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Surgical and endovascular treatment of pelvic venous disorder: Results of a multicentre retrospective cohort study

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ABSTRACT

Objective: In the present study, we investigated the clinical outcomes after gonadal vein resection (GVR) and gonadal vein embolization (GVE) with coils in patients with pelvic venous disorder (PeVD). We also assessed the rates of procedural complications and disease recurrence.

Methods: Our multicenter retrospective cohort study included 361 female patients with PeVD-related chronic pelvic pain (CPP) and gonadal vein reflux who underwent GVR (n = 184) or GVE with coils (n = 177) from 1999 to 2020. The clinical outcomes (ie, presence and severity of CPP, procedural complications, disease recurrence) were assessed at 1 month and 1, 3, and 5 years after intervention. The pain intensity before and after treatment was assessed using a visual analog scale. All the patients underwent duplex ultrasound after GVR and GVE, and those with persistent CPP and suspected perforation of the gonadal vein by the coils were also evaluated by multiplanar pelvic venography.

Results: GVR and GVE was associated with the reduction or elimination of CPP at 1 month after treatment in 100% and 74% of patients and postprocedural complications in 14% and 37% of patients, respectively ($P < 0.01$ for both). The most common complication after either GVR or GVE was pelvic vein thrombosis (11% and 22% patients, respectively; $P < .01$ between groups). GVE was associated with postembolization syndrome in 20%, coil protrusion in 6%, and coil migration in 1% of patients. The long-term recurrence rate after GVR and GVE was 6% and 16%, respectively ($P < .01$).

Conclusions: Both GVR and GVE were found to be effective in treating patients with PeVD. However, GVR was associated with better efficacy in the relief of CPP and lower rates of procedural complications and disease recurrence. (J Vasc Surg Venous Lymphat Disord 2023;11:1045-54.)

Keywords: Chronic pelvic pain; Complications; Gonadal vein embolization with coils; Gonadal vein intervention; Gonadal vein resection; Pelvic venous disorder; Recurrence

Interventions on the gonadal veins are an effective approach for treating pelvic venous disorder (PeVD) caused by dilation and reflux in the gonadal, parametrial, and uterine veins, except for gonadal vein reflux caused by nutcracker syndrome or May-Thurner syndrome.[1,2] The main goals of treatment for these patients are elimination of chronic pelvic pain (CPP) and restoration of venous outflow from pelvic organs.[3,4] The blood flow reduction in the gonadal veins after coil embolization or surgical resection is accompanied by significant relief or the elimination of symptoms and signs of PeVD.[5,6]

Gonadal vein embolization (GVE) with nitinol or platinum coils is a common procedure for treating PeVD.[7-9] An alternative is gonadal vein resection (GVR) performed using an open retroperitoneal or endoscopic technique.[5,10,11] Although GVE with coils has been recognized in clinical guidelines and international consensus documents as a first-line treatment,[2,9] no robust evidence is available of its higher efficacy vs GVR in the treatment of patients with PeVD. In addition, to the best of our knowledge, no clinical studies have compared these techniques. The main argument in favor of GVE is that this procedure can be performed using local anesthesia and provides a great aesthetic result (no postoperative scars). In contrast, GVR is an invasive procedure and requires general anesthesia.[12,13] However, 6% to 32% patients will experience persistent pain after GVE.[14] The few available studies on the use of GVR for PeVD provide only scarce data about its clinical outcomes, including the complication and recurrence rates.[15,16]

In the present study, we compared the efficacy of GVE and GVR in the relief of CPP for patients with PeVD. We

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also evaluated the complication and disease recurrence rates for these techniques.

METHODS

The present multicenter, retrospective cohort study included 361 female patients with PeVD caused by gonadal, parametrial, and/or uterine vein dilation and reflux treated at the vascular surgery clinics in Moscow, Kazan, and Yaroslavl from 1999 to 2020. The institutional ethics committee of the Pirogov Russian National Research Medical University approved the present study. The requirement for patient informed consent was waived because of the retrospective nature of the study.

The inclusion criteria were the presence of symptoms and signs of PeVD, including CPP, dyspareunia, discomfort and/or heaviness in the hypogastric region, and vulvar varicose veins; reflux >1 second in the gonadal, parametrial, and/or uterine veins, according to duplex ultrasound (DUS); and coil embolization or resection of only the gonadal veins. The exclusion criteria were the presence of nutcracker syndrome and/or May-Thurner syndrome confirmed by DUS, renal venography, and multiplanar pelvic venography (MPV); hybrid interventions on the gonadal and iliac veins or pelvic veins and organs; and comorbidities associated with CPP.

The diagnosis of PeVD was confirmed by transabdominal and transvaginal DUS, ovarian venography, and/or MPV, as described previously.[17,18] A pelvic (parametrial, uterine, or gonadal) vein was considered dilated if its maximal diameter was >5 mm. Pelvic reflux was deemed pathologic if the reflux flow lasted for >1 second.[2]

Patients. The study included 361 patients from a cohort of 6852 women with CPP (age, 18-69 years), who had been examined at the participating sites from 1999 to 2020. Of the 6852 patients, 2672 (39%) were diagnosed with PeVD because of DUS findings of the presence of pelvic varicose veins with pathologic reflux. Using the selection criteria, 184 and 177 patients with a history of GVR and coil GVE, respectively, and all the necessary data available in their medical records were eligible for analysis. The intensity of CPP and pain before and after GVR and GVE was assessed using a visual analog scale (VAS), with the score ranging from 0 (no pain) to 10 (worst possible pain). The flowchart of the study is presented in Fig 1.

Indications for gonadal vein intervention. The indications for isolated intervention on the gonadal veins were the presence of PeVD symptoms (ie, CPP, dyspareunia, discomfort and/or heaviness in the hypogastric region), pathologic reflux (>1 second) in gonadal veins with valvular incompetence of the pelvic veins and uterine veins found on transvaginal and transabdominal DUS, and the absence of nutcracker syndrome and May-Thurner syndrome on DUS, renal venography, and/or MPV. These indications were common for both GVR and GVE. In the absence of any guidelines for the selection of a specific treatment approach, for the vast majority of the patients, the choice between GVR and GVE was not determined by any special criteria other than those listed. However, the patients with a gonadal vein diameter of ≥10 mm underwent only GVR using either an open or endoscopic technique.

ARTICLE HIGHLIGHTS

- **Type of Research:** A multicenter retrospective cohort study
- **Key Findings:** Gonadal vein resection and gonadal vein embolization are highly effective in the treatment of pelvic venous disorder caused by gonadal vein reflux.
- **Take Home Message:** Gonadal vein resection and gonadal vein embolization are associated with chronic pelvic pain relief in 100% and 74% of patients in the early postprocedural period, respectively, and 100% of patients in the long term.

Gonadal vein interventions. Open retroperitoneal GVR had been used for PeVD treatment until 2010. Subsequently, with the development and introduction into clinical practice, transperitoneal (laparoscopic) endoscopic GVR has become the main technique for treating bilateral gonadal vein lesions. In 2016, a technique of retroperitoneal endoscopic GVR, which is more appropriate for unilateral gonadal vein lesions, was developed and introduced for the treatment of these patients.[12]

Open retroperitoneal GVR was performed with the patient under general anesthesia and in the reverse Trendelenburg position and angled at 30° to the left or right depending on the side of the gonadal vein lesion. In the left or right iliac region (according the lesion side), retroperitoneal access was created with a 5- to 7-cm incision, the gonadal vein was mobilized over a distance of 10 to 12 cm, and the gonadal vein tributaries were ligated. The vein was ligated at the caudal and cranial segments and resected.

Transperitoneal endoscopic GVR was also performed with the patient under general anesthesia and in the same position as described for open GVR. After applying carboxyperitoneum (intra-abdominal pressure, 12 mm Hg), three access ports were installed: a 10-mm port in the umbilicus, a 5-mm port in the left (right) iliac region, and a 5-mm port 5 cm below the umbilicus. After dissection of the parietal peritoneum, the gonadal vein was mobilized over a distance of 10 to 12 cm, its tributaries were ligated, the caudal and cranial sections of the vein were clipped or ligated, and the vessel was resected. The parietal peritoneum was sutured with continuous suture.

Retroperitoneal endoscopic GVR was performed with the patient under general anesthesia in the reverse

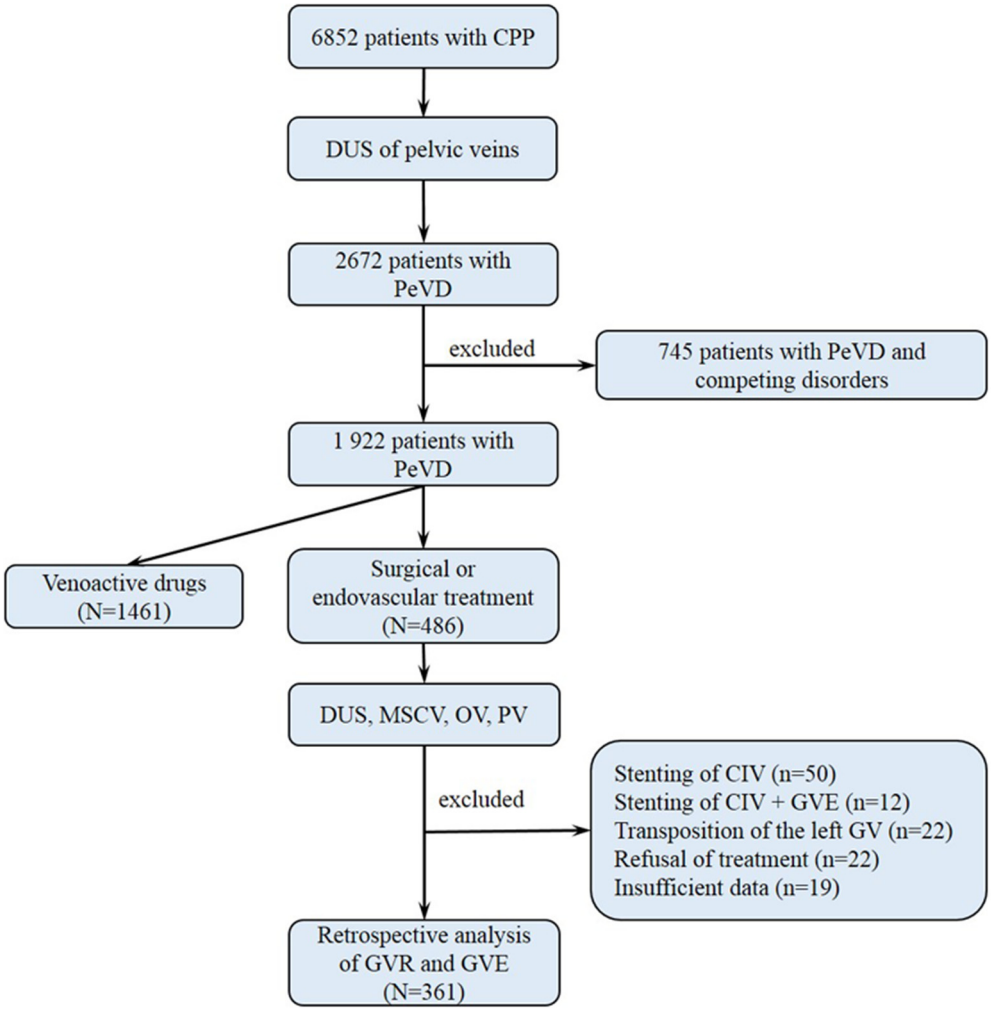

Fig 1. Flowchart of the study. *CCP,* Chronic pelvic pain; *CIV,* common iliac vein; *DUS,* duplex ultrasound; *GV,* gonadal vein; *GVE,* gonadal veins embolization; *GVR,* gonadal veins resection; *MSCV,* multislice computed venography; *OV,* ovarian venography; *PeVD,* pelvic venous disorder; *PV,* pelvic venography.

Trendelenburg position and lying on their left or right side (depending on the lesion side). Carboxyretroperitoneum (intra-abdominal pressure, 12 mm Hg) was applied using the Veress needle. A 10-mm camera port was installed between the posterior superior iliac spine and lower edge of the 12th rib. Next, one or two 5-mm instrument ports were installed. The gonadal vein was mobilized over a length of 10 to 12 cm, the gonadal vein tributaries were ligated, the caudal and cranial segments of the vein were clipped, and the vessel was resected (Fig 2).

GVE with coils was performed using local anesthesia with 5.0 to 10.0 mL of 0.5% lidocaine solution after intravenous sedation. Left GVE was performed using the transfemoral approach, and right GVE or bilateral occlusion of the gonadal veins was performed using the transjugular approach. Vein puncture was performed with ultrasound guidance using 5F multipurpose angiographic catheters (Cordis), a standard "moving core" J 0.035-in. guidewire, and an angled hydrophilic wire (Radiofocus; Terumo Corp). To occlude the gonadal vein, push-able 0.035-in. standard stainless steel coils (Gianturco; William Cook) and 0.035-in. coils of Inconel with interwoven long collagen fibrils (Cook Medical Inc) were used. The diameter of the coils was 8 to 12 mm, and the length was 10 to 20 cm. All the patients underwent follow-up ovarian venography after GVE. No sclerosing agents or cyanoacrylate glue were used.

All interventions were performed in surgical clinic settings. Anticoagulation therapy to prevent thromboembolic events after treatment was not routinely prescribed. All the patients wore compression stockings before and after intervention. Patient mobilization after GVE or GVR started 2 hours after the procedure.

Assessment of treatment outcomes. The primary efficacy end point was CPP relief evaluated at 1, 12, 36, and 60 months after the procedure, and the primary safety

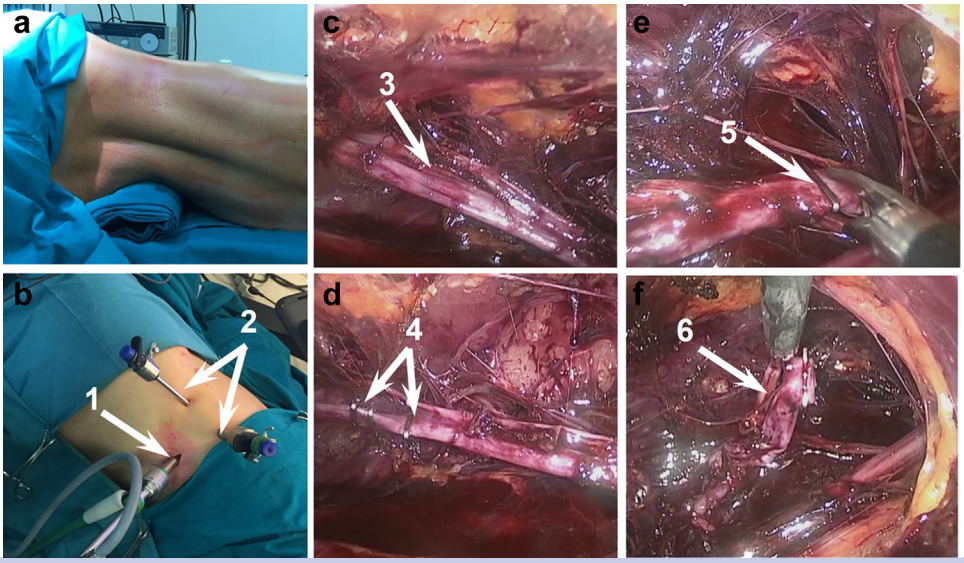

Fig 2. Images at different stages of retroperitoneal endoscopic resection of the left gonadal vein (*LGV*). **a,** Patient's position on the table. **b,** Location of access ports. **c,** mobilization of caudal segment of LGV. **d,** Clipping of caudal segment of LGV. **e,** Clipping of cranial segment of LGV. **f,** Removal of resected part of LGV. *1,* Camera port; *2,* instrument ports; *3,* caudal segment of LGV; *4,* clips on caudal segment of LGV; *5,* clips on cranial segment of LGV; *6,* resected part of LGV.

end point was the 30-day postprocedural complication rate. The secondary efficacy end point was the rate of disease recurrence, defined as the recurrence of the clinical manifestations of PeVD (ie, CPP, dyspareunia, discomfort and/or heaviness in the hypogastric region) with DUS evidence of retroperitoneal venous reflux (through the accessory gonadal vein or large gonadal vein tributary) at the site of previous intervention; visible reflux veins at the site of embolized or resected gonadal veins on ovarian venography; and/or reflux of contrast medium through the gonadal vein previously embolized with coils.

Assessment of GVE and GVR complications. The GVE complications were graded using the Society for Interventional Radiology adverse event classification system.[13] The GVR complications were defined using the Clavien-Dindo classification of surgical complications.[19]

All the patients underwent DUS of the veins of the pelvis and lower limbs 1 day after and 30 days after the procedure. In the case of persistent pelvic pain or the occurrence of hyperthermia and pain above the embolized vein, DUS was performed on days 1, 3, and 7 after GVE. Patients with persistent pain syndrome also underwent multislice computed venography (MSCV) and ovarian and pelvic venography within 7 to 10 days after the procedure.

Statistical analysis. Statistical analysis was performed using the software package Statistica, version 10 (StatSoft; TIBCO Software Inc). The continuous variables are presented as the mean ± standard deviation or median and interquartile range (quartile 1 to quartile 3), depending on the distribution of normality. Comparisons were performed using the Student *t* test or Mann-Whitney *U* test, as appropriate. Quantitative variables are presented as frequencies and percentages and were compared using the χ^2 test. The factors influencing postprocedural complications were investigated using multivariate logistic regression analysis, and the results are presented as odds ratios with the corresponding 95% confidence intervals (CIs) and *P* values computed using the Wald test. Differences were considered statistically significant at $P < .05$.

RESULTS

The two groups were comparable for all pretreatment characteristics, including age, body mass index, disease duration, clinical manifestations of PeVD, and concomitant disease rates, except for the higher proportion of patients with CEAP (clinical, etiologic, anatomic, pathophysiologic) class 2 to 3 chronic venous disease in the GVR group compared with the GVE group (22% and 11%, respectively; $P = .03$; Table I). Patients with a gonadal vein diameter >10 mm only underwent GVR.

Clinical efficacy

Gonadal vein resection. Patients who underwent open or endoscopic GVR were combined for the analysis of GVR outcomes because they had almost identical clinical results (CPP relief) and complication and PeVD recurrence rates. GVR was left sided for 151 (82%), right sided for 4 (2%), and bilateral for 29 patients (16%). The GVR duration ranged from 25 to 40 minutes (mean, 31.5 ± 2.3 minutes) for unilateral GVR and 40 to 65 minutes (mean, 48.6 ± 3.7 minutes) for bilateral treatment.[20]

Table I. Pretreatment patient characteristics (n = 361)

Parameter	GVR (n = 184)	GVE (n = 177)	*P* value
Age, years	31.7 ± 2.9	32.1 ± 3.6	NS
BMI, kg/m^2	22.4 ± 2.3	21.3 ± 2.1	NS
Pregnancies, No.	2 (2–3)	2 (2–4)	NS
Births, No.	2 (1–2)	2 (2–3)	NS
Known allergy to metals or contrast agents	1 (0.5)	0 (0.0)	–
Disease duration, years	7.1 ± 4.7	6.5 ± 5.3	NS
CPP before treatment	184 (100)	177 (100)	–
VAS score for CPP intensity before treatment	6.1 ± 2.0	6.3 ± 1.9	NS
Dyspareunia	143 (78)	146 (82)	NS
Heaviness in hypogastrium	178 (97)	171 (97)	NS
Vulvar varicosities	47 (26)	33 (19)	NS
Concomitant disease			
Lumbosacral osteochondrosis	8 (4)	6 (3)	NS
Chronic gastritis	9 (5)	12 (7)	NS
Cholelithiasis	6 (3)	4 (2)	NS
Small uterine fibroids	7 (4)	8 (5)	NS
CVD, CEAP class C1	57 (31)	53 (30)	NS
CVD, CEAP class C2-C3 (PR)	41 (22)	20 (11)	<.001
Diameter of LGV, mm	9.4 ± 1.3	8.1 ± 0.7	.37
Reflux duration in LGV, seconds	3.5 ± 1.7	2.8 ± 1.1	.72
Diameter of RGV, mm	7.7 ± 0.3	7.1 ± 0.6	.37
Reflux duration in RGV, seconds	2.5 ± 0.4	2.8 ± 0.3	.54

BMI, Body mass index; *CEAP,* clinical, etiologic, anatomic, pathophysiologic; *CPP,* chronic pelvic pain; *CVD,* chronic venous disease; *GVE,* gonadal vein embolization; *GVR,* gonadal vein resection; *LGV,* left gonadal vein; *NS,* nonsignificant; *PR,* pathophysiologic class reflux; *RGV,* right gonadal vein; *VAS,* visual analog scale.
Data presented as mean ± standard deviation, median (interquartile range), or number (%).

Technical success (ie, adequate mobilization and resection of the gonadal vein) was achieved in 100% of the patients (Table II). The VAS score for the intensity of pain in the area of the postoperative wound on day 1 after the procedure ranged from 4 to 6 for GVR and 2 to 4 for GVE, for an average score of 3.5 ± 1.4. The postoperative pain duration was not longer than 3 to 4 days (mean, 3.0 ± 0.5 days). Blood flow reduction in the gonadal vein at 1 month after GVR was achieved in 100% of the patients, and CPP had decreased significantly from a score of 6.1 ± 2.0 to 1.1 ± 0.2 ($P = .02$). No patient reported the persistence of, or an increase in, CPP after GVR.

GVE with coils. The GVE procedure was left sided in 140 (79%), right sided in 9 (5%), and bilateral in 28

Table II. Short- and long-term outcomes (n = 361)

Parameter	GVR (n = 184)	GVE (n = 177)	*P* value
Reduction in gonadal vein blood flow	184 (100)	177 (100)	NS
CPP relief 1 month after treatment	184 (100)	131 (74)	<.001
VAS score of CPP intensity 1 month after treatment	1.1 ± 0.2	4.1 ± 1.1	<.001
VAS score of CPP intensity 5 years after treatment	1.7 ± 0.8	2.1 ± 1.4	NS
Postoperative pain	184 (100)	–	–
VAS score of postoperative pain intensity	3.0 ± 0.5	–	–
Postembolization pain	–	35 (20)	–
VAS score of postembolization pain intensity	–	6.7 ± 1.3	–
Postoperative or postembolization pain duration, days	3.5 ± 1.4	17.3 ± 3.5	<.001
Increase in CPP within 30 days after treatment	0 (0)	10 (6)	–

CPP, Chronic pelvic pain; *GVE,* gonadal vein embolization; *GVR,* gonadal vein resection; *NS,* nonsignificant; *VAS,* visual analog scale.
Data presented as number (%) or mean ± standard deviation.

Table III. Complications of gonadal vein resection (GVR; n = 184)

Complication	Clavien-Dindo grade	Event, no. (%)
Bleeding	I-V	0 (0)
Wound infection	I	0 (0)
Postoperative paralytic ileus	I	2 (1)
PVT	II	20 (11)
DVT	II	2 (1)
Total	NA	25 (14)

DVT, deep vein thrombosis; *NA*, not applicable; *PVT*, pelvic vein thrombosis.

patients (16%). The GVE duration ranged from 20 to 55 minutes (average, 22.5 ± 1.3 minutes for unilateral and 41.3 ± 4.2 minutes for bilateral embolization). Occlusion of one gonadal vein required three to eight coils (mean, 5.2 ± 1.4 coils).[21] The mean volume of contrast medium was 30.2 ± 3.2 mL for unilateral and 48.5 ± 5.1 mL for bilateral GVE. Technical success (ie, cessation of blood flow in the gonadal veins) was achieved in 100% of the patients (Table II). A nonsignificant trend was found toward CPP intensity reduction at 1 month after GVE, with a decrease in the VAS score from 6.3 ± 1.9 to 4.1 ± 1.1 ($P = .31$). Pain was reduced or eliminated at 1 month after GVE for 131 patients (74%; score decreased from 6.7 ± 1.5 to 2.1 ± 0.8; $P = .01$) and persisted or increased in 46 patients (26%). Pain in the area of the embolized vein as a sign of postembolization syndrome (PES) was reported by 20% of the patients, with a mean VAS score for pain of 6.7 ± 1.3 and mean duration of 11.3 ± 2.2 days. At 5 years after GVR and GVE, the CPP intensity did not differ significantly between the two groups (VAS score, 1.7 ± 0.8 and 2.1 ± 1.4, respectively; $P = .8$).

Complications

Gonadal vein resection. Complications of GVR were observed in 14% of patients and consisted mostly of pelvic vein thrombosis (PVT) in 20 patients (11%), deep vein thrombosis (DVT) of the lower extremities in 2 (1%), and self-resolved ileus events in 2 patients (1%; Table III).

In all cases, venous thrombosis was diagnosed by DUS the day after GVR. These patients received anticoagulant therapy with unfractionated heparin 450 U/kg three times daily or low-molecular-weight heparin 1 mg/kg twice daily subcutaneously into the abdominal wall for 1 to 2 weeks, followed by prescription of indirect anticoagulant agents (warfarin, rivaroxaban) for 3 months. No case of pulmonary embolism was identified. In line with the Clavien-Dindo classification system, these events corresponded to grade I or II and were mild in severity. No case of intra- or postoperative bleeding, injury of an abdominal organ, or wound infection complications developed.

GVE with coils. Major and minor complications of GVE were detected in 10 patients (5%) and 66 patients (37%), respectively. Major complications (class C/D) included thrombosis of the pelvic veins or uterine veins, DVT, and protrusion of coils, while minor complications (class A/B) were presented by access-site hematoma and allergy to the contrast agent (Table IV).

PVT was diagnosed by DUS in 41 patients (23%) and DVT in 3 patients (2%) the day after GVE. All these patients received the same anticoagulant therapy as the patients with venous thrombosis after GVR. No case of pulmonary embolism was detected.

PES was identified in 35 patients (20%; 29 after left-sided and 6 after bilateral GVE) and lasted for 5 to 23 days (mean, 11.3 ± 2.2 days). PES was characterized by the occurrence of pain over the embolized veins (isolated in 23 patients and combined with worse pelvic pain in 12 patients), fever ≤37.4° to 37.9°C, fatigue, and malaise. No relationship was found between the gonadal vein diameter, coil size, and PES occurrence. Patients with PES were treated in the vascular surgery department. To relieve symptoms, nonsteroidal anti-inflammatory drugs (NSAIDs; diclofenac, 150 mg/d for 7 days) and venoactive drugs (VADs; micronized purified flavonoid fraction, 1000 mg/d for 2 months) were administered. Medical treatment was effective in the reduction or even elimination of PES symptoms in all patients at month 1. The GVE efficacy in the relief of CPP after cessation of PES manifestations was 94%. Therefore, PES development can be considered an adverse event of GVE with coils and an equivalent of the pain syndrome that can occur after surgical intervention but with a longer duration.

Coil protrusions occurred in 10 patients (6%; all after left-sided GVE), and all were identified visually during an open or endoscopic procedure for removal of the gonadal vein with coils. These patients tended to have a low body mass index (mean, 18.3 ± 0.5 kg/m^2), and all had experienced intense pain (VAS score of ≤6-9) along the embolized vein for >30 days after the procedure. The treatment with NSAIDs and VADs was not effective. Follow-up DUS, MPV, MSCV, and ovarian and pelvic venography did not reveal gonadal vein perforation or any abdominal or vascular accident that could explain the persistent pain. Therefore, coil protrusion was suspected, and open retroperitoneal excision for eight patients and endoscopic retroperitoneal excision for two patients of the left gonadal vein with coils was performed within 32 to 45 days (mean, 34.3 ± 3.8 days) after the index procedure. All the patients reported significant pain reduction by days 3 to 5 and complete pain elimination by day 30 after surgery.

Coil migration was reported in two patients (1%) and included transfer of the coil into the branch of the right pulmonary artery and left renal vein (one patient each). The coils were removed from the vessels via an endovascular approach without any consequences.

Table IV. Procedural complications and adverse events after gonadal vein embolization (GVE) with coils (n = 177)

Variable	SIR class	Event, no. (%)
Procedural complication		
Access-site hematoma	A	6 (3)
Allergic reaction	B	4 (2)
PVT	C	41 (23)
DVT	C	3 (2)
Coil protrusion	D	10 (6)
Coil migration	D	2 (1)
Any	A-D	66 (37)
Adverse event		
PES	NA	35 (20)
Any complication or adverse event	NA	101 (57)

DVT, deep vein thrombosis; *PES*, postembolization syndrome; *PVT*, pelvic vein thrombosis; *SIR*, Society of Interventional Radiology.

Six patients (3%) were identified with access site hematoma. This complication did not require any additional treatment. Allergic reactions occurred in four patients (2%) and manifested as dyspnea, palpitation, arterial hypotension, and nausea. In all patients, the symptoms developed during follow-up ovarian venography immediately after embolization with coils. These symptoms ceased immediately after intravenous administration of glucocorticoids (prednisolone, dexamethasone). No symptoms of an allergic reaction were found in the postprocedural period.

PeVD recurrence after GVR and GVE with coils

PeVD recurrence was diagnosed in 11 patients (6%) after GVR (9 after an open and 2 after a transperitoneal approach) and 29 patients (16%) after GVE ($P < .05$ between groups; Table V). No relationship was found between the gonadal vein diameter, coil size, and PeVD recurrence. Recurrence was characterized by CPP relapse, dyspareunia and heaviness in the hypogastric region, and ultrasound and venographic evidence of varicose veins with reflux in the area of intervention in 100% of the patients.

The time to recurrence ranged from 7 to 41 months after GVR (mean, 29.2 ± 8.3 months) and 3 to 32 months after GVE (mean, 17.1 ± 7.9 months). The most common causes of recurrence after GVR were technical errors during the intervention (46%) and disease expansion to the previously intact right gonadal vein (45%). The most common causes of GVE failure were reflux through the previously embolized gonadal vein (n = 15; 52%) and dilation of the previously intact right gonadal vein with reflux (n = 9; 31%).

In one patient, disease recurrence was caused by May-Thurner syndrome, which had not been diagnosed before GVE. At 3 months after GVE, this patient complained of CPP recurrence. DUS and multislice computed tomography venography revealed dilation of the pelvic and uterine veins to 12 to 14 mm in diameter, dilation of the left internal iliac vein with reflux, and narrowing of the left common iliac vein by 70% at the site of intersection with the right common iliac artery, in the absence of dilation of, or reflux in, the embolized left gonadal vein.

DISCUSSION

The vast majority of studies on the treatment of PeVD caused by the gonadal vein reflux focused on the use of coils for embolization of these vessels.[17,18,22-26] The investigators consistently reported 100% elimination of blood flow in the gonadal veins, the relief of PeVD symptoms in ~70% of patients, and very good aesthetic results. Despite the huge variation in the clinical efficacy reported (40%-100%) and risks of serious complications,[5,27-34] this technique was recognized as the reference standard for treating PeVD caused by gonadal vein insufficiency.[2,9,22] However, GVR represents an effective, but less common, alternative in the treatment of PeVD.[10,11] A number of investigators have reported high clinical efficacy in treating PeVD (84%-100%) and low rates of associated complications.[6,35] GVE with coils has a number of obvious advantages compared with GVR, such as low invasiveness, the use of local anesthesia, and an outpatient setting or a day hospital.[4,22] However, the efficacy and safety of any intervention is measured, not only by its aesthetic results and the use of local anesthesia, but also the ability to eliminate the symptoms of the disease as completely as possible, with fewer complications and a low rate of disease recurrence.

In the present multicenter, retrospective study, we compared the efficacy of GVR and GVE with coils in terms of CPP relief and a reduction in the complication and disease recurrence rates. Only vascular surgery centers with large experience in the surgical and endovascular treatment of patients with PeVD were invited to take part in this study.

The results have demonstrated that in the 30-day follow-up period, CPP relief was achieved in 100% of patients after GVR and 74% of patients after GVE with coils ($P = .001$). This difference can be explained by the development of PES and coil protrusions in 26% of patients after GVE, which was accompanied by the persistence of, or even an increase in, CPP. In the long-term follow-up period (≤5 years), the CPP intensity ranged from a VAS score of 0 to 3 after GVR and GVE (mean, 1.7 ± 0.8 and 2.1 ± 1.4, respectively; $P = .8$). Therefore, no significant differences were found between GVR and GVE with coils in the clinical outcomes after treatment of PES and elimination of coil protrusions. However, the occurrence of complications after GVE requires additional treatment, leading to an increase in the economic burden associated with the treatment of patients with PeVD.

Table V. Pelvic venous disorder (PeVD) recurrence after gonadal vein resection (GVR) and gonadal vein embolization (GVE) with coils (n = 361)

Parameter	GVR (n = 184)	GVE (n = 177)	*P* value
Recurrence	11 (6)	29 (16)	<.05
Time to recurrence, months	29.2 ± 8.3	17.1 ± 7.9	NS
Pregnancy or childbirth after intervention	4 (36)	8 (28)	NS
Presence of CPP	11 (100)	29 (100)	NS
VAS score of CPP intensity	6.3 ± 1.4	6.1 ± 1.8	NS
Dyspareunia	7 (64)	12 (41)	<.01
Heaviness in hypogastric region	5 (45)	17 (58)	NS
Technical error during intervention			
Reflux in nonligated major tributary of GV	5 (46)	–	–
Reflux in embolized GV	–	15 (52)	–
Reflux in major tributary of GV not in embolization site	–	2 (7)	–
Misdiagnosis			
Dual-trunk GV missed before intervention	1 (9)	2 (7)	NS
May-Thurner syndrome missed before intervention	0 (0)	1 (3)	NS
Disease progression (dilation of previously intact right GV with reflux)	5 (45)	9 (31)	<.05

CPP, Chronic pelvic pain; *GV,* gonadal vein; *NS,* nonsignificant; *VAS,* visual analog scale.
Data presented as number (%) or mean ± standard deviation.

Procedural complications occurred less frequently after GVR than after GVE (14% and 37% of patients, respectively; $P = .001$), and the odds of developing complications after GVE were 8.14 (95% CI, 4.08-16.23). The most common complication after GVR and GVE was PVT, which was identified by DUS the day after the intervention in 11% and 23% of patients, respectively ($P = .02$). To the best of our knowledge, the issue of venous thromboembolic complications after interventions on the gonadal veins has not been addressed in the available literature at all, and the clinical guidelines have not provided information regarding the significance of PVT in the development of pulmonary embolism and its treatment.[36,37] We believe that the risk of PVT development should not be ignored and requires close monitoring and anticoagulant therapy, because we do not know whether the thrombotic process will spread to other veins, such as the tributaries and trunk of the internal iliac vein, or lead to pulmonary embolism.[21,38,39] The development of thrombosis in the nontarget (parametrical and uterine) veins after GVR and GVE with coils is quite an expected event after interventions on the gonadal veins. Sudden cessation of blood flow in the gonadal veins, especially after bilateral intervention, in addition to the low blood flow velocity in the varicose veins of the uterus and parametrium, leads to worsening of blood stasis in the pelvic veins in the first days after intervention. Moreover, lesions to the gonadal vein endothelium caused by coils can be an additional factor in the development of parametrial and uterine vein thrombosis and, therefore, can explain, at least in part, why the risk of PVT is 2.5 times greater after GVE with coils than after GVR (95% CI, 1.107-5.275).

The development of PES in 20% of patients after GVE was considered an adverse event. It occurred only after GVE with coils and was accompanied by a high-intensity pain syndrome (VAS score, ≤6-9). Although the PES symptoms were eliminated within 3 weeks for all the patients, PES was the reason for the extremely negative estimation of GVE efficacy by the patients at 30 day after the intervention.[21,40] Administration of VADs before and after GVE had no effect on the incidence of PES but might have contributed to the earlier relief of symptoms.[41]

Coil protrusion in 6% of patients after GVE in our study represent a major complication requiring surgical intervention. It is difficult to detect this condition in the early postembolization period because the intense pain in the area of the embolized vein is characteristic for PES. Coil protrusion can be suspected in the case of steady and long-lasting pain resistant to NSAIDs and even opioid analgesics. Examinations with DUS, MSCV, or ovarian venography do not provide any specific data regarding coil protrusion, because these imaging modalities show the location of the coils in the venous lumen and the absence of contrast medium extravasation. Excessive coil embedment into the gonadal vein wall, which can be seen with DUS, occurs in all patients after embolization and cannot be a criterion for coil protrusion. Thus, the diagnosis of protrusions must be s based on clinical symptoms such as pain in the area of the embolized vein and during palpation and the persistence of pain despite the use of analgesics for >1 month. Rapid (within 3-5 days) relief of the pain syndrome after surgical removal of the gonadal vein with coils in all patients

with coil protrusion confirmed that our assumptions were correct.

Coil migration occurred in only 2 patients (1%). The low incidence of this complication might have been because we used coils larger than the diameter of the gonadal vein, which could be an effective method to prevent coil migration. Other rare complications of GVE not requiring any special treatment were access-site hematoma and allergic reactions (3% and 2% of patients, respectively). However, given the prevalence of metal allergy in 15% of the population, the reported cases of severe allergic reactions to nitinol coils in GVE,[42,43] laboratory testing for metal hypersensitivity might be reasonable before performing GVE with coils.

The odds of PeVD recurrence were three times higher after GVE than after GVR (2.98; 95% CI, 1.12-7.98). The most common cause of PeVD recurrence after GVR (46% of patients) was technical error during surgery, with reflux in the large nonligated tributary resulting in CPP recurrence. Among the patients with PeVD recurrence after GVE, 52% had reflux through the coils in the gonadal vein, which we regarded as a technical error during the procedure. However, we could not rule out that reflux in the embolized vein could have developed owing to an increase in the vein diameter. The time to PeVD recurrence after GVR and GVE did not differ significantly and, for the vast majority of cases, ranged from 1.5 to 3 years. Thus, the occurrence of reflux through the nonligated large trunk or embolization coils will require significant time, during which various events can occur that contribute to recurrence, such as pregnancy and childbirth or hormonal treatment. In 45% of patients after GVR and 31% of patients after GVE, the recurrence was caused by reflux in the previously intact right gonadal vein, suggesting the presence of factors contributing to the dilation of the right gonadal vein and reflux. Among those who experienced disease recurrence, pregnancy or childbirth was reported by 36% and 28% of the patients in the GVR and GVE groups, respectively. Moreover, childbirth was reported by 40% of patients with reflux in the previously intact gonadal vein. Therefore, the findings from the present study suggest that pregnancy and childbirth can be considered significant risk factors for PeVD recurrence, in addition to misdiagnosis and technical errors during surgery.

Study limitations. The present study has several limitations. First, we performed a retrospective study to evaluate the clinical outcomes of previous endovascular and surgical interventions on the gonadal veins using data from the medical records. Thus, the influence of surgeon preference regarding the treatment choice on the treatment outcome could not be ruled out. Second, a significant cohort of patients was excluded from the study because of insufficient data in their medical records, the presence of concomitant diseases of the veins or pelvic organs, and/or simultaneous endovascular procedures on the gonadal and iliac veins. In addition, no baseline or historical data were available on the presence of hypersensitivity to metals and iodine-containing drugs, which did not allow for analysis of this factor. Another limitation relates to the diagnosis of PeVD recurrence. It was not possible to comprehensively assess the factors contributing to recurrence, other than the obvious errors in diagnosis and treatment. However, the patients with PeVD recurrence had reported pregnancy or childbirth after intervention on the gonadal veins. In contrast, such reports were missing for almost all patients without PeVD recurrence. Also, no information about hormonal therapy after interventions on the gonadal veins was available in the medical records, making it impossible to evaluate this factor.

CONCLUSIONS

GVR and GVE can be considered effective methods for the treatment of PeVD and provide CPP relief in all patients in the long term. Procedural complications occurred eight times more often after GVE with coils than after GVR, indicating the need for a differentiated approach in choosing the technique for blood flow reduction in the gonadal veins (ie, the rational use of resection and embolization techniques). In addition, GVE with coils has specific complications and the potential for adverse events (ie, PES, coil protrusion, coil migrations) that cannot be completely avoided. The recurrence rate was three times greater after GVE than after GVR. The main factors contributing to PeVD recurrence after GVR and GVE are diagnostic and technical errors and intrinsic disease progression. Prospective comparative studies of the efficacy and safety of GVR and GVE with new embolization agents for vascular occlusion are warranted.

AUTHOR CONTRIBUTIONS

Conception and design: SG, RA
Analysis and interpretation: SG, AS, RA, RB, GK, NM, AV
Data collection: SG, AS, RA, RB, GK, NM, AV
Writing the article: SG, RA, RB, GK
Critical revision of the article: SG, AS, RA, RB, GK, NM, AV
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