Endovascular treatment of chronic obstructions of the iliocaval segment

Tratamento endovascular das obstruções venosas crônicas do segmento iliocaval

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Abstract

Chronic venous insufficiency is an important public health issue worldwide, that consumes significant amounts of resources and impairs the quality of life of patients who suffer from its more severe clinical types. Surgery for the treatment of deep venous system obstruction has not been incorporated to the practice of most vascular surgeons, being restricted to a few medical centers in some countries. With the advent of endovascular surgical techniques, the possibility of treating some obstructive lesions with a minimally invasive technique that has promising results has renewed the interest of the vascular community for the treatment of more complex forms of vascular disease.

Keywords: venous insufficiency; post-thrombotic syndrome; angioplasty.

Introduction

Chronic venous insufficiency (CVI) is a common condition whose complete clinical picture affects up to 85% of the studied individuals at some level¹. In 2004, the revised CEAP classification consensus statement for CVI was published, and provided broad and complete international standardization of different criteria for clinical and scientific purposes².

CEAP classification has been more accepted in the past few years, but it is still underused, especially for scientific purposes. Epidemiological research on the true prevalence of venous disease in the general population is very rare, which is a reflex of the little importance accredited to CVI, mainly because it does not present risk to the limb or the life of the patient, unlike other vascular diseases such as peripheral arterial obstructive disease (PAOD) and critical limb ischemia. Despite being benign, the most advanced stages of CVI (swelling and skin changes, including ulcers) cause psychological and social disorders, especially because they impact the patients' quality of life and generate costs related to worktime loss or clinical complications that require assistance by health care services; the latter may deplete 1 to 3% of the budget destined to health in developed countries¹,³.

A study on CVI published in Brazil analyzed the prevalence of signs of advanced disease related to varicose veins, and the outcome was a mean rate of 19.7% for edema, 5.7% for hyperpigmentation, 1.4% for eczema and 0.6% for dermatofibrosis⁴.

Patients with CVI presented different symptoms that could not be related exclusively to the venous disease,
especially in less severe cases (CEAP class C0 to C2)\textsuperscript{5,6}. However, the symptoms worsen according to clinical classification\textsuperscript{5,7,8}, and the impact on the quality of life of patients with advanced CVI (classes C5 and C6) may be similar to that caused by heart failure\textsuperscript{1}. Symptoms are usually associated with discomfort, fatigue and pain. Cramps are frequent, but also unspecified, and pruritus may manifest in early stages, but it is usually associated with eczema. Intermittent claudication, described as intense pain at physical exercise, is a rare symptom that occurs in more severe cases\textsuperscript{4,8}.

The pathogenic mechanisms responsible for CVI changes are not particularly clear yet, but clinical manifestations seem to be related to two basic hemodynamic mechanisms: reflux and efflux pumps\textsuperscript{1,5-11}. Some researchers suggest that the obstruction is associated with pain and swelling in the lower limbs, while reflux is related to skin changes, including ulcers\textsuperscript{4}. Both pathogenic mechanisms are frequent in most individuals with moderate to advanced venous disease\textsuperscript{3,8,11,12}.

Besides clinical treatment, surgical approach in all variations of the disease became gold standard for the correction of valve reflux of the superficial and perforating veins of the lower limbs through interruption methods, such as conventional saphenectomy and video-assisted subfascial ligation of perforating veins\textsuperscript{4}. Surgical treatment for deep venous reflux and venous obstructive disease, which are related to advanced cases of CVI, are complex and present less satisfactory outcomes, so these methods have not been diffused among vascular surgeons, except for those who work in reference centers for venous disease\textsuperscript{13-15}.

With the advances in angioradiology and endovascular surgery in the past few years, there was a new interest on the treatment of iliofemoral and inferior vena cava obstruction, increasing the possibility to improve the quality of life of patients with CVI by minimally invasive procedures.

Although the terms “occlusion” and “obstruction” are used in Medicine to describe the complete luminal closure of a structure, their proper definition is related to any degree of luminal narrowing, whether total or partial\textsuperscript{16}. The world literature often misuses these terms, relating them to other concepts. Thus, this study presents the terms “partial” or “total” when referring to lesions in order to avoid the lack of semantic clarification.

Iliofemoral venous obstruction may be thrombotic or not, even when it is chronic. When total or partial obstructions are considered for symptomatic patients, non-thrombotic lesions are predominant (up to 53% of the patients), especially described extrinsic compressions, such as Cockett’s syndrome, referred to by some authors as “symptomatic nonthrombotic iliac vein obstructive lesions”, which are more prevalent in women and on the left limb. When only total occlusions non-related to tumor compression are analyzed, as in this study, almost all cases present post-thrombotic etiology associated or not with extrinsic compressions\textsuperscript{5,15,17-20}.

In 1958, Palma described the surgery to treat unilateral iliac vein occlusion by femoro-femoral crossover saphenous bypass. With the development of stents, femorocaval and cross-femoral PTFE bypass graft came up. Also, spiral saphenous vein graft was described to bypass for proximal obstructions. These types of surgery are performed by few groups on a small number of patients, which makes scientific analyses of the results prone to criticism. However, secondary patency rates of up to 83% for saphenous bypass (Palma’s surgery) and of 53% for axial ePTFE were described with satisfactory clinical progress\textsuperscript{13,14}.

Percutaneous transluminal angioplasty (PTA) was first described as a therapeutic alternative for venous obstructions in cases of Budd-Chiari syndrome and hepatic vein lesions; however, the results were temporary and patients needed reinterventions.

The first stents used in the venous system date from 1969 and were described by Cesar Gianturco et al. The first stent implantation for the inferior vena cava was reported in 1986 by Zollikofer et al. At the beginning, there was a high incidence of restenosis due to miointimal hyperplasia and stent migration, but these problems have considerably decreased with technological advances and the advent of new endovascular techniques\textsuperscript{18}.

**Preoperative evaluation and intervention preparation**

Patients candidate for endovascular recanalization therapy in the femoral iliocaval system must be subjected to a systematic preoperative evaluation. Diagnosis is usually suggested by clinical picture and non-invasive examinations, such as venous duplex scan, air plethysmography, difference of blood pressure in the arms and legs, and ambulatory blood pressure monitoring (ABPM). However, these examinations are not specific or sensitive enough to detect and quantify venous obstruction\textsuperscript{11,18,19}. Definitive diagnosis is determined by imaging methods such as ascending phlebography and phlebography by femoral vein puncture. The latter properly demonstrates the proximal territory and enables the identification of disease alterations such as partial occlusions and the
presence of pelvic collateral vessels in the affected segment (Figure 1). CT angiography and magnetic resonance imaging (MRI) provide images and diagnostic capacity that are similar to those of conventional phlebography, but they are used in few centers to study the venous system. Most patients are already under clinical optimized treatment but presenting unsatisfactory response.8,15-22.

Besides preoperative routine tests, candidates to treatment must be tested for inherited thrombophilia, or the most common ones. All clinical information, such as disease and severity classification, must be registered. Lower-extremity girth measurements and photographs should also be properly taken.8,22. Specific questionnaires regarding CVI are also useful, especially to analyze the improvement on quality of life after the intervention.19. The use of fibrinolytic agents should be considered at preoperative evaluation, and requires additional care, such as fibrinogen dosage, hemoderivative storage and postoperative in intensive care units.18.

Patients should be completely enlightened as to the technical aspects of the procedure, its potential complications and expectations. After the procedure, continuous follow-up is important, so the patient and the medical team must be committed to the success of the treatment.18-20.

Surgical technique

The recanalization of the iliocaval system must be regarded as a major surgery, and all the attention is required.15-22. Patients on oral anticoagulants should discontinue the medication, according to the service routine. Anesthesia may be local or general, due to the length of the procedure, which causes pain and discomfort to the patient.18-22. The choice of access sites is very important and must be detailed. To assure patency, the recanalized segment must be considered as the affected arterial segment, which must be treated with derivatives; thus, good influx and efflux are necessary in order to prevent early thrombosis. The access should enable the treatment of the whole affected area, making room for the liberation of stents, balloon insufflation and sheath introduction.18-19.

The common femoral vein is the best vascular access, but others are often necessary (for example, bilateral common femoral vein puncture). Sometimes, the disease also affects these veins, so the access must be performed by other routes. The most common alternatives are femoral veins (previously called superficial femoral veins), popliteal veins (in which the patient should be in the ventral supine position), and the right internal jugular vein.18,19,22,23. Less usual options are the deep femoral veins, tributary and vicarious veins of the femoral region.19. Ultrasound-guided puncture decreases the chance of complications, and is used in many health care services.15,14,20-23. Surgical accesses with common femoral vein thrombectomy and endophlebectomy are possible in extreme cases in order for the devices to pass.18,19,22.

The access is performed by the Seldinger technique and introduction of 5 or 6 Fr sheath of 15 cm, fluoroscopy and digital subtraction. A hydrophilic guidewire of 0.035” with a flexible tip and right angle catheter is the first option to cross the lesion. The process of crossing the whole affected area is monotonous and slow. Systemic heparin is administered during the procedure for anticoagulation.15,18-23.

It is important not to force the passing of the guidewire due to the risk of perforation. One of the options is to use a smaller guidewire and try to dilate the path with a small balloon (2 to 4 mm in diameter) before continuing, although some authors consider this to be a counterproductive attempt.18. This may also be done when the guidewire has already crossed the whole affected area.
region, but the catheter will not proceed. The exchange for rigid guidewires must be safe (inside a catheter), like in other endovascular procedures. Through and through technique may be used for support, but it necessarily requires an access by the internal jugular vein. Some authors support the use of a local fibrinolytic to dissolve old or new thrombi and allow the passing of the guidewire. Bolus infusion could be performed in an attempt to advance the guidewire, or the infusion may be slow and continuous in the ICU, interrupting the procedure and continuing the next day.

The guidewire and catheter passage should be carefully made, and the position should be checked with different incidences if necessary. Some areas, such as the confluence of common iliac veins, require attention since there are many tributary veins which are parallel to the inferior vena cava. The guidewire could be in a false route of one of these veins. After positioning the set in a disease-free site (according to phlebography), a new confirmation is required.

Intravascular ultrasound (IVUS) is essential to the procedure, being frequently used by Raju and Néglen. These authors believe it is possible to dilate an affected vein into the correct size in one step with IVUS, with no risk of rupture by a large balloon catheter. Also, minor lesions that may go unnoticed by digital phlebography are detected with IVUS, so the whole affected area can be treated with no harm to the recanalization function. However, IVUS is very expensive, and many authors do not have access to this technology or use it only in selected cases. The diameters of the balloons range from 10 to 24 mm, according to the segment.

Stents should be self-expandable and exceed the estimated vessel diameter in 2 to 4 mm. Wallstent (Boston Scientific, Natick, MA, USA) is preferentially used, but nitinol stents may also be used. IVUS enables the choice of the stent diameter and length. However, some maneuvers that may insufflate a balloon up to an unknown diameter causing intravenous traction may help, because if it is easily displaced, a stent that is at least 20% larger than the balloon diameter will be used. The whole affected area should be covered, including the femoral vein at times. Stent fracture crossing the inguinal ligament in the venous territory is described as a rare complication. Stent release is distal or proximal, and there may be different diameters for different segments (for instance, 12 mm for the common femoral and external iliac veins, 14 to 16 mm for the common iliac vein and 18 to 20 mm for the inferior vena cava), or a single diameter for all segments, in which the stent should be chosen according to the largest diameter. This last method allows stent expansion, so its final diameter is limited by the luminal diameter along the segments.

The overlapping of each consecutive stent should have at least 2 cm to avoid migration and disconnections, and the stents should be as long as possible. When it is necessary to release a stent in the inferior vena cava due to unilateral iliac disease, it does not seem necessary to perform the kissing stent technique like in the arterial system, once the contralateral arterial flow crosses the stent mesh and there is no significant increased thrombosis. In cases of bilateral iliac disease, many stent configurations are described, such as Y-shaped iliac vein stent parallel to the inferior vena cava until above the infected area (Figure 2A). In this case, one of the iliac stents is extended into the inferior vena cava until the non-diseased area, and the contralateral fenestrated stent-graft ends distally in the longest stent mesh (Figure 2B). It may also end in inverted Y-configuration, that is, the iliac stents end in a single stent into the inferior vena cava (Figure 2C). After all stents have been released, the balloon is dilated according to the size of each segment.

The presence of an inferior vena cava filter in the segment to be treated is not a contraindication for the procedure, although it may be more challenging. In such cases, the guidewire should pass through the metal trocars of the filter, not around it, so the balloon can deflate and be opened, and the stents can expand easily.

Final control is performed by a distal injection, and it is adequate when a rapid contrast passage is observed, with no contrast retention inside the treated segment and with disappearance or important reduction of the pelvic collateral circulation filling, which demonstrates that the blood flow should be preferentially into the recently created path. IVUS use may still detect lesions that are imperceptible to digital phlebography.

Sheathes are removed with anticoagulants and the patient rests for 24 hours. Most authors start treatment with warfarin or other oral anticoagulant after the procedure, maintaining unfractionated heparin until normalized international ratio is achieved (NIR – between 2.0 and 3.0). The oral anticoagulant is maintained for at least six months, associated or not with clopidogrel. Some health care services choose to use anti-platelet agents at postoperative, except for patients with indication of anti-coagulation for a base disease. Since most patients with total chronic occlusions in the iliacaval territory have post-thrombotic syndrome, oral anticoagulation is indicated.
Follow-up consists of outpatient clinic appointments for examinations and one annual duplex scan or more, at least in the first year. If there are signs or symptoms such as pain, discomfort and swelling or if the ultrasound detects any change, patency maintenance may be performed with simple angioplasty via right internal jugular vein without hospitalization.\(^{18,22}\)

**Discussion**

Most studies on endovascular treatment of the femoral iliocaval system analyze cases of partial and total obstruction, but hardly mention cases of total occlusion.\(^{19}\) Raju and Néglen have recently published their results on the treatment of total occlusion.\(^{19}\) In an experience with 1,402 patients treated for venous disease from 1999 to 2007, 167 (159 patients) were allocated in the group of total chronic occlusion secondary to deep vein thrombosis (DVT). All patients were symptomatic and 32 of them had active ulceration. Initial technical success rate was 72%, however, after new procedures performed in different dates, it increased to 83%. Almost half of the distal stents were placed at the common femoral vein, crossing the inguinal ligament (47%), and most of the proximal stents were placed at the inferior vena cava (98%). Primary, assisted primary and secondary patency rates were, 31, 57 and 66%, respectively, in 48 months, with acceptable standard error (Graph 1). Clinical improvement was statistically significant for variables analyzed by the Chronic Venous Insufficiency Questionnaire (CVIQ), and there was no improvement or worsening for hemodynamic variables. Pain relief was of approximately 80% in 4 years (70% of complete improvement); recovery from swelling was partial and complete in approximately 60 and 35% of the patients in 4 years. About 58% of the sample had healed ulcers without recurrence in 30 months. No predictive factors of treatment failure were observed in this study.

Razavi published the treatment of 17 total occlusions, with initial technical success rate of 88%, primary patency of 80%, and primary assisted patency of 88% in 19 months; however, the outcomes as to symptoms were not analyzed.\(^{23}\) Hartung’s group, at analyzing a mixed sample, reported a 93% technical success rate for the treatment of total occlusions, however, the specific patency for this group of patients was not mentioned. All six cases of CEAP C6 of the study were healed, and there was an important improvement in venous claudication (68% of cure and 27% of relief). The common femoral vein being affected was a risk factor for decreasing primary patency, but it was only statistically significant at univariate analysis.\(^{22}\)

Mortality was not related to the procedure in the papers assessed, and the incidence of complications was low; the most frequent complication was pain, controlled with simple analgesics. The hematoma at the

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**Figure 2** – Examples of stent configuration in the inferior vena cava and confluence of common iliac veins. (A) Illustration by parallel stents or simultaneous kissing stents (SKS) (Thorpe and Osse); (B) inverted Y, in which the shorter stent is crossed and dilated by the metallic mesh (Raju and Néglen); (C) modified inverted Y, with two parallel iliac stents inside a larger stent in the inferior vena cava.
puncture site is rare when compared to arterial route. Retroperitoneal hematoma by perforation of the inferior vena cava responds well to conservative treatment. Transitory elevation of creatinine levels, iatrogenic injuries of the femoral artery and stent infection were also described, despite being rare. However, early thrombosis (< 30 days) is described in most publications15,18-23.

Conventional surgery for obstructive venous disease of the iliocaval territory is restricted to reference centers due to technical and clinical limitations. Excellence groups such as Mayo clinic have published satisfactory outcomes with the surgical treatment, with no casualties related to the procedure, low complication rates and secondary patency rates of 83% for Palma surgery in 4 years and of 54% for axial derivations with PTFE in 2 years13. On the other hand, endovascular therapy seems to provide promising results when compared to surgical treatment, besides increasing the number of indications18.

Regardless of the technique, results are promising, with improvements on symptomatology and the quality of life of the patients, who usually have normal life expectancy in relation to individuals of the same age, unlike patients with peripheral arterial obstructive disease with critical ischemia. However, venous obstructive disease requires simple, non-invasive, hemodynamic or imaging diagnostic techniques to a proper preoperative evaluation. Duplex scan follow-up at postoperative has similar criteria to the ones used in the arterial system, which is probably inadequate.

Stenting across the inguinal ligament is widely used, and the number of fractures is not significant because the material is under less stress than the high pressure environment, with pulsatile flow in the arterial system19,20,23,24.

This leads to a more careful choice of accesses, which may be performed with minimal complications in sites that are rarely used for arterial accesses (femoral vein and popliteal vein)18,19. There is a concern regarding the implantation of stents in the infra-renal vena cava because of possible damages to the renal function, once occlusions of this segment often reach this site. However, this kind of complication has not been described20. The venous system seems to have a better tolerance to metal load than the arterial system19.

As the prevalence of proximal venous disease (especially non-thrombotic obstructive lesions) is higher in young women in the fertile period, the behavior of the stents in the pelvic region and during pregnancy is a concern. The only case of occlusion during pregnancy happened with a patient with a balloon-expandable stent, which was crushed by her uterus. Other patients received a self-expandable stent, were on prophylactic enoxaparin and were subjected to duplex scan to analyze all pregnancy stages. Four patients were diagnosed with compression and hemodynamic repercussion over the stent, and started on therapeutic enoxaparin. None of the patients with a self-expandable stent presented with thrombosis or recurrence of compression symptoms after pregnancy. Self-expandable stents seem to be safe, but they must be carefully indicated for women who plan to have children26.

The worsening of venous reflux to the inferior limb affected by CVI is also a concern. Some authors believe that proximal efflux obstruction would be a protection factor against reflux in the veins of the limb. If treated, the increased intensity of the reflux could lead to a worse clinical picture, especially regarding skin manifestations. In practice, this problem has not been observed, and patients had clinical improvement and kept using elastic compression stockings even with the increased reflux15,19,25. Some groups had the superficial venous system reflux treated like endovascular recanalization: conventionally (saphenectomy by eversion, ligation) or minimally invasive methods (laser or radio frequency)22,27.

The incidence of restenosis was analyzed by Néglen and Raju, and was found to be very high in stents implanted in the iliocaval segment (77% in 2 years). However, restenosis is mostly below 20%, or between 20 and 50% (not significant), and occurs especially in the

![Graph 1]  
Source: Raju and Néglen19.

**Graph 1** – Primary, primary assisted and secondary patency estimates.
first 2 years after implantation. Risk factors associated with non-significant and significant restenosis (> 50%) were previous DVT, thrombophilic disorders, extension of the segment with stent > 13 cm, and stenting across the inguinal ligament23.

There is no established protocol regarding medications to prevent thrombosis after endovascular venous recanalization, but most authors agree that patients with post-thrombotic occlusion – most of the cases – should be on full and continuous anticoagulation18,22,23,25.

Conclusion

The deep venous system is often subjected to interventional endovascular techniques, both in acute (such as DVT fibrinolysis) and chronic cases (angioplasties of lesions at the femoral ilioacaval system).

With the diffusion and knowledge regarding the endovascular venous recanalization method, which is relatively simpler than conventional surgery, symptomatic patients who first depended on one strict clinical treatment to achieve mild relief may obtain effective and rapid clinical improvement by means of a minimally invasive and safe procedure with low complication rates. With the new interest for the study and venous disease treatments, the endovascular method evolves and spreads rapidly. Perhaps the surgery for complex venous disorders may also be performed in centers where it was once unknown or abandoned.

References


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