MRI and venographic aspects of pelvic venous insufficiency

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Abstract Pelvic venous insufficiency is a frequent pathology in multiparous women. Diagnosis can be made by chance or suspected in the case of symptoms suggesting pelvic congestion syndrome or atypical lower limb varicosity fed by pelvic leaks. After ultrasound confirmation, dynamic venography is the reference pretherapeutic imaging technique, searching for pelvic varicosity and possible leaks to the lower limbs. MRI is less invasive and allows a three-dimensional study of the varicosity and, with dynamic angiography, it can assess ovarian reflux. It also helps to plan or even sometimes avoid diagnostic venography.

Pelvic venous insufficiency is permanent venous dilatation due to valvular incompetence (type I), or an obstacle to venous return due to venous obstruction or extrinsic compression, particularly by pinching of a vein (type II), or a local cause (type III) [1].

The varicose veins formed extend from the pelvis to the top of the legs, often fed by an incompetent left ovarian vein, and are at the crossroads between gynaecological pathology and vascular medicine. First-line examinations are ultrasonography and Doppler ultrasonography in these two specialties, but only a few knowledgeable specialists can evaluate the two aspects of the condition.

Even if the varicose veins can be seen with pelvic ultrasound, the diagnosis is still not commonly suggested due to the lack of information concerning their potentially symptomatic nature and deficient diagnostic performance [2], probably because the varicose veins collapse due to filling of the bladder, which is necessary for a suprapubic view.

MRI, already used by several teams [3], can cover all the anatomical regions concerned. With a specific protocol, its sensitivity is satisfactory, better than that of ultrasound for diagnosis [4]. In addition, it allows dynamic evaluation of ovarian reflux, as well as good

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morphological evaluation of the pelvic venous insufficiency. It is reproducible, less expensive than diagnostic venography and is non-irradiating in these young female patients. When evaluating type I venous insufficiency, it can substitute for pretherapeutic venography, indicating from the outset, with the clinical findings, the pathogenic incompetent afferents to be embolized.

In this review of imaging, we compare the appearance of pelvic venous insufficiency in MRI with venography.

Symptoms and method of detection

Pelvic venous insufficiency is common in multiparous women because of the major strains on the venous system during pregnancy. It is mainly diagnosed in three situations:

• in the first instance, by chance during abdominopelvic imaging, requiring comparison with the clinical picture to look for the sometimes neglected symptoms caused by it;

• secondly, where there are atypical varicose veins of the perineum or top of the thighs, and/or pelvic supply to varicose veins of the legs, observed in a Doppler examination;

• thirdly, in the event of chronic pelvic pain with negative gynecological findings, where the symptoms suggest congestion [5,6], and may associate pelvic heaviness or pain (more towards the end of the cycle, increasing at the end of the day, with effort and with standing), dyspareunia or post-coital pain, dysuria or dysmenorrhea, the symptoms having been present for more than six months and no other etiology being found.

This venous insufficiency needs only to be treated when it is symptomatic. The pretherapeutic examination must therefore eliminate type II or III insufficiency and evaluate the incompetent collectors to prepare for their embolization, which is usually performed later.

Our experience for this review of imaging is based on retrospective study of the files of 141 patients referred to Angers University Hospitals’ Medical Imaging Department between September 2010 and September 2012 for investigation of pelvic venous insufficiency. All the patients had an MRI and venography examination.

MRI protocol

The MRI was performed before the venography (on a Siemens Magnetom 1.5T imager) using a body phased-array coil. No rectal or vaginal marking was used and the bladder was empty to avoid compressing the varicose veins. The examination included:

• a scout sequence in the three spatial planes centered on the abdomen and pelvis;

• T2-weighted sequences with fat saturation (T2FS) in the axiale plane covering the kidneys to the pelvis and in the sagittal plane centered on the pelvis and top of the thighs;

• a dynamic angiography sequence with injection of contrast agent (Time-resolved angiography With Interleaved Stochastic Trajectories: TWIST Siemens) in the coronal plane, with contiguous slices of 1.6mm, and a field of 45cm covering the kidneys to the pelvis. The acquisition, with normal breathing, was repeated twenty times, every 5 seconds, and the contrast agent bolus (Dotarem: dose = 0.2 ml/kg, rate = 2 ml/s) was injected between the first and the second acquisition, the first series serving for subtraction from those following. The series obtained were studied in maximum intensity projection (MIP) reconstruction and kept for slice by slice analysis if necessary;

• a T1-weighted sequence with fat saturation after gadolinium injection (T1FSGd) covering the kidneys to the pelvis.

The varicose veins were defined as serpiginous images, hyperintense with T2FS and T1FSGd, which were parametrial, perirectal, perivaginal, sometimes perineal or on the top of the thighs.

Venography protocol

Venography was performed via the femoral venous route or exceptionally via the brachial route. It first consisted of catheterization of the left renal vein and its opacification, looking for a nutcracker syndrome and reflux in the left ovarian vein. Secondly, the left ovarian vein was catheterized for better filling and its reflux quantified using the description by Hiromura et al. [7], and the periovarian, parametrial or perineal varicose veins fed by it were evaluated. Then the iliac veins were successfully catheterized looking for incompetent collectors, leaks to the legs and a left May-Thurner syndrome. The right ovarian vein was catheterized to its ostium to look for reflux only when dilatation was seen on the MRI.

Anatomical overview

Venous draining of the pelvis is via a richly anastomosed median collector system, the main collectors of which are the internal iliac veins, the ovarian veins and the superior rectal vein. The ovarian veins empty directly into the inferior vena cava on the right and via the renal vein on the left. The internal iliac collectors are composed of anterior visceral (uterine, vaginal, vesical, rectal) and parietal (inferior gluteal, obturator, pudendal) afferents and posterior pelvic parietal (iliolumbar and sacral) and extrapelvic (superior gluteal) afferents. Rich anastomoses exist between these collectors explaining the possible communications between a varicose vein developed at the expense of visceral collectors (particularly ovarian and uterine), and the saphenous system of the legs, via the parietal collectors (Fig. 1).

Radiological description

Examination of the left renal vein

Before envisaging ovarian embolization, type II insufficiency, according to the classification described by Greiner et al. [1] involving compression of the renal vein between the aorta and mesenteric artery (nutcracker syndrome), must be eliminated by looking for an imprint in the terminal part of the renal vein (Fig. 2) combined with congestion of the renal venous system. Definitive diagnosis of the nutcracker syndrome is still difficult. It is currently based on measuring the vena cava and renal vein pressures, the diagnosis being made if there is a difference of more than 3 mmHg.
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Figure 1. Diagram of the anatomy. OvV: ovarian vein; CIV: common iliac vein; IIV: internal iliac vein; CFV: common femoral vein; DFV: deep femoral vein; GSV: great saphenous vein; UV: uterine vein; VaV: vaginal vein; VeV: vesical vein; RV: rectal vein; PV: pudendal vein; ObV: obturator vein; SGluV: superior gluteal vein; IGluV: inferior gluteal vein; ILSV: iliolumbar and sacral veins; dotted lines: anastomosed avulvular median venous plexus communicating between the internal iliac venous system and the saphenous vein. Dark grey ovals: ovaries and uterus.

MRI still has difficulty with this point through lack of spatial resolution. The renal vein may appear laminated on axial acquisitions (Fig. 3). The appearance of an impression on the left renal vein can be seen with dynamic angiography sequences (Fig. 4). However, in no case can these signs be considered as pathognomonic of the nutcracker syndrome. In all cases, pressure measurements are only possible during venography.

Examination of the left ovarian vein

MRI examination starts by measuring the diameter of the ovarian veins; diameters of more than 8 mm measured 10 mm from their termination is an argument for their incompetence (Fig. 5) [8]. Commonly used in ultrasonography, this criterion is easily measured on T2FS axial slices, but is not available with venography without calibration. It seems, however, debatable, as indicated by Black et al. [9] In addition, an MRI is performed with the patient lying, without a Valsalva maneuver, so that the incompetence is underestimated.
Ovarian reflux is scored from 0 to 3 according to the description by Hiromura et al. [7] on dynamic MR angiography sequences (Fig. 6) and following selective catheterization of the ovarian vein in venography (Fig. 7). The pelvic/ovarian venous network is, like the majority of veins, subject to many anatomical variations, often including a left ovarian vein with a complex structure with many collaterals (Fig. 8).

Examination of the right ovarian vein

The diameter of the right ovarian vein can also be measured in MRI (Fig. 4) as well as any reflux, rare however on this side. A TWIST sequence may also find a vicarious right ovarian vein (Fig. 9) increasing its calibre by an increase in flow rate without loss of competence.

In our practice, venography is only performed to look for reflux when dilatation can be seen with MRI. Vicariousness observed in the MRI in the lying position can mask effort incompetence, which will be revealed by the Valsalva maneuver (Fig. 10).

Examination of the internal iliac veins and their collectors

Searching for type II pelvic venous insufficiency through compression of the left common iliac vein between the sacral promontory and the right common iliac artery, the May-Thurner syndrome is an essential prerequisite to embolizing iliac incompetence.

Figure 5. T2FS axial slice at the level of the inferior pole of the kidneys. Left (short arrow) and right (long arrow) ovarian veins with a diameter of more than 8 mm.

Figure 6. Dynamic MR angiography sequence in coronal MIP. Contrast agent reflux in the left ovarian vein (long arrow) as far from the peri-ovarian region and the parametrium (star) crossing the mid-line via the uterine arcuate veins (U) to fill the right parametrium (short arrow), producing a grade 3 reflux.

Figure 7. Diagnostic venography: selective catheterization of the left ovarian vein. Contrast agent reflux (long arrow) as far from the peri-ovarian region and the parametrium (star) crossing the mid-line via the uterine arcuate veins (U) to fill the right parametrium (short arrow), producing a grade 3 reflux.
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MRI may show the morphological compression on axial images, as well as the impression on dynamic angiography sequences (Fig. 11), but there again, diagnosing May-Thurner needs to result from a combination of the clinical data, the morphological appearance, and dynamic study with measurement of the ilio-caval pressures by venography (Fig. 12).

MRI does not provide complete evaluation of the incompetent iliac collectors but maps the large internal iliac venous trunks and sometimes shows the continuity between the iliac system and perineal or leg varicosities very well. This can guide catheterization where there are difficulties, as in the case of this patient with a leak to the top of the left thigh fed by an incompetent obturator vein (Figs. 13–15).

**Examination of pelvic varicose veins**

In MRI, pelvic varicosities are visible as serpiginous objects, which are hyperintense with T2FS. Pelvic varicosities are enhanced on late acquisitions with T1-weighting with gadolinium injection (Fig. 16). In venography, the varicose veins appear as tortuous, dilated veins with stagnation of the contrast agent (Fig. 17).

These varicose veins may be located around the parametrium, the uterus (Figs. 18–20) and the vagina (Figs. 21–24). They may continue into vulvar projections, sometimes fed by an incompetent internal gluteal collector (Fig. 25), or projections into the buttock and top of the thighs (Figs. 13–15).

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**Figure 8.** Dynamic venography: catheterization of the left ovarian vein showing the complex structure of the left ovarian vein with many incompetent collectors (arrows) feeding periovarian varicose veins (star).

**Figure 9.** Dynamic MR angiography sequence in coronal MIP. Reflux within the left ovarian vein can be seen (long arrow); the venous blood then drains contralaterally passing through the parametrial and uterine networks to the right ovarian vein (dotted arrow), where the rate of flow is vicarious.
Figure 10. Dynamic venography: catheterization of the right ovarian vein. There is grade I reflux in the right ovarian vein (short arrow) with spontaneous breathing (9a) which is clearly increased in the Valsalva maneuver (9b) which reveals grade II reflux down to the periovarian region (star).

Figure 11. Dynamic MR angiography sequence in coronal MIP. May-Thurner syndrome. Impression (long arrow) on the left iliac vein made by the right common iliac artery and the sacral promontory. Note the associated left ovarian reflux (short arrows).

Figure 12. Dynamic venography: catheterization of the left common iliac vein. May-Thurner syndrome. Impression at the origin of this vein (long arrow) caused by compression between the right common iliac artery and the sacral promontory.
Figure 13. MRI sequence: T2FS sagittal slices with thin MIP reconstruction. Left parametrial varicose veins (long arrow) and large varicose vein continuous with the pelvic varicosities descending onto the top of the thigh (short arrows).

Figure 14. MRI sequence: T2FS axial slices with thin MIP reconstruction. Varicose veins of the medial surface of the top of the left thigh (arrow).

Figure 15. Dynamic venography: catheterization of the left obturator vein (long arrow) with Valsalva maneuver. Reflux of contrast agent to the top of the left thigh (short arrows).

Figure 16. MRI T1FSGd sequence in axial slices. The varicose veins appear as enhanced serpiginous objects around the uterus (U), filling the parametrium (arrows).
**Figure 17.** Dynamic venography of the same patient as Fig. 15: right internal iliac catheterization. Voluminous right parametrial varicose veins (arrow).

**Figure 18.** Dynamic venography: distal catheterization of the left ovarian vein with Valsalva maneuver. Opacification of left periovarian (long arrow), parametrial (star), periuterine (U) varicose veins crossing the mid-line and opacification of the right parametrial and periovarian varicose veins (dotted arrow) and a voluminous pudendal varicose vein (short arrow).
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Figure 19. MRI: axial T2FS sequences. Pelvic varicosity of varying size, almost non-existent in the first case (a), limited to a few varicose veins around the uterus (U) particularly on the left and in the last case (d), very large, peruterine and totally filling the parametrium (star).

Figure 20. Dynamic venography: catheterization of the distal left ovarian vein. Opacification of periovarian (long arrow), bilateral parametrial (stars), peruterine (U), perivaginal (thin arrow) and vulvar (double arrow) varicose veins. There are obturator leaks (arrow short) and the right ovarian vein is slightly vicarious (dotted arrow).
**Figure 21.** MRI T2FS sequence in the axial plane. Perivaginal varicosity (arrows) increasing in size (a) to (c) around the vagina (V).

**Figure 22.** MRI T2FS sequence in the sagittal plane. Parametrial varicosity of varying size.
**Figure 23.** MRI T2FS sequence in the sagittal plane. Perivaginal varicose veins (long arrow). Congestive appearance of the uterus (short arrows) (a). Hysterectomized patient (b).

**Figure 24.** Dynamic venography: catheterization of the left internal iliac vein. Opacification of a perivaginal varicose cluster (long arrow) prolonged anteriorly towards the vulvar varicose veins (short arrow).
Figure 25. Vulvar varicosities: a: axial T2FS MRI sequence centered on the vulva showing many bilateral varicose veins (long arrow). Presence of a small right gluteal varicose vein (dotted arrow); b: sagittal view in the same patient. Varicose veins (long arrow) extending through the whole thickness of the pelvic floor. Little peritoneal or perivaginal varicosity (V); c: appearance on a T1FSGd axial slice (long arrow) in another patient, with vulvar varicose veins predominating on the right; d: clearly visible small perineal varicose veins (long arrow) in a 3rd woman.

Conclusion

Pelvic varicosities can be quantified using MRI, which usually also shows left ovarian reflux in dynamic angiography sequences. Investigation of right ovarian vein dilatation indicates, or not, the need for venographic examination which remains difficult for anatomical reasons.

Venography is still the essential step prior to embolization but can be rapidly guided by MRI towards the incompetent collectors and leaks to the legs.

A large comparative study with venography could evaluate MRI performance precisely for each criterion.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References