



Transvaginal ultrasonography predictive model for the detection of pelvic congestion syndrome

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Background: The diagnosis of pelvic congestion syndrome (PCS) remains a challenge given the lack of universally accepted criteria. Although venography (VG) is the current gold standard for the diagnosis of PCS, non-invasive techniques like transvaginal ultrasonography (TVU) appear to be a valid alternative. The aim of this study was to design a predictive model for the venographic diagnostic of PCS using the parameters identified by TVU in patients with clinical suspicion of PCS, in order to individually assess the need to perform an invasive diagnostic and therapeutic technique such as VG.

Methods: An observational and cross-sectional prospective study was conducted including 61 consecutively recruited patients with clinical suspicion of PCS, who were referred by the Pelvic Floor, Gynecology and Vascular Surgery Units, who were distributed in two groups: 18 belonging to the normal group and 43 to the PCS's group. We implemented and compared 19 binary logistic regression models, including the parameters that showed statistical significance in the prior univariate analysis. We evaluated individual predictive values with a receiver operating characteristic (ROC) curve and the area under the curve (AUC).

Results: The selected model, based on the presence of pelvic veins or venous plexus of 8 mm or larger, observed by transvaginal ultrasound, had an AUC of 0.79 (95% CI: 0.63–0.96; $P < 0.001$), with a sensitivity of 0.90 and specificity of 0.69, while the VG had a sensitivity of 86.05%, a specificity of 66.67%, and a positive predictive value of 86.05%.

Conclusions: This assessment presents a feasible alternative that could potentially be added to our usual gynecological practice.

Keywords: Pelvic congestion syndrome (PCS); chronic pelvic pain (CPP); transvaginal ultrasonography (TVU); venography (VG); predictive model

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Introduction

Pelvic congestion syndrome (PCS) is defined as the dilation and stasis in pelvic venous plexus, being one of the many reasons behind chronic pelvic pain (CPP) in female patients. CPP is defined as the non-cyclical hypogastric, lumbosacral or perineal pain lasting more than 6 months (1,2). According to the American College of Obstetrics and Gynecology (ACOG), it causes a functional disability or seeking for medical attention (3) as it causes limitations in physical, psychological, relational and work aspects of the individual's life (4). Thus, it is a relevant health issue as it is behind up to 40% of referrals for gynecology units (1,2).

The diagnosis of PCS continues to be a concern, given the lack of universally accepted criteria for the definition of dilated pelvic venous vessels. Different nomenclatures have been used for the varied clinical presentation of stasis and backflow of interconnected vessels in the abdominal, pelvis and lower extremities, which has contributed to the skepticism around this pathology, especially regarding women suffering from CPP (5). Prevalence of CPP oscillates between 6–27%, although it is often underestimated given the lack of data from many countries and the scarce number of multidisciplinary studies (4,6).

A step into improving the understanding of this disease is the unification of all these related conditions in just one clinical term, which might help healthcare professionals to accept its importance and great impact (6). The Symptoms-Varices-Pathology (SVP) classification was recently established for assessing pelvic venous disorders (PeVD), as well as the “hemodynamic and radiological classification of ovarian veins insufficiency”. Although these tools need to be validated, they might help to obtain homogenous samples for future studies (7-9).

PeVD are caused by an insufficiency of either the ovarian or the internal iliac veins and their tributary veins, which ends up causing a dilation of venous vessels. Venous insufficiency can be primary, due to the absence or degeneration of venous valves as well as changes in their walls, such as the structural and hormonal changes related to pregnancy, shifts related to uterine malposition, or congenital absence of venous valves. In addition, insufficiency may also be secondary caused by the extrinsic

compression or obstruction of pelvic venous vessels, such as the nutcracker syndrome (caused by the compression of the left renal vein between the abdominal aorta and the superior mesenteric artery) or the May Thurner syndrome (compression of the iliac vein, frequently the left, by the right common iliac artery (6,8,9).

Most authors state that venography (VG) is the gold standard for the diagnosis of PCS (2,10-12), notwithstanding that, for some years now, different groups claim that computerized axial tomography (CT), magnetic resonance imaging (MRI) or transabdominal and transvaginal ultrasonography (TVU) are valid options (10,13,14). CT and MRI have the advantage of allowing to obtain a broad view of the wide range of disorders behind pelvic venous dilation, which would allow to use the SVP classification (9,15). However, in a recent systematic review it was stated that there are not enough studies about the diagnostic value of CT for PCS. Furthermore, there is a lack of standardized criteria regarding PCS when using MRI, and along with the limited evidenced and its low availability, it is not highly recommended (11).

In contrast, TVU is a non-ionizing technique, which is easily accessible and minimally invasive. It also allows to measure pelvic veins and identify blood flow in real time (16), although it requires expertise of the examiner to properly identify the ovarian veins, which is difficult to properly do so.

Regarding the ultrasonographic assessment of PCS, there have been various suggested parameters, like the dilation and low blood flow velocity in the ovarian veins, or the dilation of the arcuate vein in the myometrium (17). Understandably, color Doppler imaging is essential for the proper assessment, as it allows to identify return or discontinued flow during Valsalva, which has been associated with backflowing or stasis in the ovarian vein in VG (18). Nonetheless, the cut-off value for the dilation of the ovarian veins is still a controversial topic, with different authors establishing it somewhere between 5 and 8 mm. A recent study was published establishing the venographic diagnostic of PCS with the identification of a pelvic vein of 8 mm or higher by TVU, as well as the disturbed flow during Valsalva and the presence of crossing veins in the myometrium (19).

The aim of this study was to design a predictive model for the venographic diagnostic of PCS using the parameters identified by TVU in patients with clinical suspicion of PCS, in order to individually assess the need to perform an invasive diagnostic and therapeutic technique such as VG. Thus, the study hypothesis was that a model based on the use of parameters identified by TVU could predict the presence of PCS in patients with clinical suspicion of PCS. We present the following article in accordance with the STROBE and STARD reporting checklists (available at <https://qims.amegroups.com/article/view/10.21037/qims-22-898/rc>).

Methods

This was an observational and cross-sectional prospective study, conducted between October 2020 and September 2021. It was set in the Gynecological Ultrasound Unit at the Valme University Hospital, including patients with clinical suspicion of PCS, who were referred by the Pelvic Floor, Gynecology and Vascular Surgery Units, following unpublished locally approved clinical protocol. This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and received approval of Andalusia's Board of Biomedicine Ethics Committee (No. 1314/2017). Informed consent was obtained from all participants of the study.

The study included 80 patients who were consecutively recruited after being referred to the Gynecological Ultrasound Unit. The inclusion criterion was the presence of non-cyclical pelvic pain for at least 6 months, whilst the exclusion criteria were: patients with a previous hysterectomy or oophorectomy, patients who were unable to undergo TVU, underage patients (under 18 years old), and patients who refused to undergo a VG. Those who accepted to participate in the study were performed a transvaginal ultrasound to take measurements as described later. After a period of time of at least 15 and no longer than 60 days since the TVU assessment, patients were submitted for a diagnostic pelvic VG to assess the presence of PCS. For the retrospective analysis of the data, patients were divided in two groups based on the results of the VG: normal group (NG) and PCS group (PCSG), depending on the absence or presence of PCS, respectively.

Data collection

The epidemiological data collected was included in a

questionnaire form, which the subjects had to complete before the diagnostic tests. The epidemiological variables were: age; parity; maximum newborn birth weight; menopausal stage (considering all patients who had been amenorrheic for at least 12 months, including patients diagnosed with early menopause using hormone replacement therapy); age of the onset of symptoms; worsening of symptoms after pregnancy; presence of vulvar varicosities during pregnancy; prior medical history of endometriosis, adenomyosis, urologic or gastrointestinal disorders; presence of varicosities in lower extremities; prior pelvic surgery; presence of uterine fibroids; and the presence of varicosities in the vulva, perineum, buttocks or lower extremities. Additionally, we registered patients' reported levels of pain in various scenarios: walking, sitting, in the supine position, dysmenorrhea, dyspareunia, postcoital pain, and lumbar pain. We considered level of pain as clinically significant if VAS score was 7 or greater.

Ultrasonography evaluation

Ultrasonography evaluation was carried out by an expert in gynecological ultrasound, with more than 15 years of experience, using a Canon Aplio 500 (Toshiba Medical systems Corp., Tokyo, Japan) with a 6.5 MHz probe. Set-up of the 2-D mode consisting in the use of 2 focal zones, with an 80–95 gain, dynamic range of 60–75. For the use of color and spectral Doppler the size of the Doppler sampling window was set at 45×45 mm, color gain between 35–45 and PRF at 5.4–7.6 cm/s. In order to carry out the examination while the bladder was empty, as is customary, patients were asked to adopt the gynecological position short after urinating. The assessment started first by completely assessing the uterus and the adnexa in a longitudinal and cross-sectional plane. We used the simplified prolate ellipsoid formula to calculate uterine and ovarian volumes. Afterwards, the uterine vein was tracked from its origin at the internal cervical os up until the internal iliac veins and collateral branches, in order to identify the largest pelvic vein as well as the venous plexus. These were measured in their anteroposterior diameter in a cross-sectional plane. For the Doppler assessment of the pelvis, we identify the flow direction with color and spectral Doppler and asked the patient to perform a Valsalva maneuver to identify changes in the flow velocity. This procedure was first performed in one side and then repeated for the contralateral side. Subsequently, we applied color Doppler in a cross-sectional plane of the uterus determine whether there were crossing

veins in the myometrium, then measured its maximum anteroposterior diameter. Thus, we collected the following ultrasonographic variables: uterine volume, right and left ovarian volume, presence of polycystic ovaries (PCO), inner diameter of the largest pelvic vein (right and left side), maximum diameter of the largest venous plexus (right and left side), reverse or altered flow during Valsalva, presence of crossing veins in the myometrium, and maximum diameter of crossing veins in the myometrium.

VG assessment

After at least 15 and no longer than 60 days since the ultrasonographic assessment, patients underwent diagnostic-therapeutic invasive pelvic VG as it is the current gold standard for the diagnostic confirmation of PeVD. Said technique was performed by specialists in Angiology and Vascular Surgery who were blinded to the results of the TVU assessment. The procedure was performed under local anesthesia. Via femoral or brachial access, the gonadal and internal iliac veins were bilaterally accessed, as well as their collaterals veins and the common iliac vein. The diagnostic criteria for PCS was based on the presence of at least one of the following: enlargement of ovarian veins ≥ 10 mm, congestion (defined as the detention of contrast in the varicose dilations for at least 20 seconds), and valvular insufficiency (20,21). When the PCS diagnosis was confirmed according to the described criteria, an embolization of insufficient ovarian or iliac veins were performed up until the last incompetent branch, from distal to proximal until the achievement of anterograde venous axis. The procedure was performed in all 43 patients who were diagnosed with PCS. For this purpose, we used controlled release platinum coils of 12–20 mm in diameter and 20–40 mm in length. In some cases, a sandwich technique with 2–3% povidocanol was used.

Statistical analysis

We carried out the statistical analysis using the statistics software IBM SPSS version 22 (IBM, Armonk, NY, USA). We used mean and standard deviations for normally distributed quantitative variables, whilst median and interquartile range were applied to non-normally distributed quantitative variables. As for qualitative variables, we used percentages to describe them. The Shapiro-Wilk test was performed to analyze the normality of the data. While Student's *t*-test was used to evaluate

normally distributed quantitative, Mann-Whitney U-test was carried out for non-normally distributed data. In case of qualitative variables, we used the Chi-square test. Finally, we evaluated individual predictive values with a receiver operating characteristic (ROC) curve and the area under the curve (AUC). All statistic comparisons were performed with a two-tailed test, with an alpha error of 5%.

Logistic regression models evaluation

Several binary logistic regression models were created to predict the venographic diagnosis of PCS. The parameters that showed statistical significance in the prior univariate analysis were included in the different models, creating a total of 19 binary logistic regression models. We applied a goodness-of-fit test (logarithmic probability of -2) and the Hosmer and Lemeshow test for each model. Then, we determined the Harrel's C-index for the models who showed an adequate fit. We evaluated their discriminatory capacity with an AUC of the predicted probabilities by each model, selecting then the final model for its maximum discriminative capacity.

Results

Study population

A total of 80 patients were initially recruited for the study. Out of them, 19 patients were excluded from the study due to refusal or impossibility to perform the VG. Thus, the final sample included 61 patients, who were distributed in two groups, according to the VG results: 18 belonging to the NG and 43 to the PCSG. The recruitment summary can be seen in *Figure 1*. There were none adverse events amongst the 61 patients who completed the study. The results of the epidemiological data are shown in *Table 1*. The mean age of patients were 44.9 years in the NG and 41.3 years in the PCSG, without reaching statistical significance ($P=0.09$). There were statistically significant differences regarding the age of the on-set of symptoms, being lower in the PCSG (NG *vs.* PCSG: 37.2 *vs.* 32.3 years; $P=0.02$). No statistically significant differences were observed for the rest of the epidemiological data.

Ultrasonography parameters

We can see in *Table 2* the results of the ultrasonography variables. We found that patients in the PCSG had higher

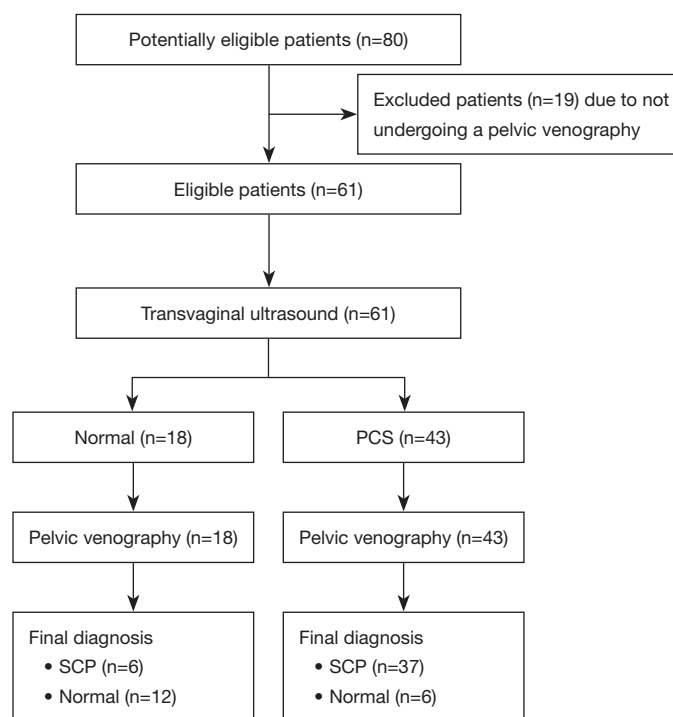


Figure 1 Flowchart of the recruitment process. PCS, pelvic congestion syndrome; SCP, pelvis congestion syndrome according to the venography.

diameters for the larger pelvic vessel (NG *vs.* PCSG: 4.8 *vs.* 6.3 mm; $P=0.04$) and pelvic plexus (NG *vs.* PCSG: 9.7 *vs.* 18.2 mm; $P=0.001$). Moreover, the PCSG showed higher rates of reverse or altered flow during Valsalva (NG *vs.* PCSG: 16.7% *vs.* 44.2%; $P=0.04$), and crossing veins in the myometrium (NG *vs.* PCSG: 33.3% *vs.* 74.4%; $P=0.003$). No statistical significance was reached for the rest of the variables.

Predictive models for PCS

Several binary logistic regression models were evaluated to predict the venographic diagnosis of PCS using TVU. The models were created using different combinations parameters that reached statistical significance in the univariate analysis: crossing veins in the myometrium, reverse or altered flow during Valsalva, and diameter of the largest pelvic vein or venous plexus, for which we used several cut-off points. A total of 19 models were created.

Models 1–4 were based on the different cut-off points of the largest pelvic vein or venous plexus, with Harrell's C-index values oscillating between 0.64 and 0.79, determined as the AUC of the predicted probabilities

(Table 3). When adding the presence of crossing veins in the myometrium, Harrell's C-index values ranged between 0.66 and 0.70, while these oscillated between 0.56 and 0.58 when adding the presence of a reverse or altered flow during Valsalva. Lastly, the models based only on the latter two variables had a Harrell's C-index value between 0.59 and 0.68.

The selected model was Model 3, which identified the presence of a pelvic vein or venous plexus of 8 mm or greater, as predictor of the venographic diagnosis of PCS. Model 3's Harrell's C-index obtained from the AUC of the predicted probabilities was 0.79 (95% CI: 0.63–0.96; $P<0.001$), with a sensitivity of 0.90 and specificity of 0.69 (Figure 2). Table 4 displays the contrast between Model 3 and the gold standard, which shows a sensitivity of with a sensitivity of 86.05%, a specificity of 66.67% and a positive predictive value of 86.05% (Table 5). Ultrasonography captions of the measurement of pelvic vein and venous plexus are displayed in Figures 3,4.

Discussion

The main finding of our study was that a model based in the presence of a pelvic vein or venous plexus of 8 mm or

Table 1 Epidemiological data

Variables	Normal group	PCS group	P
Age (years)	44.9±8.4	41.3±6.4	0.09
Multiparity	16 (88.9)	32 (74.4)	0.31
Maximum newborn birth weight (g)	3,630.8±375.5	3,591±512.7	0.32
Menopausal	4 (22.2)	3 (7.0)	0.35
Age of the onset of symptoms (years)	37.2±10.5	32.3±8	0.02
Worsening of symptoms during pregnancy	8 (44.4)	29 (67.4)	0.09
Vulvar varicosities during pregnancy	11 (61.1)	27 (62.8)	0.90
Medical history	14 (77.8)	37 (86.0)	0.46
Endometriosis	1 (5.6)	2 (4.7)	>0.99
Adenomyosis	3 (16.7)	1 (2.3)	0.07
Urologic disorders	1 (5.6)	4 (9.3)	0.31
Gastrointestinal disorders	1 (5.6)	0 (0.0)	0.30
Varicosities in lower extremities	10 (55.5)	31 (72.1)	0.14
Prior pelvic surgery	3 (16.7)	4 (9.3)	0.41
Fibroids	5 (27.8)	5 (11.6)	0.14
Presence of varicosities (vulva, perineum, buttocks, lower extremities)	10 (55.6)	33 (76.7)	0.10
Pain (VAS score ≥7)			
Walking	10 (55.6)	24 (55.8)	0.99
Sitting	6 (33.3)	22 (51.2)	0.20
Supine	7 (38.9)	17 (39.5)	0.96
Dysmenorrhea	10 (55.6)	26 (60.5)	0.72
Dyspareunia	6 (33.3)	18 (41.9)	0.53
Postcoital pain	13 (72.2)	25 (58.1)	0.30
Lumbar pain	6 (33.3)	15 (34.9)	0.86

Numeric variables are expressed as mean ± SD, while qualitative variables are expressed as frequencies and percentages. PCS, pelvic congestion syndrome; VAS, visual analogue scale; SD, standard deviation.

Table 2 Ultrasound parameters

Variables	Normal group	PCS group	P
Uterine volume (mm)	78.7±33.2	84.4±34.3	0.3
Right ovarian volume (mm)	13.1±9.5	10.1±5.4	0.33
Left ovarian volume (mm)	15.34±10.6	12.7±7.7	0.45
PCO	5 (27.8)	7 (16.3)	0.31
Largest pelvic vein (mm)	4.8±1.8	6.3±2.7	0.04
Largest venous plexus (mm)	9.7±4	18.2±11.9	0.001
Reverse of altered flow during Valsalva	3 (16.7)	19 (44.2)	0.04
Crossing veins in the myometrium	6 (33.3)	32 (74.4)	0.003
Crossing veins in the myometrium (mm)	6±3	4±1.8	0.18

Numeric variables are expressed as mean ± SD, while qualitative variables are expressed as frequencies and percentages. PCS, pelvic congestion syndrome; PCO, polycystic ovaries; SD, standard deviation.

Table 3 Evaluation of the selected models

Model	Parameters	OR	P (95% CI)	Discrimination (Harrell's C-index 95% CI)
1	• Largest pelvic vein or venous plexus ^o ≥6 mm	5.31	0.03 (1.16–24.38)	0.64 (0.45–0.83)
2	• Largest pelvic vein or venous plexus ^o ≥7 mm	9.92	0.003 (2.20–44.63)	0.72 (0.64–0.90)
3	• Largest pelvic vein or venous plexus ^o ≥8 mm	19.13	<0.001 (3.98–91.80)	0.79 (0.63–0.96)
4	• Largest pelvic vein or venous plexus ^o ≥9 mm	14.85	<0.001 (3.29–67.04)	0.78 (0.62–0.94)
5	• Largest pelvic vein or venous plexus ^o ≥6 mm	3.93	0.04 (1.05–14.69)	0.66 (0.49–0.84)
	• Crossing veins in the myometrium			
6	• Largest pelvic vein or venous plexus ^o ≥7 mm	3.93	0.04 (1.05–14.69)	0.66 (0.49–0.84)
	• Crossing veins in the myometrium			
7	• Largest pelvic vein or venous plexus ^o ≥8 mm	0.18	0.02 (0.05–0.71)	0.70 (0.53–0.87)
	• Crossing veins in the myometrium			
8	• Largest pelvic vein or venous plexus ^o ≥9 mm	4.87	0.02 (1.25–19.03)	0.69 (0.52–0.86)
	• Crossing veins in the myometrium			
9	• Largest pelvic vein or venous plexus ^o ≥6 mm	2.54	0.27 (0.49–13.28)	0.58 (0.41–0.75)
	• Reverse of altered flow during Valsalva			
10	• Largest pelvic vein or venous plexus ^o ≥7 mm	2.54	0.27 (0.49–13.28)	0.58 (0.41–0.75)
	• Reverse of altered flow during Valsalva			
11	• Largest pelvic vein or venous plexus ^o ≥8 mm	2.54	0.27 (0.49–13.28)	0.58 (0.41–0.75)
	• Reverse of altered flow during Valsalva			
12	• Largest pelvic vein or venous plexus ^o ≥9 mm	2.54	0.27 (0.49–13.28)	0.58 (0.41–0.75)
	• Reverse of altered flow during Valsalva			
13	• Largest pelvic vein or venous plexus ^o ≥6 mm	1.96	0.43 (0.37–10.44)	0.56 (0.38–0.73)
	• Crossing veins in the myometrium			
	• Reverse of altered flow during Valsalva			
14	• Largest pelvic vein or venous plexus ^o ≥7 mm	1.96	0.423 (0.37–10.44)	0.56 (0.38–0.73)
	• Crossing veins in the myometrium			
	• Reverse of altered flow during Valsalva			
15	• Largest pelvic vein or venous plexus ^o ≥8 mm	1.96	0.423 (0.37–10.44)	0.56 (0.38–0.73)
	• Crossing veins in the myometrium			
	• Reverse of altered flow during Valsalva			
16	• Largest pelvic vein or venous plexus ^o ≥9 mm	1.96	0.423 (0.37–10.44)	0.56 (0.38–0.73)
	• Crossing veins in the myometrium			
	• Reverse of altered flow during Valsalva			
17	• Crossing veins in the myometrium	1.96	0.423 (0.37–10.44)	0.56 (0.38–0.73)
	• Reverse of altered flow during Valsalva			
18	• Crossing veins in the myometrium	4.48	0.03 (1.18–16.94)	0.68 (0.50–0.85)
19	• Reverse of altered flow during Valsalva	2.86	0.21 (0.55–14.88)	0.59 (0.42–0.77)

^o, diameter (mm). OR, odds, ratio; CI, confidence interval.

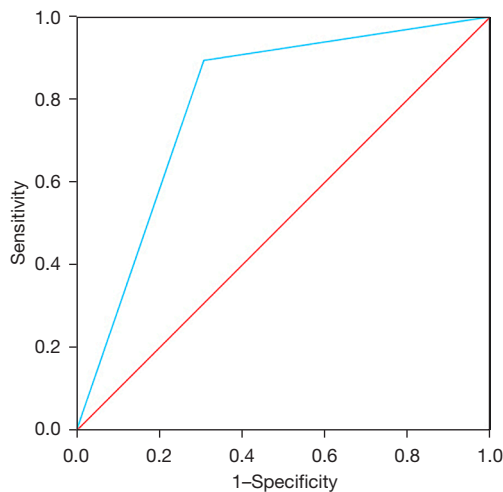


Figure 2 ROC curve for logistic regression model obtained from the presence of a pelvic vein or venous plexus of 8 mm or higher. Area under ROC curve: 0.79 (95% CI: 0.63–0.96; $P < 0.001$). ROC, receiver operating characteristic; CI, confidence interval.

Table 4 Evaluation of the diagnostic accuracy of Model 3 for PCS

Category	Venography (gold standard)			P
	Normal	PCS	Total	
“Model 3” TVU				<0.001
Normal	12	6	18	
PCS	6	37	43	
Total	18	43	61	

PCS, pelvic congestion syndrome; TVU, transvaginal ultrasound.

Table 5 Diagnostic values of Model 3 of transvaginal ultrasound for pelvic congestion syndrome

Parameter	Value	95% CI
Sensitivity	86.05%	72.07–94.7%
Specificity	66.67%	40.99–86.66%
Positive predictive value	86.05%	76.04–92.30%
Negative predictive value	66.67%	47.06–81.82%
Positive likelihood ratio	2.58	1.33–5.02
Negative likelihood ratio	0.21	0.09–0.47

CI, confidence interval.



Figure 3 Measurement of a pelvic vein with a diameter larger than 8 mm.

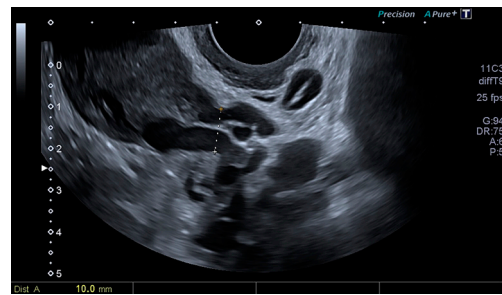


Figure 4 Measurement of a pelvic venous plexus with a diameter larger than 8 mm.

larger, identified with TVU, can predict 79% of patients with PCS, with good sensitivity (86.05%) and specificity (66.67%) values.

Our main goal was to design a predictive model to identify PCS using TVU. In the first place, a univariate analysis was carried out, which showed that the PCSG had higher diameters for the larger pelvic vessel and pelvic plexus, and higher rates of reverse or altered flow during Valsalva and crossing veins in the myometrium. These parameters have been associated before with PCS (17,19) and were all included in the following binary logistic regression models, using several possible combinations.

Different cut-off points for pelvic vein and venous plexus, or the addition of the crossing veins in the myometrium and the reverse or altered flow during Valsalva did not increase the predictive capacity of TVU. Given its simplicity, which includes only one easily achieved parameter by TVU, this model appears to be a feasible alternative, in contrast with

the predictive models previously published (2,13,14,16,18).

To the present day, VG is the gold standard for the diagnosis of PCS. It is an invasive and ionizing technique, with limited accessibility, as it is only performed in specialized centers, which increases the delay to the diagnosis and treatment of patients suffering from this condition. For this reason, research in pursuit of new non-invasive diagnostic techniques has risen in recent years (10,13,22,23). Steenbeek *et al.* published a meta-analysis comparing TVU with VG. The results showed good sensitivity and specificity for the cut-off point of 5 mm or higher for the ovarian vein, although it concludes that there is need for more studies considering the flawed methodology and the absence of diversity in the parameters used (11).

These discrepancies in the definition of PCS, along with the presence of anatomical variations of the pelvic venous system, hamper the standardization needed for research on this field. Typically, the upper limit for the diameter of the ovarian vein has been established between 5 and 8 mm (22,24). The right and left ovarian veins originate within the broad ligament and drain into the inferior vena cava and the left renal vein, respectively. Although imaging of the ovarian veins is feasibly achievable by VG, there is an increased difficulty when using TVU, given their small size and variable location far from the probe. To prevent this difficulty, we have used the methodology used in our previous study (19), which showed good results identifying patients with PCS.

Several etiologies may be behind CPP, being PCS one of them. Thus, even though 16–30% of patients with CPP present PCS, and up to 12% present PCS associated with other causes of CPP (25–27), no substantial changes have been introduced to usual gynecological practice (6). In our study there was a PCS rate of 70.5%, with a 78.9% rate of isolated PCS and a 56.5% rate of PCS associated with other causes of CPP. These differences might be due to the patients being referred after a directed anamnesis and examination by specialists in angiology and vascular surgery.

Mean age of patients at the time of the diagnosis of PCS was around 41 years in our sample, slightly above the 30–40 years described in the literature (2,18,25,28), without statistically significant differences shown in comparison with normal patients. However, there were differences regarding the age of the on-set of symptoms, with the PCSG showing symptoms around 5 years earlier (NG *vs.* PCSG: 37.2 *vs.* 32.3 years; $P=0.022$), which might be due to the fact that other causes of CPP usually appear in older patients. Nonetheless, it is worth noticing the existing gap

between the age of the on-set of symptoms and the age at the time of the diagnosis. International Pelvic Pain Society (IPPS) has developed history and physical examination forms to facilitate CPP assessment, although it does not include questions about signs of PCS or the examination of varicosities in vulva, perineum or buttocks (6,29). Even more, although TVU is used in the assessment of CPP, there is no current recommendations to look for pelvic varicosities (6). Disinformation about CPP, by healthcare specialists as well as patients, may contribute to the normalization of pain and delay its diagnosis and treatment, which could contribute to persistence of pain due to its centralization, despite adequate treatment of primary pain (6,9).

During pregnancy, pelvic venous vessels capacity increases up to 50–60%, causing venous insufficiency and backflow after pregnancy (2,18,25,30). In addition, hormonal changes such as estrogen and progesterone increase also contribute to venous dilation (22,31,32). Thus, PCS has been defined as a condition typical of multiparous women of fertile age. The decrease of estrogen and its vasodilatory effect during menopause might explain the low rates of PCS in menopausal women, as well as the improvement experienced by patients after pharmacological or surgical induction of a hypo-estrogenic state (22). In our study, just like in Beard *et al.* (2), we did not observe this association with multiparity, as well as the presence of vulvar varicosities or worsening of symptoms during pregnancy, although there were higher rates of the latter in the PCSG (NG *vs.* PCSG: 44.4% *vs.* 67.4%) (33). Additionally, it is worth mentioning that menopause was not an exclusion criterion, as we considered etiology and physiopathology of PCS to be multifactorial, which is shown in the 7% rate of menopausal women in the PCSG.

PCS has been linked to dysmenorrhea (82–84%), postcoital pain (40–75%), dyspareunia (76%) and the presence of varicosities in the vulva or lower extremities, in at least a 50% of patients (25,32,34). Our data on clinical and medical history showed similar results in PCS patients, although there were no differences found with the NG. As mentioned above, CPP is caused by several concurrent conditions that have shared symptoms. For instance, pain worsened by certain activities or body positions might be related both to pelvic venous and musculoskeletal disease, while deep dyspareunia might be caused by pelvic venous conditions as well as by endometriosis (6). All patients in our sample had CPP, which might explain why there were no significant differences between groups in terms of clinical and medical history.

One of the main problems we find in relation to skepticism about this disease is the fact the dilated pelvic veins is a quite common finding. It is estimated that they exist in approximately 15% of women between the age of 20 and 50 years, although not all of them manifest symptoms. Even more, the reason why these findings are associated with CPP in some women but not others are unknown (18,35,36).

Our study also has its limitations, such as the small sample size. Some studies establish that in asymptomatic patients ovarian veins may be observed, but the diameters are significantly larger in patients with CPP (18). However, there was not asymptomatic control group, which entails quite a limitation. It is also worth mentioning that the assessment was carried out by only one expert examiner in just one single act, and hence we could not analyze the inter- and intra-observer reproducibility. Therefore, there is a need for external validation of these results. Nonetheless, these will be considered in future studies.

Conclusions

The model based on the presence of pelvic veins or venous plexus of 8 mm or larger, observed by transvaginal ultrasound, can predict 79% of patients with pelvic congestive syndrome, and said assessment presents a feasible alternative that could be easily added to our usual gynecological practice.

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Footnote

Reporting Checklist: The authors have completed the STROBE and STARD reporting checklists. Available at <https://qims.amegroups.com/article/view/10.21037/qims-22-898/rc>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://qims.amegroups.com/article/view/10.21037/qims-22-898/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are

appropriately investigated and resolved. This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Andalusia's Board of Biomedicine Ethics Committee (No. 1314-2017). All patients gave their written informed consent before starting the study.

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