Table 3).

Table 3. Pain severity according to VAS score

VAS Score	n	%
Mild (1–3)	12	13.3
Moderate (4–6)	35	38.9
Severe (7–10)	43	47.8

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Gray-Scale Ultrasound Findings

In the majority of the pelvic congestion syndrome (PCS) patients, dilated pelvic veins were detected with gray-scale transvaginal ultrasound (Table 4).

Table 4. Gray-scale ultrasound findings

Finding	n	%
Dilated ovarian vein (>6 mm)	58	64.4
Dilated parametrial veins	60	66.7
Multiple tortuous pelvic veins	56	62.2
Dilated arcuate veins	41	45.6
Pelvic free fluid	8	8.9
Normal grayscale appearance	20	22.2

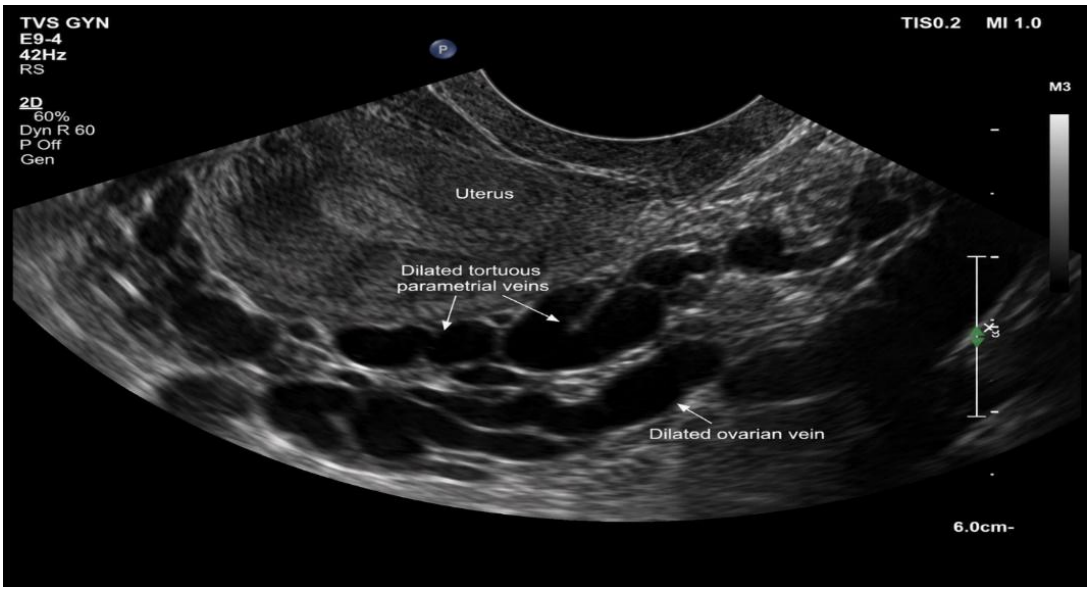

Figure 2. Transvaginal grayscale ultrasound demonstrating markedly dilated tortuous parametrial veins consistent with pelvic venous congestion.

Color Doppler Ultrasound Findings

Most patients with pelvic congestion syndrome (PCS) had abnormal venous reflux and slow venous blood flow by color Doppler examination (Table 5).

Table 5. Color Doppler ultrasound findings

Doppler finding	n	%
Venous reflux during Valsalva	61	67.8
Slow venous flow (<3 cm/sec)	57	63.3
Dilated pelvic venous plexus	59	65.6
Increased venous tortuosity	54	60.0
Bilateral ovarian vein involvement	37	41.1
Left-sided predominance	19	21.1
Right-sided predominance	9	10.0

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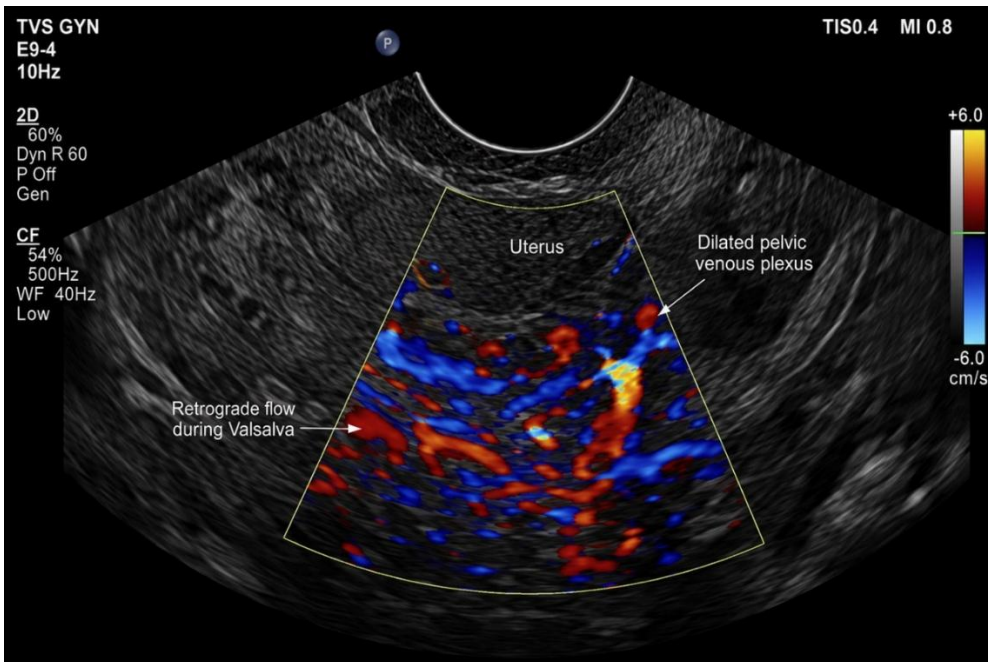

Figure 3. Color Doppler ultrasound demonstrating retrograde venous flow within dilated pelvic veins during Valsalva maneuver.

Spectral Doppler Findings

The mean duration of reflux and the mean velocity of flow in the veins were significantly prolonged in women with PCS, as shown by the spectral Doppler analysis (Table 6).

Table 6. Spectral Doppler measurements

Variable	Mean ± SD
Ovarian vein diameter (mm)	7.4 ±1.2
Parametrial vein diameter (mm)	6.1 ±0.8
Peak venous velocity (cm/s)	2.4 ±0.7
Venous reflux duration (sec)	2.2 ±0.5

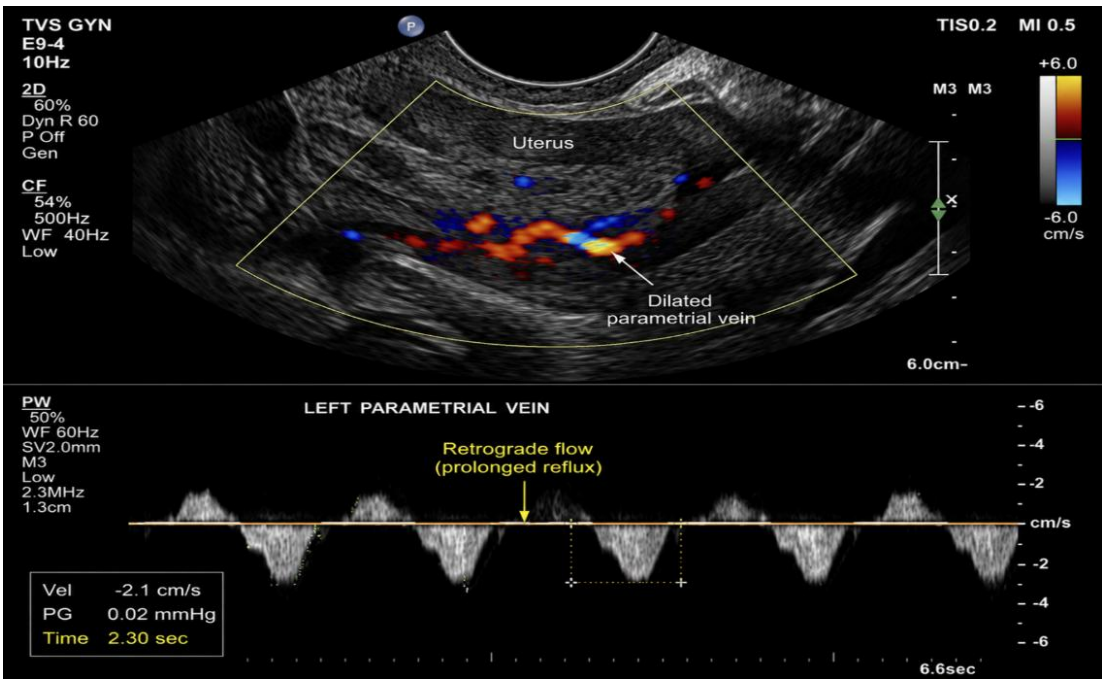

Figure 4. Spectral Doppler waveform demonstrating prolonged retrograde venous reflux characteristic of pelvic congestion syndrome.

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Final Ultrasound Diagnosis

Around two-thirds of women examined (63%) were diagnosed with pelvic congestion syndrome based on clinical findings and Doppler criteria (Table 7).

Table 7. Final ultrasound diagnosis

Diagnosis	n	%
Pelvic Congestion Syndrome	61	67.8
No Pelvic Congestion Syndrome	29	32.2

Diagnostic Performance of Transvaginal Color Doppler Ultrasound

Transvaginal color Doppler ultrasound also proved to be very diagnostic for the diagnosis of pelvic congestion syndrome in comparison with the complete clinical diagnosis (8).

Table 8. Diagnostic performance of transvaginal color Doppler ultrasound

Parameter	Value (%)
Sensitivity	91.8
Specificity	86.2
Positive Predictive Value	90.2
Negative Predictive Value	88.0
Diagnostic Accuracy	90.0

Correlation Between Doppler Findings and Pain Severity

There was a significant positive correlation between ovarian vein diameter, ovarian vein reflux time and pelvic pain severity (Table 9).

Table 9. Correlation between Doppler parameters and VAS pain score

Variable	r	P-value
Ovarian vein diameter	0.69	<0.001
Parametrial vein diameter	0.62	<0.001
Venous reflux duration	0.71	<0.001
Peak venous velocity	-0.58	<0.001

Discussion

Demographic profile of the study population was characterized by the mean age of 44.3 years and by the fact that most of the patients were multiparous premenopausal women. This is in line with Knuttinen et al. [16] and Clark and Taylor [17] who attributed hormonal factors and progressive venous valvular incompetence to the occurrence of PCS throughout the reproductive age, mostly in multiparous women. The high percentage of multiparous women in our cohort is also consistent with parity being an important risk factor for pelvic venous insufficiency.

The most common clinical symptoms in the current study were chronic pelvic pain, pelvic heaviness, dyspareunia and post-coital pain. Our results are consistent with those of Phillips et al. and Steenbeek et al. who associated post-coital discomfort and postural changes with chronic pelvic pain as the hallmark clinical presentation of PCS [18,19]. In our study, we found a significant correlation between pain severity and duration of venous reflux, thus confirming the direct dependence of the severity of the symptoms on the venous hypertension.

In most of the patients involved, dilated ovarian and parametrial veins were seen in gray-scale ultrasound. Similar observations were described by Hiromura et al. who reported that ovarian vein dilatation greater than 6 mm is highly suggestive of pelvic venous insufficiency [20]. The diameter of the ovarian veins measured by our method was similar to the diameter reported in previous publications, which supports the repeatability of the grayscale ultrasound method to be used to diagnose abnormal pelvic veins.

Color Doppler examination greatly aided the diagnosis, due to the fact that it confirmed spontaneous venous reflux and slow venous blood flow. The results are similar to those reported by Park et al. and Ganeshan et al., who highlighted the importance of Doppler assessment, as venous reflux is the most important hemodynamic abnormality in PCS [21,22]. In our study, a predominance of the left-sided ovarian veins was also found, which is in line with anatomical and physiological explanations found in previous literature.

In this study, the diagnostic accuracy of transvaginal color Doppler ultrasound was high and sensitivity and specificity were also high. The results obtained are in accordance with those of Ignacio et al. [23] and Guirola et al. [24] who indicated that the transvaginal Doppler ultrasound was an appropriate imaging technique for the initial phase

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of diagnosis, before the invasive venography examination. The high correlation of the ovarian vein diameter, reflux duration, and pain severity further support the clinical relevance of the Doppler-derived parameters.

The results of the present study were promising, however, some limitations should be recognized. Relatively small sample size and single center design possibly reduce generalizability of results. In addition, conventional venography (the historical reference standard) was not done routinely in all participants. Further multicenter studies involving larger numbers of patients and direct comparison to magnetic resonance venography or catheter venography are recommended to further validate these findings.

Conclusion

The present study showed that transvaginal color Doppler ultrasound is an accurate, safe, and non-invasive diagnostic tool for the diagnosis of Pelvic Congestion Syndrome in women with chronic pelvic pain. Dilated ovarian and parametrial veins, spontaneous or valsalva venous reflux, and decreased venous flow velocity were characteristic findings associated with clinical symptoms with a strong association to pain severity. This technique was both highly sensitive and specific and enabled an extensive evaluation of pelvic venous anatomy and hemodynamics without the use of ionizing radiation. All these benefits contribute to its being the first-line imaging test in the clinical practice setting when PCS is suspected. Rapid diagnosis by transvaginal Doppler ultrasound could well allow therapeutic action to be taken in time, symptom control to be optimized, and avoid unnecessary invasive diagnostic interventions. Larger multicenter studies that include patients at other centers and compare them with venography and/or magnetic resonance imaging are recommended to give strength to the current evidence and to standardize the diagnostic criteria.

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