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Anatomy of Pelvic leak points in the context of varicose veins

Anatomie von Becken-Leckage-Punkten im Zusammenhang mit Varizen

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ABSTRACT

Pelvic venous networks (competent themselves or not) can be the origin of reflux in the superficial leg veins. They are frequently involved in recurrences after classical venous treatment options, as they are not treated in that context. Studies based on various assessments (clinical, ultrasound, venography) conclude that around 10% of women with varicose vein

have their origin in pelvic leak points, this incidence is 4 times higher in multiparous than in nulliparous. Claude Franceschi first analyzed and described the reflux pathways for this pelvic leak points. The most frequently involved escape points or “Pelvic Leak Points” are the perineal points (PP), draining through the labial region to the leg and the inguinal points through the inguinal ring (IP). Others are the Clitoridian point (CP), gluteal points (GP) and obturatorian point (OP). Their investigation has to be performed in standing position and using Valsalva – but the most important part of the investigation is the anatomic knowledge about the different pathways.

ZUSAMMENFASSUNG

Venennetze des Beckens (eigenständig oder nicht) können Ausgangspunkt für einen Reflux in die oberflächlichen Beinvenen sein. Sie sind häufig an Rezidiven nach klassischen Venenbehandlungen beteiligt, da sie in diesem Zusammenhang nicht mitbehandelt werden. Studien auf der Grundlage verschiedener Untersuchungen (Klinik, Ultraschall, Phlebografie) kommen zu dem Ergebnis, dass bei etwa 10% der Frauen mit Varizen die Ursache in den pelvinen Leckagen liegt. Diese Inzidenz ist bei Multipara 4-mal höher als bei Nullipara. Claude Franceschi hat erstmals die Reflux-Pfade für die pelvinen Leckagen beschrieben. Die häufigsten Undichtigkeiten bzw. „pelvinen Leckagen“ sind die perinealen Punkte (PP), die über die Labienregion ins Bein abfließen, sowie die inguinalen Punkte (IP) über den Leistenring. Weitere Punkte sind der Clitoris-Punkt (CP), Glutealpunkte (GP) und der Obturator-Punkt (OP). Sie müssen im Stehen mithilfe des Valsalva-Manövers untersucht werden. Der wichtigste Teil der Untersuchung ist jedoch die anatomische Kenntnis der verschiedenen Pfade.

Introduction and clinical significance

Anatomy of the pelvic venous system and networks has been described by Hirsch in the previous issue (6/2020 Phlebologie). These intrapelvine networks can be the origin of refluxes in the superficial venous system of the legs.

Several studies based on various assessments (clinical, ultrasound, venography) consider around 10% of pelvic leaks in women with varicose veins where the number of multiparous are 4 times more frequent than in nulliparous [1–4]. A high percen-

tage of recurrences after stripping were related to pelvic venous reflux and evaluated as 17% but not specifically anatomically defined and not specifically treated [5]. Claude Franceschi first described the existence of six parietal points for each side through which a pelvic reflux can be transmitted to the lower limb and be responsible for varicose veins of the lower limbs in mono- and multiparous women [6–8]. Reflux from a pelvic leak can spread either in the ipsilateral as well as contralateral lower limb thanks to the existence of a valvulated subcutaneous plexuses, involving the tributary axes or non saphenic collectors. The N2 tributary

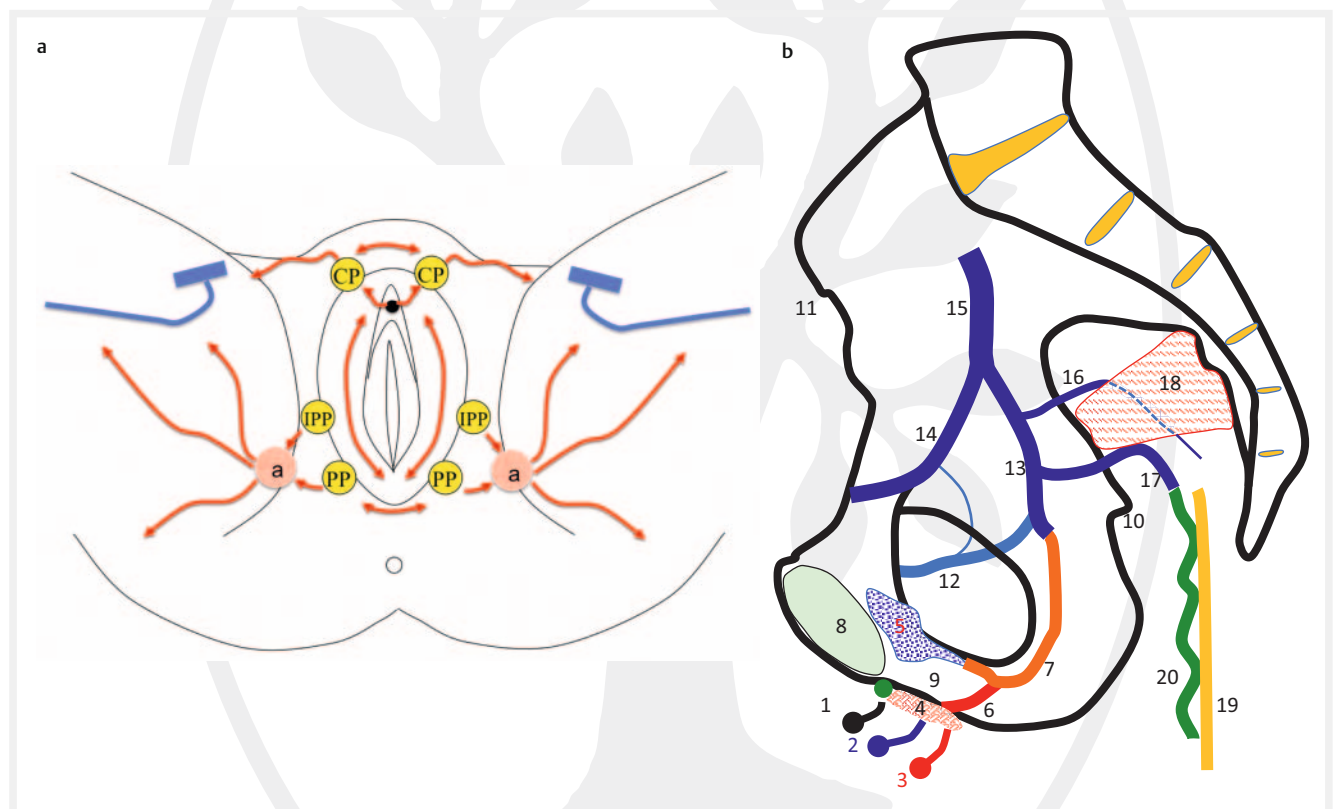
axes may represent a re-entry anatomical terminal or interposed structure. Further studies confirmed that vulvar or lower limbs varicose veins of pelvic origin exist and the echo-guided minimally invasive parietal surgical treatment of pelvic leaks under local anaesthesia, without any need of pelvic varicose embolization prior PLP reflux ablation leaks is reliable and durable [9].

The pelvic venous system is a complex network of venous vessels and venous plexuses of different embryological origin with the characteristic of draining and interconnecting different anatomic areas: pelvic viscera, front and back parietal structures, the lower limbs and particularly the inguino-crural and perineal regions, but also the back area of the thigh and through it the popliteal fossae. There are different vessels typology:

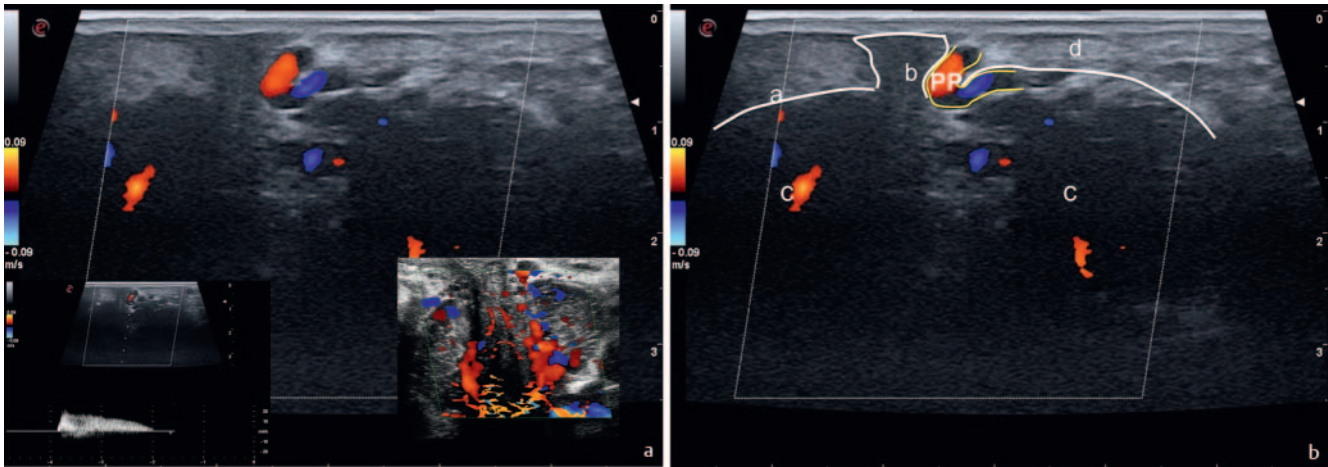
- avalvulated main venous trunks (iliac common vein, external iliac vein, hypogastric vein)
- inconstantly valvulated visceral veins (ovarian veins) or rarely valvulated visceral veins (uterine veins)

- generally valvulated parietal collectors (obturator vein, internal pudendal vein, superior and inferior gluteal veins, round ligament vein)
- avalvulated venous plexuses connecting vertically and horizontally every pelvic viscera and the pelvic wall

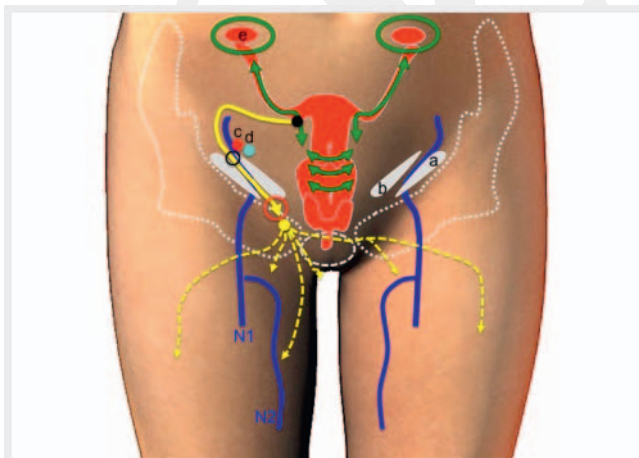
This vascular network represents the functional pelvic venous unit. A distinctive characteristic of the pelvic venous system is the absence of propulsion pumps. The venous flow takes place according to the pressure gradient existing with the right heart and according to the residual pressure. We are now aware that well-defined parietal anatomic points of interconnection between the pelvic and parietal vessels exist, and represent point of significant surgical interest [10–14]. During pregnancy a valvular damage may occur in parietal as well as visceral collectors because of the increase in pelvic vein peripheral resistances and consequently of venous transmural pressure. Due to the valve damage a venous



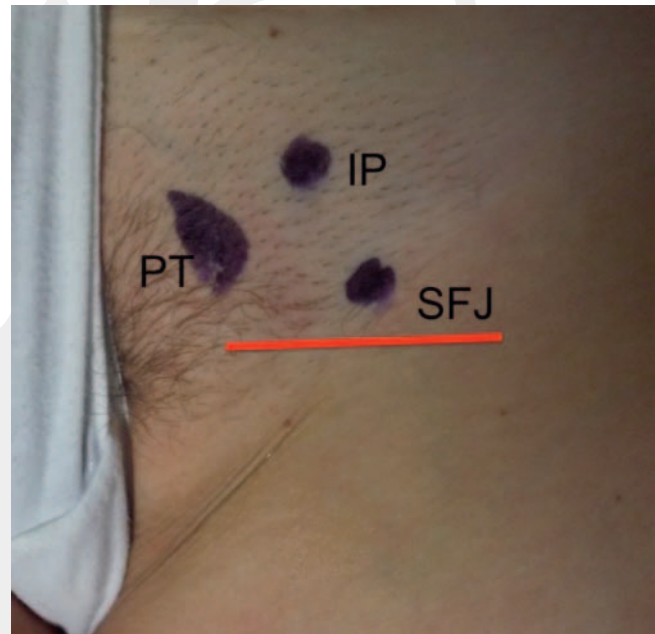
► **Fig. 1** **a** Schematic representation of the anterior and posterior perineal region and the position of the clitoridian point (CP), intermediate perineal point (IPP) and perineal point (PP). Reflux can easily spread from one side to the other and reach indifferently the great or small saphenous trunk as well as non saphenic collectors; a: subcutaneous perineal venous plexuses. **b** Internal view of the pelvis and of the venous collectors and plexuses involved in pelvic leaks. 1: the venous path joining the external pudendal vein and the anterior labial vein to the deep dorsal clitoris vein (is the venous path of the Clitoris Point CP) in female, and in male the Male C Point path (MCP) connecting the superficial and deep dorsal vein to the pudendal vein. 2: the intermediate labial vein; is the venous path of the Intermediate Perineal Point (IPP). 3: posterior labial veins: is the venous path of the classic Perineal Point PP. 4: venous labial plexus. 5: pudendal plexus. 6: perineal vein. 7: internal pudendal vein. 8: pubis. 9: inferior pubic ramus. 10: ischial spine. 11: anterior superior iliac spine. 12: obturator vein (this vein usually joins the hypogastric vein but it can even directly reach the external iliac vein). 13: internal iliac vein. 14: external iliac vein. 15: common iliac vein. 16: superior gluteal vein (it's the venous path of the Superior Gluteal Point SGP). 17: inferior gluteal vein (it's the venous path of the Inferior Gluteal Point IGP). 18: piriformis muscle. 19: sciatic nerve. 20: sciatic vein (the reflux through it reaches the SSV and the posterior region of the leg).



► **Fig. 2** **a** Ultrasound image in cross section with transducer over the labiae. In the middle of the upper part of this picture the reflux through the left PP is clearly detectable. In the lower right angle of the picture you can see the Valsalva reflux through the vulvar plexuses, and the doppler curve appearance in the left angle. **b** The white line (a) represent the vulvar fascia. The frenulum of labia minora (b). The P Point (PP) is the hole in the vulvar fascia; the posterior labial veins passes through it (yellow margins). In the middle and inferior part of the picture the vulva and its venous plexuses are represented (C).

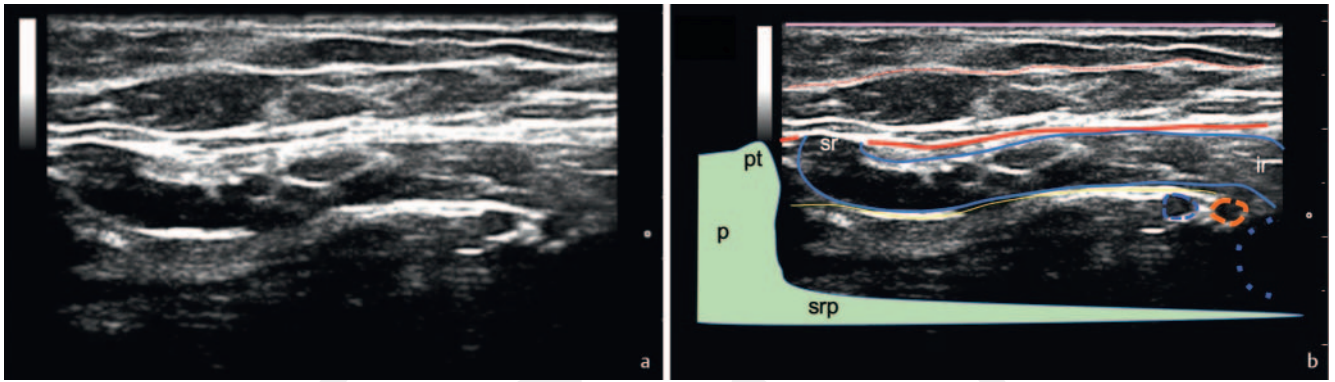


► **Fig. 3** Inguinal or I Point. The white dotted lines represent the bones of the pelvis. The white area Fascia. **a** fascia of the abdominal external oblique muscle. **b** Fascia transversalis. **c** Inferior epigastric artery, **d** Inferior epigastric vein. **e** The ovary and the ovarian veins. **f** Venous path composed by avaluated venous plexuses connecting vertically and horizontally generally valvulated parietal and visceral collectors, as well as front and back visceral structures. The yellow line represents the venous plexus of the round ligament and the vein of the round ligament. The flow of the subcutaneous plexuses of the mons veneri and of the inguino-crural area passes through the superficial ring of the inguinal canal (red circle) and reaches the venous plexus of the round ligament, then passes through the internal ring of the inguinal canal (black circle) and through the vein of the round ligament, joins the uterine veins (the green lines represent the veins of the uterine tube and the uterine vein) at the angle between the body of the uterus and the uterine tube (black point). The external iliac vein (blue line above the inguinal canal) is deeper than the internal ring of the inguinal canal, and also a little bit laterally to the inferior epigastric vessels. The yellow dashed arrows represent the possible reflux paths during the systole of the Valsalva manoeuvre: reflux may spread directly into the ipsilateral or contralateral GSV arch as well as into a non saphenic paths toward an tributary re-entry point or an upstream saphenous vein.



► **Fig. 4** Projection of the inguinal point (I Point) to the skin: PT: pubic tubercle, IP: Inguinal Point, SFJ saphenofemoral junction. The IP is a little bit above the SFJ. If you position the probe (linear as well microconvex probe) at the red line level it's possible to check both SJ and IP just leaning the probe upward.

reflux can be transmitted to the lower limb passing through well-identified parietal points: the pelvic escape points. The impact of pelvic escape point on varicose vein is significant [8, 9, 15, 16]. Misunderstood pelvic escape points may cause a relapse of varicose veins especially chaotic in case of high ligation with ablation of the GSV [9, 17]. For this reason all the haemodynamic diagnostic assessments for vulvar or lower limbs varicose veins must include the investigation with systolic Valsalva to exclude a reflux



► **Fig. 5** Inguinal point in Ultrasound. **a** Cross section through the cranial portion of the groin with linear probe (8–12 Mhz), proximal and lateral to the saphenofemoral junction to check. **b** Legend to a. The skin is the continuous violet line in the upper part of the picture. The red dashed line represents the subcutaneous fascia. The continuous red lines represent the abdominal oblique muscle fascia: the superficial ring (sr) is the hole of this fascia detectable on the left. The yellow line is the transversalis fascia. The venous plexus of the round ligament between the blue lines. In the fat tissue below the fascia transversalis on the right the inferior epigastric vein (blue dashed line) and the inferior epigastric artery (orange dashed line) are visible. Immediately below and laterally to the inferior epigastric vessel the external iliac vein is detectable (blue dotted line). The pubis (p), pubic tubercle (pt) and the superior ramus pubis are represented by the green area. The internal ring is located laterally to the epigastric vessels (ir).

of pelvic origin with the patient in standing position. The Valsalva manoeuvre is mandatory to detect a reflux of pelvic origin. The examination is performed with the patient in standing position, changing the position to check the perineal leak points. A linear probe (7.5–12 MHz) is used first, but a convex or micro convex probe (5–8 MHz) may be necessary in overweight patients. The PRF has always been adjusted between 0.75 and 1 KHz, capable of detecting even low speed reflux from 0.05 to 0.10 m/s. The convex probe (5–8 MHz) is necessary to evaluate the abdominal and pelvic vessel, without any need of trans-vaginal or trans-rectal probes. A perfect knowledge of the vascular pelvic and parietal and perineal venous and topographic anatomy is mandatory.

The P Point (PP)

The P point is the most frequent pelvic leak point (PLP), representing 60% of all the PLP treated in women [9, 17]. The subcutaneous plexuses of the perineal region converge into the posterior labial vein which passes through the superficial perineal fascia hole, located postero-laterally to the labia majora about 1 cm respect the origin of the frenulum of labia minora; the posterior labial veins drains into the vulvar plexus. The vulvar plexus drains into the perineal vein that crosses the perineal muscle to reach the internal pudendal vein into the Alcock's canal to reach the hypogastric vein. Thin nervous fibers may lie close to posterior labial vein. The diameter of the posterior labial vein ranges from 1.8 to 3 mm in my experience. An intermediate labial vein may also exist 1 cm anteriorly and may represent the Intermediate Perineal Point (IPP) (see ► Fig. 1).

In case of valvular incompetence, the reflux follows the same pathway in the opposite direction, from the deep to the surface and dilation of perineal superficial veins may occur (see ► Fig. 2).

Furthermore, reflux can also extend to the ipsilateral or contralateral saphenous network (great or small saphenous vein)

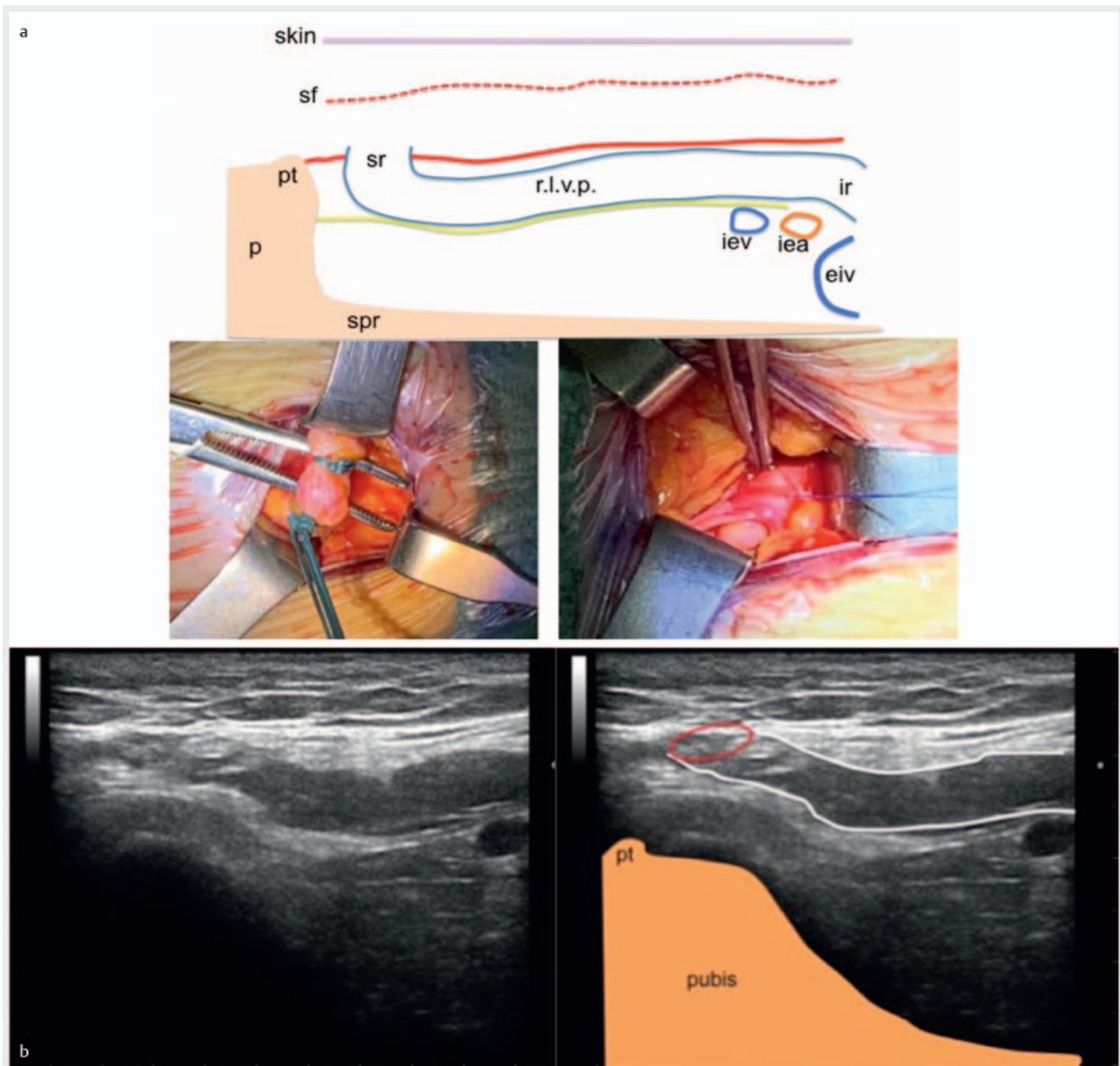
through superficial perineal plexuses and other incompetent venous paths.

The I Point (IP)

The inguinal or "I" Point represents 36% of all the PLP treated [9, 17]. The IP is the superficial ring of the inguinal canal crossed by the mons veneris veins, draining the superficial perineal and inguino-crural areas. Through the inguinal ring the superficial veins connect to the uterine round ligament vein, and pelvic plexuses to the hypogastric veins. In case of valvular incompetence reflux from the pelvic venous plexuses passing through the round ligament venous plexus can feed ipsilateral and also contralateral vulvar or perineal varicose veins, but also lower limbs varicose veins thanks to branches of the superficial perineal venous network. Moreover, reflux in the round ligament vein may itself be fed by any incompetent ipsilateral and contralateral upstream genital, visceral, iliac or ovarian vein and by the inferior vena cava (See ► Fig. 3–7).

The Clitoris Point (CP)

The CP is the anastomotic plexus between the vulvar vein and the superficial dorsal clitoris vein through which the external pudendal vein and dorsal clitoris vein connect to the internal pudendal vein. Veins from the clitoris area also pass through a hole of the superficial subcutaneous fascia to reach the inguino-crural area. Reflux can feed ipsilateral or contralateral perineal and anterior labial veins and or the lateral pudendal external vein to reach the GSV. Minimally-invasive surgery as for IP and PP is possible, but in this case the disconnection should be performed only at the subcutaneous fascia, to avoid nervous injuries if the ligation is performed deeper, this, on the other side, will allow a higher rate of possible recurrences (see ► Fig. 1, 8, 9).



► **Fig. 6 a** Topographic and surgical anatomy of the inguinal canal. The round ligament venous plexus is marked by the two blue lines (rlvp) in the upper part of the figure. In the lower part on the left you can see the round ligament ligation (N° 2 non-absorbable braided coated suture) before sectioning it. On the right the round ligament has been ligated and the downstream stump folded up into the inguinal canal thanks to a transfascial prolene stitch. **b** This image points out the close anatomical relationship between the IP (red circle) and the pubis tubercle. The pubis tubercle is really useful for the preoperative skin marking.

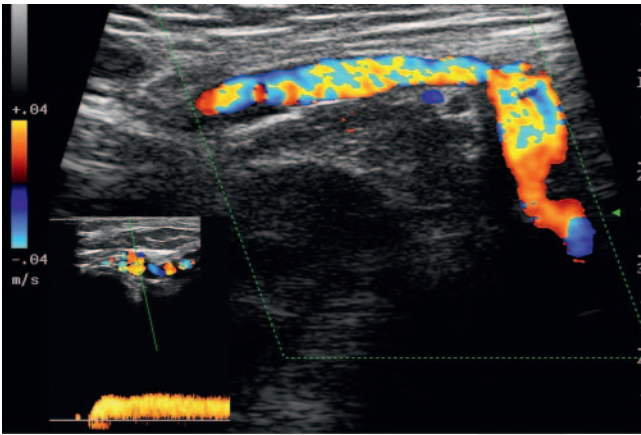
Superior Gluteal Point (SGP) and Inferior Gluteal Point (IGP)

The superior and inferior gluteal veins drain into the hypogastric vein. The inferior gluteal vein drains the venous plexus of the sciatic nerve and enters into the pelvis passing below the piriform muscle (IGP), while the superior gluteal vein passes above it (SGP). The venous plexus of the sciatic nerve can be detected pos-

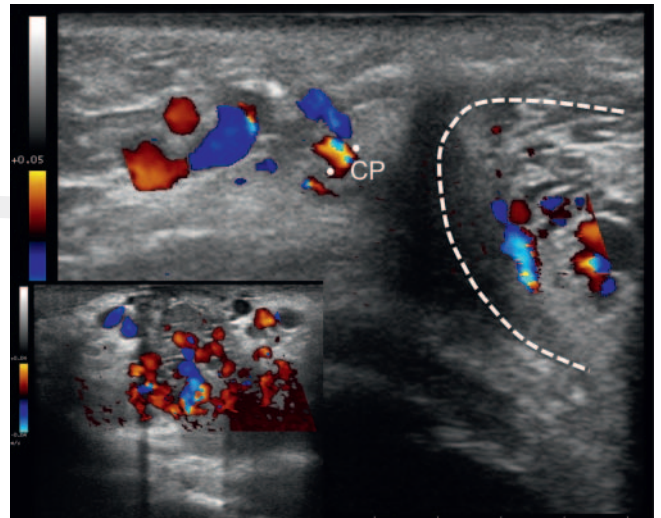
teriorly in the thigh around the hyperechoic image of the sciatic nerve. A minimally invasive surgical approach doesn't exist, and sclerotherapy is the first choice (see ► **Fig. 1, 10**).

Obturator Point (OP)

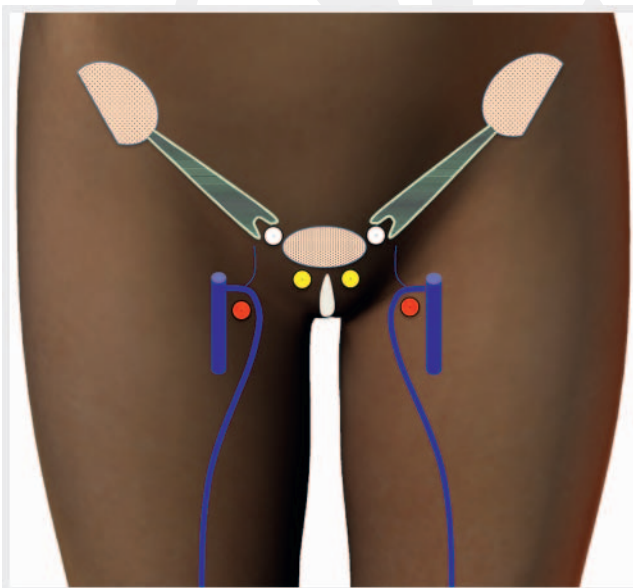
Is the confluence of the anterior muscular circumflex vein into the confluence between the saphenous arch and the femoral



► **Fig. 7** The Valsalva manoeuvre is mandatory to properly check pelvic leaks, which will show a retrograde flow through the I Point in case of a classical varicose vein filled by pelvic reflux. A continuous spontaneous outward flow through a pelvic leak is the expression of the existence of an open vicarious shunt (bypass deviation in case of deep vein obstruction) as in pelvic congestion syndrome.

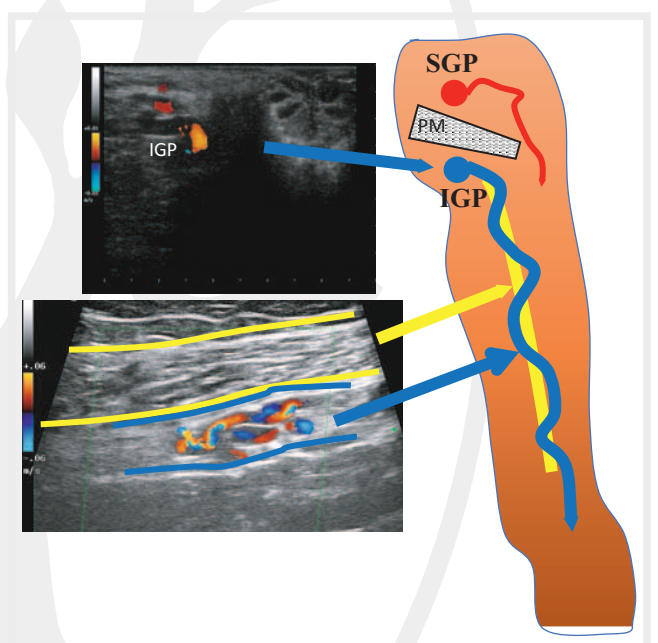


► **Fig. 9** Valsalva reflux through the clitoris point (CP). The white dashed line represents the clitoris. In the left inferior angle of the picture Valsalva reflux in the clitoris veins.

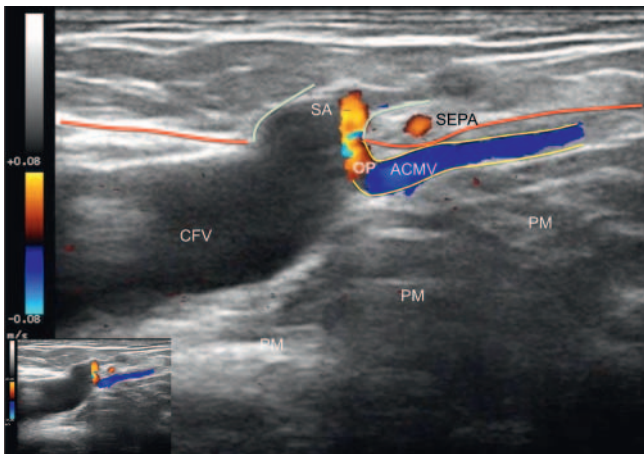


► **Fig. 8** The yellow points represent the Clitoris Point (CP), the white points the Inguinal Point (IP) and the red points the Obturator Point (OP).

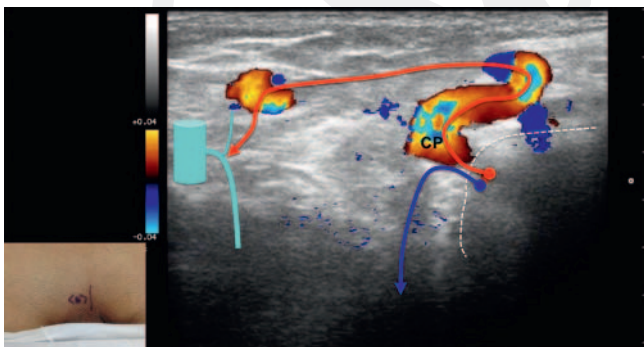
vein. The anterior muscular circumflex vein represents the anterior origin of the Obturator vein, that passing through the obturator channel reaches the hypogastric vein. The anterior muscular circumflex vein passes between the pectineus muscle and fascia and reaches the SFJ immediately below or above the terminal valve from medially. It represents a female but also a male escape point. This escape point can be associated both with the incompetence or competence of the terminal valve. This escape



► **Fig. 10** The superior gluteal point (SGP) is represented by the red circle, while the inferior gluteal point (IGP) is represented by the blue circle, the piriformis muscle (PM) between them. The blue line on the right represents the venous plexus of the sciatic nerve. The sciatic nerve is the yellow line on the right and on the left is highlighted by the two yellow lines. The venous plexus of the sciatic nerve is clearly detectable (lower left angle) close to the nerve and is highlighted by the blue lines. In the upper left angle on the left you can see the Valsalva reflux through the IGP and medially to it the not-homogeneous B-Mode appearance of the anus.



► **Fig. 11** The obturator point (OP) is the point where the anterior muscular circumflex vein (ACMV) joins the confluence between the saphenous arch (SA) and the common femoral vein (CFV). The anterior muscular circumflex vein represents the anterior origin of the Obturator vein, which reaches the hypogastric vein through the obturator channel. In presence of valvular incompetence of the obturator vein a reflux can be transmitted into the GSV arch and trunk. The anterior circumflex muscular vein (ACMV) runs in the pectineus muscle (PM) immediately below his fascia (red line on the right); SEPA, superficial external pudendal artery. The Obturator Point reflux is clearly detectable during the Valsalva manoeuvre.



► **Fig. 12** The Male C Point (MCP) is a subcutaneous fascia hole crossed by a venous collector connecting the penis superficial and deep paths to the subcutaneous venous plexus and the GSV arch. The venous penis drainage consists of a deep and a superficial path extensively interconnected at the corona glans and at the root of the penis. The two main collectors are the superficial and the deep dorsal vein, the former draining into the superficial subcutaneous plexus while the latter joins the internal pudendal vein. The red line represents the reflux transmitted through the MCP into the GSV trunk or arch. The blue line is a further possibility of reflux spreads towards the scrotum with possible contralateral transmission. The white dashed line highlights the root of the penis. In the left inferior angle the preoperative skin mark representing the position of the right MCP: the blue straight vertical line points out the position of the root of the penis, located immediately below.

point can be disconnected during a saphenous femoral disconnection or, in case of competent terminal valve, passing through

the pectineus fascia. A perfect preoperative skin mark is mandatory (► **Fig. 1, 11**).

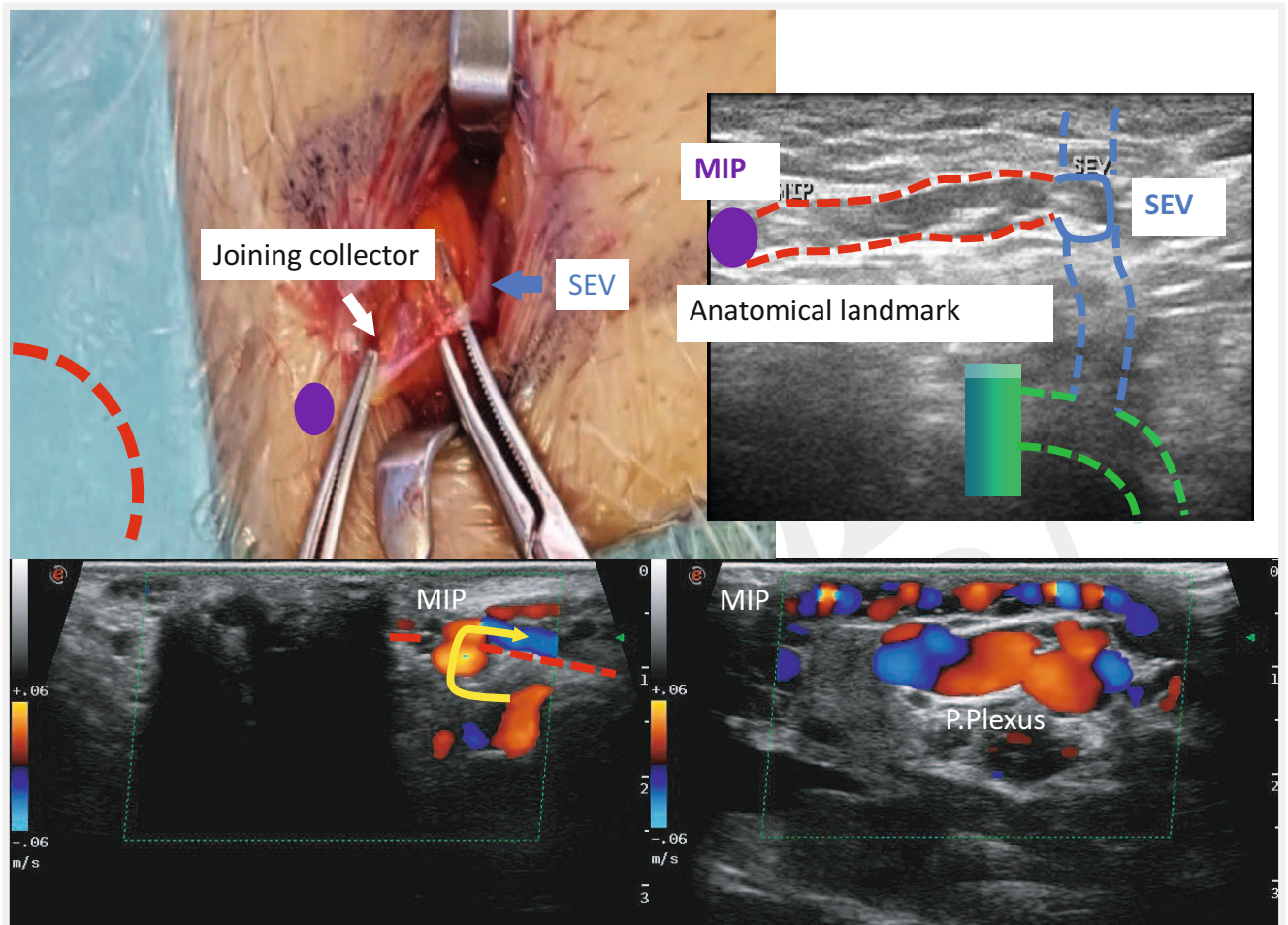
Male I Point (MIP) and Male C Point (MCP)

Pelvic leak points have been described in (multi-)parous women. Nevertheless in male patients it is possible to find any pelvic escape points (► **Fig. 12, 13**).

The veins of the pampiniform plexus communicate with the superficial veins of the region through a venous collector that cross the hole of the subcutaneous fascia near the pubis in the inguinal region to reach directly the saphenous arch or with the intermediate of the superficial epigastric veins. Two different venous paths but a venous collector that cross the subcutaneous fascia hole (MIP), clearly detectable with a B-mode evaluation, and easy to reach with a surgical dissection. As for the female I point there is a wide possibility of transmitting the reflux from one side to the other thanks to the superficial and deep dorsal veins and plexus surrounding the urethra and penis, and also scrotal veins. In the penis there is a superficial and a deep venous network. The subcutaneous penile venous path drains mainly the skin and the subcutaneous tissue, and the flow normally runs into the subcutaneous dorsal veins of the penis. The dorsal vein of the penis drains into the subcutaneous plexus of the inferior part of the abdomen. This plexus drains into the saphenous arch. There is a wide communication between veins of both sides. The subcutaneous penile venous path drains also into the scrotal veins. Thanks to the veins crossing through the scrotal septum a communication between the paths of the two scrotal veins of both sides is possible. A reverse flow can be easily transmitted from one side to the other. The deep venous path of the penis drains into the deep dorsal vein of the penis and through it into the pudendal vein (which normally is valvulated). There is a wide communication between the superficial and deep venous path. A venous collector passing through a subcutaneous fascia hole reaches the dorsal plexus of the penis. A reverse flow can be detected in this collector and transmitted to the lower limb. The MCP it's easy to reach with a minimally invasive surgical approach under local anaesthesia. A refined preoperative skin mark is mandatory.

Conclusion

Pelvic venous networks (competent themselves or not) can be the origin of reflux in the superficial leg veins. Their investigation has to be performed in standing position and using Valsalva – but the most important part of the investigation is the anatomic knowledge about the different pathways. The most frequently involved escape points or “Pelvic Leak Points” are the perineal points (PP), draining through the labial region to the leg and the inguinal points through the inguinal ring (IP).



► **Fig. 13** The Male I Point (MIP). In the inferior right angle a venous collector rises from the pampiniform plexus and passes through a hole (MIP) of the subcutaneous fascia (red dotted line) joining the superficial epigastric vein or directly the GSV arch; the yellow line represent the direction of the flow during the Valsalva systole or the Parana manoeuvre diastole. Perfectly detectable Valsalva reflux in the images in the right inferior angle of this image. A Valsalva reflux into the pampiniform plexus can spread ipsilateral or contralateral passing through the deep and superficial venous plexuses as well as the scrotal veins. In the upper left angle of the image the red dashed lines represent the root of the penis, the violet point the MIP, the joining collector reaching the Superficial Epigastric Vein (SEV) and the SEV are clearly detectable. In the right superior angle the image the b-mode appearance of MIP (violet point) and of the joining collector (red dashed lines) as well as of the SEV (blue lines), you can also see the position of the saphenous arch and the common femoral vein (green lines and green cylinder).

Conflict of Interest

The authors declare that they have no conflict of interest.

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