Introduction

Lower extremity chronic venous insufficiency (CVI) is a common cause of severe leg symptoms, including pain, swelling, and ulceration estimated to affect millions of people worldwide (1). Although the majority of cases are generally believed to be related to venous valvular incompetence and abnormal reflux, awareness of the importance of iliac venous obstruction as a cause of lower extremity symptoms is increasing. In a cadaver study investigating the anatomy of the aortoiliac arterial and venous bifurcations, May and Thurner (2) reported compression of the left iliac vein against the fifth lumbar vertebra by the right iliac artery in 22% of cases. Variants of this syndrome have been described resulting in compression of the right iliac vein or distal vena cava by the aortic bifurcation as well (3).

Although May-Thurner syndrome is believed to be a contributing factor related to iliofemoral venous thrombosis, compression occurs in many asymptomatic patients as well. Kibbe et al (4) reviewed abdominal/pelvic computed tomography (CT) scans performed on patients with no lower extremity symptoms for the presence of ilio-caval abnormalities. They reported that 24% of patients with no history of lower extremity deep vein thrombosis (DVT) or symptoms had at least 50% obstruction of the left common iliac vein. Conversely, it is known that anatomic compression of the iliac vein may predispose patients with other promoting factors to thrombosis of the iliofemoral system leading to a high risk of chronic venous insufficiency symptoms.

Patients at the end stage of chronic venous insufficiency (CEAP clinical class 4, 5 and 6) have complex venous disease, with involvement of deep, superficial, and perforator veins in the majority of cases (5). It has previously been reported that patients with severe symptoms of chronic venous disease have a high incidence of compression of the ilio-caval system when studied with intravascular ultrasound (IVUS) (6). Symptomatic patients diagnosed with ilio-caval outflow obstruction (ilio-caval venous obstruction [ICVO]) may be treated with percutaneous stent insertion resulting in relief of iliac obstruction. Raju and Neglen (6) and others (7) (8) have documented improvement in venous hemodynamics, patient symptoms, and quality of life after stenting for this condition.

In patients with (chronic) venous disease, the first imaging tool is, and generally should be, duplex ultrasound (DUS). DUS has proven to be adequate in the assessment of the venous system of the legs, pelvis and abdomen both anatomically and hemodynamically (5) (9). However, in certain cases the examination is impaired. In the leg this can be due to ulceration, edema and thickened skin. In the pelvis and abdomen this is more frequently due to obesity, uncompressible air in the bowel and difficult (abnormal) anatomy, in particular in patients with (chronic) obstruction of the deep veins. Additionally, accurate assessment of the pelvic and abdominal deep veins with DUS is operator dependent and requires extensive experience (5). Imaging the pelvic and abdominal veins to identify obstruction has been shown to contribute to the treatment of chronic venous disease (CVD), with the option of recanalization and stenting of stenotic or occlusive lesions (10) (11) (12). Computed tomographic venography (CTV) and magnetic resonance venography (MRV) are not hampered by afore mentioned limitations of DUS when it comes to visualization of the (deep) veins. While DUS is superior in hemodynamic evaluation of the veins, both CT and MR imaging offer high resolution, anatomical three dimensional (3D) volume images of the pelvis and abdomen and if required, the legs. A CT scan may demonstrate acute thrombus as a filling defect in an opacified vein but the diagnosis of chronic iliac vein pathology is by inference rather than by direct imaging (13). On the other hand MRV can rule out the presence of pelvic masses and DVT while simultaneously demonstrating the anatomy characteristic (vein wall thickening and webs/spurs/trabeculation) of these lesion which CTV cannot (14).

The prevalence and characteristics of iliac venous outflow obstruction have not been well described in patients with CEAP class 4, 5 and 6 CVI. The majority of patients with venous ulceration in the India are currently treated in wound clinics or primary care offices where this cause of correctible venous hypertension is poorly understood and rarely investigated. The purpose of this study was to identify the prevalence of venous outflow obstruction in the iliac veins and/or vena cava in patients with class 4, 5 and 6 CVI and risk factors related to its occurrence.

AIMS OF THE STUDY

- To find the prevalence of ICVO in C4, C5 and C6 disease patients using MR venography.

- To study the risk factors associated with occurrence of ICVO in patients with C4, C5 and C6 disease.

Review of literature

Historical Background

Virchow (15) attributed the increased left-sided predilection of deep venous thrombosis to left iliac vein compression by the crossing artery. In 1908, McMurrich (16) first reported the presence of web-like intrinsic Intraluminal lesions in 33% of 107 unselected cadavers.

The anatomy was further defined by May and Thurner in 1956 on the basis of their analysis of 430 autopsies (2).The main anatomic component of the syndrome that bears their names is the location of the aortic bifurcation above the ilio-caval junction, resulting in compression of the left common iliac vein between the right iliac artery and the fifth lumbar vertebrae. In 1965 Cockett and Thomas (17) coined the term "iliac vein compression syndrome" to describe the clinical symptoms associated with an isolated area of obstruction at the mouth of the left common iliac vein that resulted in chronic left leg symptoms. Since that initial report, several additional reports have addressed iliac vein compression syndrome.(18)(19)(20)(21)(22)

Variants of this syndrome have been described resulting in compression of the right iliac vein or distal vena cava by the aortic bifurcation as well (23). The high prevalence of NIVL in symptomatic CVD using IVUS was shown by Neglen P, Raju S (24) (6) and Hurst DR.(25) Nexus et al. found bands at the mouth of the left iliac vein in 22% of dissections; he suggested that this was a normal anatomic variant and was not necessarily related to significant venous disease (26). Similarly Kibbe e tal (4) reviewed abdominal/pelvic computed tomography (CT) scans performed on patients with no lower extremity symptoms for the presence of ilio-caval abnormalities. They reported that 24% of patients with no history of lower extremity deep vein thrombosis (DVT) or symptoms had at least 50% obstruction of the left common iliac vein. But Seshadri Raju and Peter Neglen showed that high prevalence of NIVL (53%) in severe symptomatic CVD using IVUS with sensitivity 90% (6).

Definition

Chronic deep venous obstruction of the lower limbs may generally be described as a blockage of the outflow of blood from the lower extremity. (27)

Prevalence

The lack of precise definition of hemodynamic obstruction also hampers accurate information regarding prevalence. McMurrich (16) first reported the presence of web-like intrinsic intraluminal lesions in 33% of 107 unselected cadavers. Some retrospective studies have indicated that MTS exists in as many as 22% to 24% of these patients (17) (28) (29). Seshadri Raju and Peter Neglen showed that high prevalence of NIVL (53%) in severe symptomatic CVD using IVUS with sensitivity 90% (6).

Etiology

1. CHRONIC THROMBOTIC OBSTRUCTION
2. NONTHROMBOTIC, NONMALIGNANT, PRIMARY OBSTRUCTION
3. INTRALUMINAL LESIONS
4. MISCELLANEOUS ETIOLOGY

CHRONIC THROMBOTIC OBSTRUCTION

Poor recanalization following acute deep vein thrombosis is the most common cause of chronic venous blockage. Remaining obstruction is the principal cause of symptoms in approximately one-third of post thrombotic limbs.(30),(31)In addition, it has been demonstrated that persistent obstruction of proximal veins is associated with progressive distal vein incompetence.(32)(33) The most symptomatic outflow obstruction occurs following deep vein thrombosis involving the iliac segment. It may be limited to the iliofemoral segment or contiguous from the calf to the iliac veins. Approximately 20% of these iliac veins will completely recanalize on anticoagulation treatment, and the remaining veins recanalize partly and develop varying degrees of obstruction and collateral formation.(34)(35) Recanalization appears to be inhibited and more incomplete when an external compression (e.g., left iliac vein compression) is present.(36). Observed that the obstructive lesion that precipitated the thrombosis impeded its resolution and the post-thrombotic perivenous fibrosis appeared to develop excessively at the initiating lesion site, the combination resulting in severe clinical presentation.(26)(37) This observation is of great importance since it has been reported that 80% of limbs with iliofemoral DVT has underlying extrinsic iliac compression-type of lesions detected by spiral CT venography.(38) The remaining post thrombotic obstruction is often symptomatic. Five years after iliofemoral DVT is treated conservatively with anticoagulation, 90% of patients suffer symptoms of CVD. Debilitating venous claudication is found in 15 to 44% of patients and venous ulcer has developed in 15% of limbs.(39)(34)

The typical post-thrombotic iliofemoral lesion often involves both common and external iliac veins with irregular stenosis or occlusions and axial, transpelvic, and ascending lumbar collaterals are present. More uncommon is the finding of a diffusely narrowed long segment of the iliac vein without any collateral formation. We have named it a Rokitansky stenosis, from the nineteenth century pathologist who described the phenomena (Fig.1.1). A perivenous fibrosis develops due to the periphlebitic inflammation following acute deep vein thrombosis. The chronic result is a fibrotic cylinder, which impedes any collateral development and expansion of the vein. Thus, significant outflow obstruction cannot be excluded because of lack of collaterals.

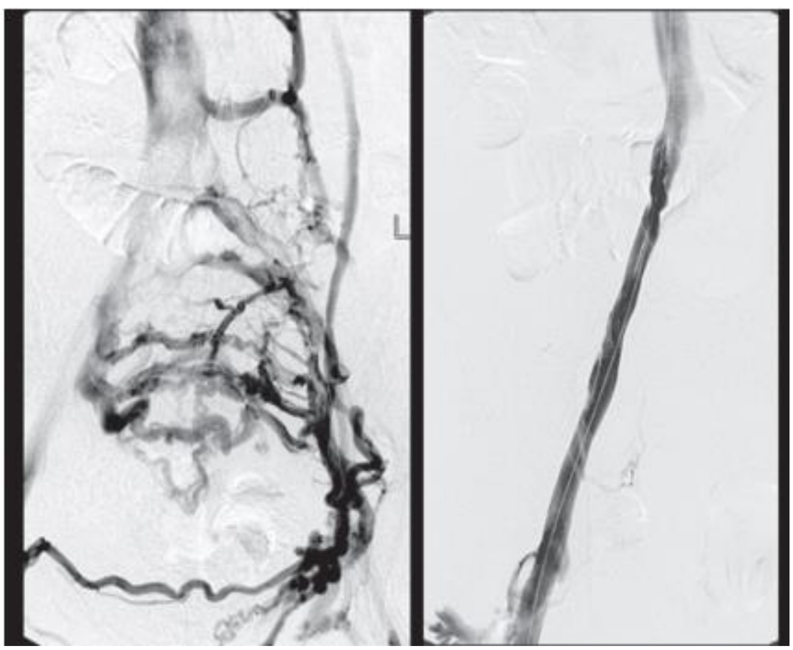


FIGURE 1.1 Transfemoral ascending venograms. (Left) The typical image of a chronically occluded post thrombotic vein with axial and transpelvic collaterals. (Right) A less frequently seen extensive iliac vein narrowing, a so-called Rokitansky stenosis, with a post-thrombotic perivenous fibrotic cylinder, which impedes any collateral development and expansion of the vein (courtesy Vein book chapter 59)

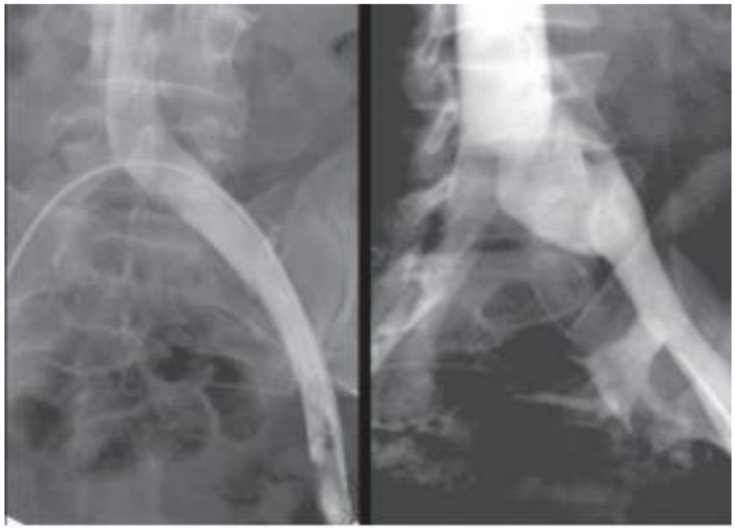


FIGURE 1.2 Transfemoral ascending venograms. (left) A normal venogram showing a smooth continuously widening iliofemoral outflow tract. (Right) Common iliac vein compression with severe flattening, “pancaking,” in the frontal plane. A web is shown in the compression and collaterals are present. collaterals is suggestive of hemodynamically significant obstruction. (courtesy Vien book chapter 59)

NONTHROMBOTIC, NONMALIGNANT, PRIMARY OBSTRUCTION

It is increasingly recognized that primary obstruction (iliac compression–type lesions) may be more important in the expression of nonthrombotic CVD than previously thought.(40) A so-called primary, nonthrombotic iliac vein obstruction (May-Thurner syndrome (2)or Cockett’s or iliac vein compression syndrome (17)) has been described. Typically, a stenosis of the left proximal common iliac vein is caused by compression by the right common iliac artery with secondary band or web formation (Figs. 1.2).(26) The prevailing concept is that this syndrome is only clinically expressed in the left lower extremity of predominantly young women of child-bearing age. This limitation is not true since compression lesions are not uncommon in males, in elderly patients, and may involve the right limb. In authors (6) experience of treating iliofemoral obstruction in 938 limbs in 879 patients, 53% of limbs had nonthrombotic compression lesions (defined as absent history of DVT, no venographic or ultrasound findings indicating previous

DVT), 40% had postthrombotic obstruction, and 7% had a combined etiology. The ages of the patients with nonthrombotic blockage ranged from 18 to 90 years (median 54 years), 20% of patients were men, and 25% of the symptomatic lower limbs were on right side.

INTRALUMINAL LESIONS

The important relationship of iliac vein compression lesions to the preponderance of left iliofemoral thrombosis was early recognized. Virchow attributed the marked left sided predilection for deep venous thrombosis to stasis caused by compression of the left iliac vein by the right iliac artery against the fifth lumbar vertebral body.(15) Iliac vein compression syndrome a misleading nomenclature since the lesion is not only characterized by narrowing due to external compression, but also frequently by presence of intraluminal lesions acting as a weir in the bloodstream. The nature of these lesions was described by McMurrich in 1908 to be an "adhesion" resulting in "fusion of the anterior and posterior wall of the vein." He thought the lesion was congenital and was surprised by its frequency (33%) in 107 unselected cadavers.(16) Ehrich and Krumbhaar confirmed the high prevalence of these obstructive intraluminal lesions (30% in 412 unselected autopsies) although they contested the etiology to be congenital.(41) These early studies lay dormant until interest was revived by detailed studies by May and Thurner in 1957.(2) They found a 22% incidence of iliac intraluminal lesions in 430 unselected cadavers. The morphology of the lesion varied from a thin membrane to "ridges, velums, chords, spurs or bridges" to total occlusion. Interestingly, the anatomist DiDio had already described these lesion in his doctoral thesis in 1949 and also introduced the concept of "venous spur" (personal communication by Alberto Caggiati). May and Thurner also discounted a congenital etiology and suggested that the predominant fibroblastic content of the lesion resulted from a proliferation of cells originating from the endothelium in response to chronic injury by the pulsating artery. Operating on these obstructions, Wanke earlier had observed a cicatricial sclerotic transformation of the common sheath secondary to iterative trauma and perivenous inflammation.(42) Arteriosclerotic inflammation of the artery at the vessel crossing also may affect the underlying vein and explain the finding of venous obstruction in elderly people. Increased incidence in women has been attributed to compression by the gravid uterus or increased lordosis. In the 1960s, Cockett et al. confirmed the high prevalence of the compressive iliac lesion in the general population (eight out of nine corrosion casts of the vein [88%] showed at least some degree of external compression) and 14% of 100 unselected cadavers had intraluminal lesions.(37), (17)

Although the theory of congenital etiology is not prevailing, there is some support for it. The presence of muscle, elastin, and collagen has been described in these lesions in a layered structure, which would suggest an ontogeny, not traumatic origin.(26) (41) The arterial crossover points also coincide with embryonic venous fusion sites where congenital webs and membranes may be present.(43) These occur more commonly on the left side. A post-thrombotic etiology of the intraluminal lesions appears to be ruled out due to the absence of hemosiderin and other features of an organizing thrombus, even though secondary thrombosis at the site or distally often is associated.(26),(2) The etiology of these intraluminal lesions has not been proven convincingly.

MISCELLANEOUS ETIOLOGY

Less common causes of chronic blockage of the ilio-caval vein include benign or malignant tumors, retroperitoneal fibrosis, iatrogenic injury, irradiation, cysts, and aneurysms. Relief of symptoms is immediate following successful stenting of malignant obstructions. The long-term outcome appears to depend largely on the progress of the tumor.(44) Ilio-caval stenosis due to retroperitoneal fibrosis has been treated successfully by stenting.(45)

ANATOMICAL CONSIDERATIONS

The exploration of iliofemoral veins with intravascular ultrasound (IVUS) has given new information regarding the iliac compression lesions. Although usually found in the common iliac vein, at least 15% of the limbs with primary disease have stenosis of both common and external iliac veins.(12) The anatomical differences between the right and left pelvic vasculature may explain the variable distribution of proximal and distal obstructive lesions.(26) The level of aortic bifurcation is variable, which affects relevant left-side anatomy very little, but has a major effect on artery/vein course relationships on the right side. The right iliac artery always crosses the left common iliac vein abruptly with the level of crossing showing minor variations (proximal left lesion). On the right side, the right iliac artery crosses the right common iliac vein only in 22% of cadavers coursing lazily across the vein over a longer length (proximal right lesion) (Fig. 1.3). In three-quarters of limbs, the right iliac artery crosses the right common iliac vein somewhat more abruptly low down at internal-external iliac vein junction (distal right lesion). In most cases, the right internal iliac artery does not cross the common or external iliac veins, because it originates before the iliac artery crossed the vein. The left internal iliac artery always crosses abruptly across the left iliac vein (distal left lesion) (Fig. 1.4). These anatomical variations may explain the greater frequency of proximal left compression lesions, the focal stenosis on the left and the diffuse lesion on the right side, and the same frequency of the distal lesions occurring bilaterally. The possibility that these limbs with primary, nonthrombotic disease may have had an isolated subclinical iliac vein thrombosis that initiated at the vessel crossing and then propagated distally into the external iliac vein cannot be excluded. On the other hand, limbs with obvious postthrombotic disease may have had an underlying iliac vein compression resulting in an iliofemoral vein thrombosis.(37),(46) Whatever the chain of events, it serves to remind us that patients complaining of leg pain and swelling and no history of previous DVT or other venous disease may have isolated iliac vein obstruction.

The iliac vein is the common outflow tract of the lower extremity, and chronic obstruction of this segment appears to result in more severe symptoms than does lower segmental blockage.(47),(48) Distal obstructions are more readily compensated for, because of facilitated collateralization in the femoral-popliteal segment owing to the presence of double veins, direct connection to the profunda vein, sapheno-saphenous connection, and deep muscular tributaries in the thigh. Conversely, the collateral formation is relatively poor in the iliofemoral segment. Although the pelvic collaterals may appear large on venogram, they may be of little functional value. The flow is often retrograde due to reversed valve orientation and impeded due to the meandering course of the vessel. Interestingly, it has been shown by intravascular ultrasound (IVUS) that the average iliac venous stenosis was tighter in presence of collaterals than without. The rate of a significant obstruction as per preoperative pressure measurements were the same as in limbs with and without collaterals. One third of limbs had significant provoked femoral pressure differential; that is, positive hemodynamic test for obstruction, during surgery.(49) It appears that a presumed increased flow through collaterals did not adequately compensate for the outflow obstruction in all instances. The prevailing view that collateral formation compensates for a venous outflow obstruction, therefore, is challenged. These observations support the concept that pelvic collateral formation suggests the presence of a significant venous obstruction.

FIGURE 1.3 Transfemoral ascending venograms. (left) Distal iliac vein compression of the proximal external iliac vein in the sagittal plane (see also Figure 59.5). (middle) Long compression by the right iliac artery gradually transversing the right external iliac vein. (right) Left common iliac vein in a 76-year-old woman fl attened by the arteriosclerotic artery, which is outlined by its calcifications. (source vein book chapter 59)

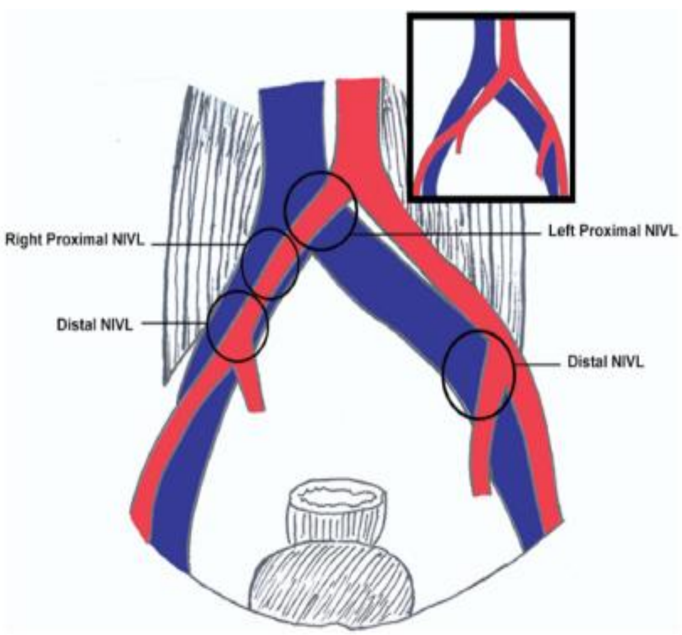


Fig 1.4.The pathologic anatomy of a nonthrombotic iliac vein lesion (NIVL). The classic left-sided proximal lesion is related to abrupt crossing of the left iliac vein by the right iliac artery. The subsequent course of the right iliac artery is variable (see text). The minority pattern (22%) is shown in the large drawing. Coursing lazily across the vein, the right iliac artery may be related to the proximal or distal NIVL, or both. In the majority pattern (prevalent in 75%, shown in the inset), the right iliac artery crosses the right common iliac vein more abruptly, but lower down at or near the external iliac vein level, inducing distal right NIVL but will not be a factor in proximal right NIVL. The left hypogastric artery crossing may be related to left distal NIVL. The Hypogastric veins have been omitted to reduce clutter. (source J Vasc Surg 2006;44:136-44)

Clinical features

Symptomatology

Symptoms of proximal chronic venous obstruction may vary greatly, ranging from moderate swelling and pain to discoloration and stasis ulcers. Symptoms are also influenced by any concomitant deep or superficial reflux. Obstruction plays an important role in the clinical expression of chronic venous disease, especially as pain. Negus et al. suggested that limb swelling and pain were related to the obstructive component whereas limb ulceration resulted from valve reflux.(26) Ulcer is rarely seen with isolated obstruction, and formation of ulcer appears to require presence of reflux.(40) Nevertheless, correction of outflow obstruction results in substantial symptom relief including ulcer healing. A substantial number of patients with CVD complain of disabling limb pain and swelling without skin changes. (50)The dominant pathophysiologic component in these patients may be obstruction rather than reflux, and it is possible that these symptoms are mainly attributable to the outflow blockage. “Venous claudication” is a condition described as an exercise-induced “tense” pain, which requires several minutes of rest and often leg elevation to achieve relief. Following iliofemoral thrombosis, venous claudication has been diagnosed by treadmill test in 44% of patients. Certainly patients with significant outflow obstruction may have less dramatic symptoms with less distinct lower extremity pain and discomfort with decreased quality of life and moderate disability.

Clinical findings

Abnormal veins

1) Varicose veins

Subcutaneous dilated veins equal to or more than 3 mm in diameter measured in the upright position. These may involve saphenous veins, saphenous tributaries, or non saphenous superficial leg veins. Varicose veins usually are tortuous, but tubular saphenous veins with demonstrated reflux may be classified as varicose veins. Synonyms include varix, varices and varicosities.

2) Telangiectasia(thread, spider vein)

   A confluence of dilated intradermal venules of less than 1 mm in caliber. Synonyms include spider veins, hyphen webs, and thread veins. (FIG 1.5)

3) Reticular veins

   Dilated bluish subdermal veins usually from 1 mm in diameter to less than 3 mm in diameter. They usually are tortuous. This excludes normal visible veins in people with thin, transparent skin. Synonyms include blue veins, subdermal varices, and venulectasies. (FIG 1.6)

Abnormal skin

1) Corona phlebectatica

   A fan-shaped pattern of numerous small intradermal veins on the medial or lateral aspects of the ankle and foot. This commonly is thought to be an early sign of advanced venous disease. Synonyms include malleolar flare and ankle flare. (fig 1.8)

2) Edema

A perceptible increase in volume of fluid in the skin and subcutaneous tissue characteristically indenting with pressure. Venous edema usually occurs in the ankle region, but it may extend to the leg and foot.

3) Pigmentation

A brownish darkening of the skin resulting from extravasated blood, which usually occurs in the ankle region but may extend to the leg and foot.(fig 1.9)

4) Eczema

An erythematous dermatitis, which may progress to a blistering, weeping, or scaling eruption of the skin of the leg. It is most often located near varicose veins but may be located anywhere in the leg. Eczema usually is seen in uncontrolled CVD but may reflect sensitization to local therapy. (fig 1.7)

5) Lipodermatosclerosis (LDS)

Localized chronic inflammation and fibrosis of the skin and subcutaneous tissues of the lower leg, sometimes associated with scarring or contracture of the Achilles tendon. LDS is sometimes preceded by diffuse inflammatory edema of the skin, which may be painful and which is often referred to as hypodermitis. This condition must be distinguished from lymphangitis, erysipelas, or cellulitis by their characteristically different local signs and systemic features. LDS is a sign of severe chronic venous disease.

6) Atrophie blanche or white atrophy

Localized, often circular whitish and atrophic skin areas surrounded by dilated capillaries and sometimes hyperpigmentation. This finding is a sign of severe chronic venous disease and not to be confused with healed ulcer scars. Scars of healed ulceration also may have atrophic skin with pigmentary changes but are distinguishable by history of ulceration and appearance from atrophie blanche is excluded from this definition.

7) Venous ulcer

Full thickness defect of the skin most frequently in the ankle region that fails to heal spontaneously and is sustained by CVD. (fig 1.9)

Finally, because the veins of the leg empty into the pelvic and abdominal veins, inspection of the abdomen is very important, since dilation of veins on the abdominal wall or across the pubic region suggests an old iliofemoral thrombus. Dilated veins along the medial or posterior aspect of the proximal thigh or buttocks most often arise from varicosities involving the pudendal or other pelvic vessels, and these can be of ovarian reflux origin.

Fig 1.5 Telangiectasia (thread, spider vein)

Fig 1.6 Reticular veins

Fig 1.7 Venous eczema

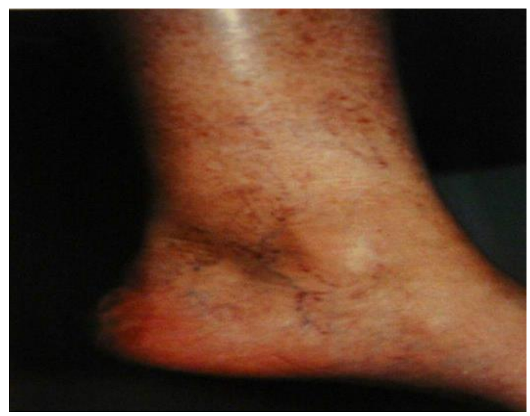


Fig 1.8 Corona phlebectatica

Fig 1.9 venous ulcer and pigmentation

CLINICAL TESTING

Historically important tests of venous function have been part of the physical examination of venous insufficiency (see Table 1.1). These tests have been laid aside largely because of their lack of specificity and sensitivity. The continuous wave Doppler examination has replaced most of these tests, and confirmatory duplex testing has relegated them to an inferior role. However, the educated physician who treats venous insufficiency must have knowledge of these tests and their physiologic background, such as the Trendelenburg test or Brodie-Trendelenburg test.

Table 1.1 Tests of Historic

Trendelenburg Test
Cough Test
Schwartz Test
Perthes' Test

Trendelenburg Test

A tourniquet may be placed around the patient's proximal thigh while the patient is standing. The patient then assumes the supine position with the affected leg elevated 45 degrees. The tourniquet is removed, and the time required for the leg veins to empty, which is indicative of the adequacy of venous drainage, is recorded. When compared with the contralateral leg, the method just described may demonstrate a degree of venous obstructive disease. Another approach is to elevate the leg while the patient is supine and to observe the height of the heel in relation to the level of the heart that is required for the prominent veins to collapse. Unfortunately, neither procedure is sufficiently neither sensitive nor accurate and does not differentiate acute from chronic obstruction, thus being of minimal assistance in current medical practice.

Cough Test

One hand is placed gently over the GSV or SFJ, and the patient is asked to cough or perform a Valsalva maneuver. Simply palpating an impulse over the vein being examined may be indicative of insufficiency of the valve at the SFJ and below to the level of the palpating hand.

Percussion/Schwartz Test

One hand is placed over the SFJ or SPJ, and the other hand is used to tap very lightly on a distal segment of the GSV or SSV. The production of an impulse in this manner implies insufficiency of the valves in the segment between the two hands. Confirmation of the valvular insufficiency can be achieved by tapping proximally while palpating distally. This test can also be used to detect whether an enlarged tributary is in direct connection with the GSV or SSV by palpating over the main trunk and tapping lightly on the dilated tributary, or vice versa. The presence of a direct connection results in a palpable impulse being transmitted from the percussing to the palpating hand. As might be expected, these tests are far from infallible.

Perthes' Test

The Perthes' test has several uses, including distinguishing between venous valvular insufficiency in the deep, perforator, and superficial systems and screening for DVT. To localize the site of valvular disease, the physician places a tourniquet around the proximal thigh with the patient standing. When the patient walks, a decrease in the distension of varicose veins suggests a primary process without underlying deep venous disease because the calf muscle pump effectively removes blood from the leg and empties the varicose veins. Secondary varicose veins do not change caliber (if there is patency of the deep venous system) because of the inability to empty blood out of the veins as a result of impairment of the calf muscle pump. In the setting of a current DVT, they may increase in size. If there is significant chronic or acute obstructive disease in the iliofemoral segment, the patient may note pain (venous claudication) as a result of the obstruction to outflow through both the deep and superficial systems. The Perthes' test is now of more historical than actual clinical importance.

Classification of CVI

Today, classification of diseases is a basic instrument for uniform diagnosis and meaningful communication about the disease. In chronic venous disorders (CVD) reliance for too long has been placed on the clinical appearance of the superficial effects of CVD, such as spider veins, varicose veins, swelling, skin changes, and ulcerations, without requiring accurate objective testing of the venous system to substantiate the diagnosis. This practice has caused errors of diagnosis and has been largely responsible for the poor correlation of results between treatment methods.

THE CREATION OF THE CEAP CLASSIFICATION

At the fifth annual meeting of the American Venous Forum (AVF) in 1993, John Porter suggested using the same approach as TNM for cancer to develop a classification system for venous diseases. Following a year of intense discussions a consensus conference was held at the sixth annual meeting of AVF in February 1994 on the island of Maui, Hawaii, at which an international adhoc committee, chaired by Andrew Nicolaides, and with representatives from Australia, Europe, as well as the United States, developed the first CEAP consensus document.(51) It contained two parts, a classification of CVD and a scoring system of the severity of CVD. The classification was based on clinical manifestations (C), etiologic factors (E), anatomic distribution of disease (A), and the underlying pathophysiologic findings (P), thus the name CEAP. The severity scoring system was based on three elements: the number of anatomic segments affected, grading of symptoms and signs, and disability. The CEAP consensus statement was published in 26 journals and books in nine languages, truly a universal document for CVD. It was endorsed by the Joint Councils of the SVS and the North American Chapter of the ISCVS, and its basic elements were incorporated into venous reporting standards.(52) Today most published clinical papers on CVD use all or portions of the CEAP classification.

REVISION OF CEAP

Diagnosis and treatment of CVD were developed rapidly in the 1990s and the need for an update of the classification logically followed. Now, it is important to stress that CEAP is a descriptive classification. Venous Severity Scoring (VSS) (53) was developed to allow longitudinal outcomes assessment, but it became apparent that CEAP itself required updating and modification. In April 2002, an adhoc committee on CEAP was appointed by AVF to review the classification and make recommendations for change by 2004; 10 years after its introduction. An International adhoc committee also was established to assure continued universal utilization (see Table 1.2). The two committees held four joint meetings in Hawaii, November 2002; Cancun, Mexico, February 2003; San Diego, August 2003; and Orlando, February 2004.The following passages summarize the results of these deliberations, by describing the new aspects of the revised CEAP.(54)The recommended changes, detailed next, include additions to or refinements of several definitions used in describing CVD, refinement of the C-classes of CEAP, addition of the descriptor n(no venous abnormality identified), incorporation of the date of classification and level of clinical investigation, and the description of basic CEAP, introduced as a simpler alternative to the full (advanced) CEAP classification.

Table 1.2 REVISION OF BASIC CEAP: SUMMARY

Clinical Classification

C0: No visible or palpable signs of venous disease
C1: Telangiectasia or reticular veins
C2: Varicose veins
C3: Edema
C4a: Pigmentation and/or eczema
C4b: Lipodermatosclerosis and/or atrophie blanche
C5: Healed venous ulcer
C6: Active venous ulcer
S: Symptoms including ache, pain, tightness, skin irritation, heaviness, muscle cramps, as well as other complaints attributable to venous dysfunction A: Asymptomatic

Etiologic Classification

Ec: Congenital
Ep: Primary
Es: Secondary (postthrombotic)
En: No venous etiology identified

Anatomic Classification

As: Superficial veins
Ap: Perforator veins
Ad: Deep veins
An: No venous location identified

Pathophysiologic Classification

Pr: Reflux
Po: Obstruction
Pr,o: Reflux and obstruction
Pn: No venous pathophysiology identifiable

Advanced CEAP

Same as basic, with the addition that any of 18 named venous segments can be utilized as locators for venous pathology.

Superficial veins

1. Telangiectasias/reticular veins
2. Great saphenous vein (GSV) above knee
3. GSV below knee
4. Small saphenous vein
5. Nonsaphenous veins

Deep veins

6. Inferior vena cava
7. Common iliac vein
8. Internal iliac vein
9. External iliac vein
10. Pelvic: gonadal, broad ligament veins, other
11. Common femoral vein
12. Deep femoral vein
13. Femoral vein
14. Popliteal vein
15. Crural: anterior tibial, posterior tibial, peroneal veins (all paired)
16. Muscular: gastrocnemial, soleal veins:

Perforating veins

17. Thigh
18. Calf

Revised venous clinical severity score (vcss)

In response to the need for a disease severity measurement, the American Venous Forum committee on outcomes assessment developed the Venous Severity Scoring system in 2000. There are three components of this scoring system, the Venous Disability Score, the Venous Segmental Disease Score, and the Venous Clinical Severity Score (VCSS). The VCSS was developed from elements of the CEAP classification (clinical grade, etiology, anatomy, pathophysiology), which is the worldwide standard for describing the clinical features of chronic venous disease. However, as a descriptive instrument, the CEAP classification responds poorly to change. The VCSS was subsequently developed as an evaluative instrument that would be responsive to changes in disease severity over time and in response to treatment. Based on initial experiences with the VCSS, an international adhoc working group of the American Venous Forum was charged with updating the instrument. This revision of the VCSS is focused on clarifying ambiguities, updating terminology, and simplifying application. The specific language of proven quality-of-life instruments was used to better address the issues of patients at the lower end of the venous disease spectrum. Periodic review and revision are necessary for generating more universal applicability and for comparing treatment outcomes in a meaningful way.(55)

Table 1.3 Venous clinical severity score

	None = 0	Mild= 1	Moderate = 2	Severe = 3
Pain Or other discomfort (ie, aching, heaviness, fatigue, soreness,burning) Presumes venous origin		Occasional pain or other discomfort (i.e. not restricting regular daily activities)	Daily pain or other discomfort(ie interfering with but not preventing regular daily activities)	Daily pain or discomfort (ie, limits most regular daily activities)
Varicose veins "Varicose" veins must be 3mm in diameter to qualify in the standing position		Few scattered and Also includes corona phlebectatica	Confined to calf or thigh	Involves calf and thigh
Venous edema Presumes venous origin		Limited to foot and ankle area	Extends above ankle but below knee	Extends to knee and above knee
Skin pigmentation Presumes venous origin Does not include focal pigmentation over varicose veins or pigmentation due to other chronic disease	None	Limited to peri malleolar region	Involves lower one third of calf	Wider distribution above lower third of calf
Inflammation More than just recent pigmentation(ie, Erythema, cellulitis, venous eczema, dermatitis)		Limited to peri malleolar region	Involves lower one third of calf	Wider distribution above lower third of calf
Induration Presumes venous origin of secondary skin and subcutaneous changes (i.e. chronic edema with fibrosis, hypodermitis). Includes white Atrophy and Lipodermatosclerosis		Limited to peri malleolar region	Involves lower one third of calf	Wider distribution above lower third of calf
Active ulcer number	0	1	2	3
Active ulcer duration	N/A	<3month	>3month but< 1yr	>1yr
Active ulcer size	N/A	<2cm	2-6cm	>6cm
Use of compression therapy	0 NO USE	Intermittent use	Use most of day	Fully complaint to stocking

DIAGNOSIS OF VENOUS OBSTRUCTION

HEMODYNAMIC TESTS

The largest obstacle to the diagnosis, treatment and assessment of outcome is the inability to adequately characterize the hemodynamic significance of a venous obstruction. Algorithms for evaluating patients with chronic venous insufficiency often completely omit tests for out flow obstruction. Unfortunately, there is no accepted "gold standard" for quantifying the hemodynamic significance of an obstructive lesion, and there currently is no reliable noninvasive study for preoperative evaluation. Duplex Doppler and plethysmography are helpful in the diagnosis of acute venous obstruction. However, ultrasound findings and outflow fractions obtained by air and strain gauge plethysmography are unreliable in chronic obstruction and play a limited role. Although abnormal plethysmographic findings may indicate out flow obstruction, significant blockage may be present with abnormal examination.(25)(56)(57) Unfortunately, many ultrasound departments do not routinely evaluate the iliac veins, and even if examined, adequate imaging of these segments is often limited by body habitus, depth, overlying bowel gas, and incompressibility of the retroperitoneal veins. Although visualization of at least one iliac vein segment has been reported in up to 79% of ultrasound studies, the common iliac vein was adequately imaged in only 47%.(58) Indirect findings in the common femoral vein, including continuous venous flow, absent respiratory variation and continuous flow with Valsalva, may suggest proximal obstruction but cannot exclude non occlusive thrombus or extrinsic compression.

Even invasive pressure measurements, such as the hand/foot pressure differential and pressure increase with reactive hyperemia, and indirect resistance calculations are insensitive and do not define the level of obstruction.(56) The venous circulation is a low-pressure, low velocity and large-volume vascular system compared with the high-pressure, high-velocity, and small-volume arterial system.

The venous pressure in such as system is a function not only of resistance to flow (degree of obstruction and collateral formation), but also depends to a higher degree on flow velocity and volume. Unfortunately, it is not known how much resting venous flow has to be increased to detect a hemodynamically significant stenosis and how to do it in are producible manner. This has important implications for the development of tests evaluating out flow obstruction. Pull through pressure differentials and pressure increases with exercise or hyperemia are much lower with venous than arterial obstructions.(59)(60)(61) Small pressure increases at rest may be associated with significant obstruction. Current definitions of significant venous pressure changes are largely arbitrary. Currently, supine pull-through gradients greater than 2 to 3 mm Hg at rest or a gradient exceeding 2 to 5mm of Hg in comparison with the contralateral femoral pressure are accepted as evidence of significant obstruction. The prevailing rule is that the femoral venous pressure increase with exercise should be at least 5 mm Hg to warrant intervention. However, it is difficult, especially during surgery, to increase venous outflow sufficiently to detect a hemodynamically relevant obstruction in the supine position. Many attempted to increase flow in the supine position by inducing hyperemia with ischemic cuff occlusion, ankle exercise, intra arterial papaverin injection and in the erect position by toe stands.(62)(63)None of these methods seems to be accurate. Although a positive test result may indicate hemodynamic significance, a normal test result does not exclude it. Thus, it is currently impossible to detect potentially important borderline obstructions.

Significant vascular obstructions often are defined as stenosis of greater than 70%to 80%, a concept derived from observations on the arterial system. However, these conclusions may not be applicable in the venous system because there are many fundamental differences. The effects of the venous obstruction are upstream (lack of emptying) rather than downstream (lack of perfusion). The signs and symptoms of venous obstruction, thus, are different. A proximal arterial stenosis does not become significant until it meets and exceeds the level of the high downstream peripheral resistance. In contrast, an iliac vein lesion must exceed only a low downstream resistance and may become significant at a substantially lesser degree of stenosis. The contralateral veins converge beyond an iliac vein stenosis, which may mitigate any pressure gradient at rest.(64) Furthermore, the geometrical form of an obstruction may change the pattern of blood flow. A slit like narrowing of the venous lumen, even with no alteration in cross-sectional area, may increase resistance to flow. This may explain why relatively minor degrees of compression may affect blood flow in the left iliac vein. Finally, the hemodynamic significance of an iliac vein stenosis may be influenced by the degree of collateralization. Venous collaterals can be considered either an indicator of significant obstruction or as a compensatory mechanism by passing and neutralizing the obstruction. The factors responsible for and mechanisms of collateral formation are unclear. However, arm or foot venous pressures may be abnormal despite impressive collateralization.(65) Thus, it is not known at what degree a venous stenosis should be considered hemodynamically "critical."

Recently S. Raju in his experimental model showed that Clinical features of iliac vein stenosis are related to peripheral venous hypertension. The interplay of the many factors (outflow stenosis, volume of inflow, Starling pressure, and atrial pressures) that influence peripheral venous pressure and hence the “criticality” of iliac venous stenosis are clarified using an experimental venous model. The beneficial effects of iliac vein stenting are related to peripheral venous decompression as detailed in duplex flow and plethysmographic studies in stented limbs. These insights may be useful in assessing individual patients with iliac vein stenosis for stent correction.(66)

MORPHOLOGIC INVESTIGATIONS

Since accurate hemodynamic tests are unavailable, diagnosis and treatment must be based on morphological findings.

VENOUS DOPPLER

Indirect findings in the common femoral vein, including continuous venous flow, absent respiratory variation, and continuous flow with Valsalva, may suggest proximal obstruction but cannot exclude non occlusive thrombus or extrinsic compression. Unfortunately, many ultrasound departments do not routinely evaluate the iliac veins, and even if examined, adequate imaging of these segments is often limited by body habitus, depth, overlying bowel gas, and incompressibility of the retroperitoneal veins. Although visualization of at least one iliac vein segment has been reported in up to 79% of ultrasound studies, the common iliac vein was adequately imaged in only 47%.(58)

TRANSFEMORAL VENOGRAM

Single-plane transfemoral venogram is the standard investigation and may show definite obstruction and development of collaterals. Although a defined lesion may be obvious, findings on the anterio-posterior (AP) view are often subtle and only suggestive of an underlying obstruction; for example, widening of the iliac vein (pancaking), thinning of the contrast dye resulting in a translucence of the area, partial intraluminal defect (septum), or a minimal filling of transpelvic collaterals. Increased accuracy may be achieved with multiple angled projections, which may reveal surprisingly tight stenosis on oblique projections, although the AP view is quite normal (Fig. 1.10 and 1.11).(67) The hemodynamic impact of this stenosis is not known from morphologic studies. As pointed out previously, the compensatory role of collateral formation is doubtful since blood flow through these meandering vessels hardly can replace the flow through the straighter main vein. The collaterals observed pre-stent often disappear promptly following stenting of a significant stenosis. The flow through the stent is obviously favored. The presence of collaterals in a symptomatic patient perhaps should be considered an indicator of obstruction. Compared with IVUS venography has sensitivity of 66%.(68)

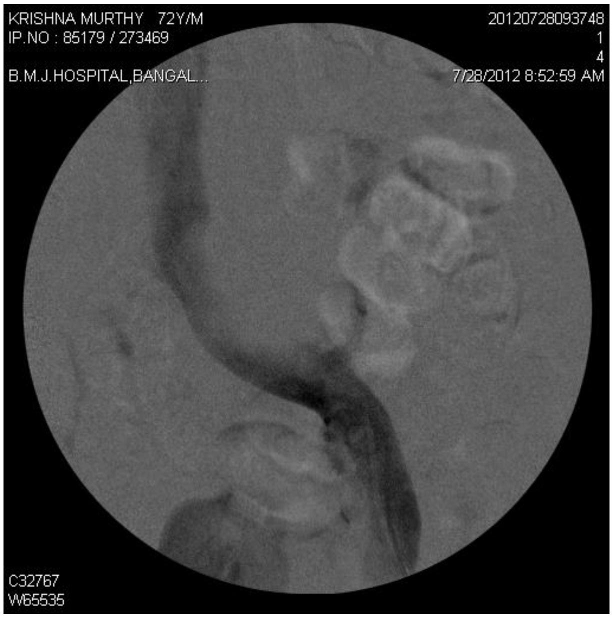


Figure 1.10 Venogram AP view.

Figure 1.11 venogram lateral view.

Computed tomographic venography

CTV has been proven to be adequate at depicting thrombosis, both in the pulmonary arteries and the deep veins.(69) The biggest challenge with CTV is sufficient and homogeneous opacification of all the lower extremity veins. A few investigators have looked at the potential for CTV in

CVD. Most extensively investigated has been the prevalence of left common iliac vein (LCIV) compression by the right common iliac artery (RCIA), referred to either as May– Thurner syndrome or Cockett's syndrome. (4) (70) In a few cases other causes of LCIV compression, for example by the left common iliac artery, arterial aneurysms (on both the common and internal iliac vein) or other masses have been described.(71) Furthermore a 3D anatomical assessment of the lower extremity, showing the increase in mass due to oedema or retroperitoneal fibrosis has been described.(72) Other authors focused on imaging the IVC. Gayer et al. (73)described a method to define the collaterals depicted with CTV by tracking the veins to their destination and recognized typical patterns of collateralization as well. Murphy et al. described that it is important to acquire a 3D image of the deep veins or, when using a two dimensional (2D) technique, multiple projection planes. In particular larger diameter veins can suggest a patent volume or lumen on a single 2D projection, where a second 2D projection in another plane (preferably perpendicular to the first) clearly shows a compromised lumen.(74) Clinical relevance of the assessment of isolated obstruction of the (left) common iliac vein has been debated due to the prevalence in asymptomatic people. However, other authors clearly showed a relation between extensive iliofemoral deep vein thrombosis (DVT) and the severity of iliac vein stenosis or obstruction. (75) (70) Jeon et al.(75) divided patients with LCIV-obstruction into three groups based on imaging findings: focal compression, atrophy and complete obliteration. In their experience these groups are reproducible and identifiable, however the true question remains: what degree of obstruction validates treatment, preferably with endovascular recanalization and stenting. In the light of patient selection for treatment of stenosis or occlusion of the IVC and/or iliac veins identification of a significant versus non-significant stenosis is crucial.

Magnetic resonance venography

MRV was investigated first in the 1990s and there have been only limited follow-up studies on the initial results. Magnetic resonance imaging (MRI) does not use ionizing radiation or iodine contrast, which is an advantage over CT. The gadolinium based contrast agents used in MR Angiography are rarely associated with complications. There are however contraindications. Due to the requirements of the magnetic field used for MR imaging, patients have to be positioned in a narrow tube, which can be a claustrophobic experience. Furthermore, patients with (suspected) metallic fragments, clips or devices in the brain, eye or spinal canal need to be screened to make sure it is safe to undergo a MRI scan. As with CTV and duplex, most MRV research has been centered on DVT. With regard to CVD, May– Thurner syndrome and pelvic congestion syndrome have been investigated by various groups.(76) (36) (77) In 1993 prospective trial, Evans and associates(78) found no statistically significant difference between MRI and venography for the diagnosis of pelvic, thigh, or calf DVTs. Magnetic resonance imaging was 100% sensitive for the diagnosis of pelvic and thigh DVTs and 87% sensitive for the determination of calf DVTs. The specificity was 95%, 100%, and 97%, respectively. In a small study by Laissy and co-workers, a comparison between magnetic resonance venography and duplex sonography resulted in a difference of 13% in sensitivity (MRV 100% sensitive vs. 87% for duplex sonography) and a 17% difference in specificity (MRV 100% specific vs. 83% for duplex sonography).(79) Studies by Ruehm, Pfeil, Asciuto and Fraser (36)(76) (80)(81) have shown that high-quality imaging of the venous system with MRI, from the calf up to the IVC, is feasible and reproducible with a number of different imaging protocols. Their findings implicate that MR imaging of the veins results in accurate visualization of the venous anatomy, comparable to conventional venograms. Asciuto (76) showed that pelvic varicosities could be displayed as accurate with MR as with phlebography and in their opinion, in particular gadolinium-enhanced MRV with a bloodpool contrast agent seems to be the examination of choice due to the high intravascular enhancement and acquisition of isotropic voxels with a high spatial resolution allowing for evaluation of subtle changes. Furthermore, 3D volumetric imaging is to be preferred over MR direct thrombus imaging or time-of-flight subtraction angiography, since the soft tissue surrounding the veins needs to be visible to identify causes of stenosis/occlusion. (82)(80)Evaluation of compression of the left common iliac vein by the RCIA can also be appraised. (82)(36)The sequelae of prior DVT events include partial filling defects, trabeculation or webs, vessel narrowing, thickened vessel walls and the development of a collateral circulation (see fig 1.12 A, B and C). All these changes can be depicted with MRV, although large studies confirming these observations are still lacking, the data available looks promising (82)(81)(83)(Table 1.4).

Table 1.4 Image findings in CVD and ability of CTV and MRV to visualize them

Image finding	**CTV**	**MRV**	**Comments**
Stenosis	can visualize	can visualize	
Occlusion	can vizualize	can visualize	
Atresia	can vizualize	can visualize	
Collaterals	can vizualize	can visualize	
Webs/spurs/trabeculations	cannot visualize	can visualize	
Vein wall thickening	cannot visualize	can visualize	With CT instent hyperplasia can be seen

INTRAVASCULAR ULTRASOUND (IVUS)

IVUS can detect only axial collaterals running close to the original vessel. Transpelvic collaterals will escape detection. Several studies have shown, however, that IVUS is superior to the single-plane venography in detection of the extent and morphologic degree of stenosis· (49)(84)(85)(86)IVUS shows intraluminal details (e.g., trabeculations and webs) that may be hidden in the injected contrast dye (Fig. 1.14 and 1.13). An external compression with the resulting deformity of the venous lumen can be directly visualized, and wall thickness, neointimal hyperplasia, and movement can be seen. Most importantly, IVUS appears superior to standard single-plane venography for estimating the morphological degree of iliac vein stenosis. On average, the transfemoral venogram significantly underestimated the degree of stenosis by 30%. The venogram actually was considered normal in one-fourth of limbs despite the fact that IVUS showed >50% obstruction.(87) Interestingly, Cockett and colleagues made similar observations. Venography was diagnostic in only 65% of obstructed limbs in their material, and collaterals were visualized only in 63%. It was noted that in 54% of symptomatic patients, transfemoral venography appeared normal with smooth contours of contrast in the iliac vein and without collaterals. The authors noted that absence of collateral formation should not negate consideration of the pathology.(26)(37)(17) IVUS is clearly superior (with sensitivity of > 95%) to single-plane venography in providing adequate morphological information and is presently the best available method for diagnosing clinically significant chronic iliac vein obstruction.

Fig 1.12 A Magnetic resonance venography 3D reconstruction

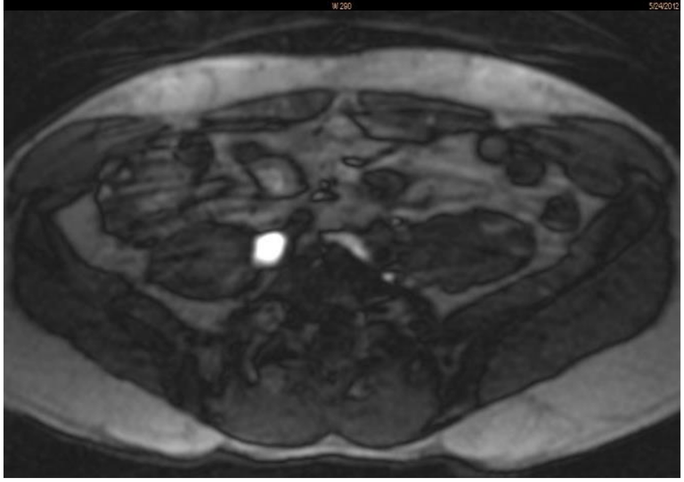


Fig 1.12 B Magnetic resonance venography with negative window showing compressed LCIV

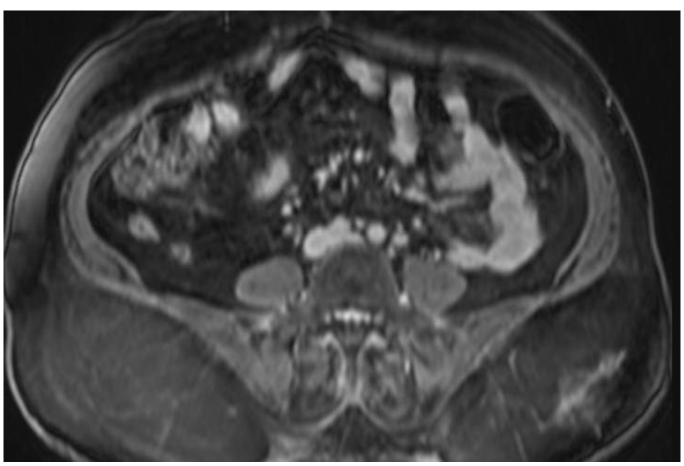


Fig 1.12 C Magnetic resonance venography cross section showing RCIA compressing LCIV

Fig 1.13 Transfemoral venogram and IVUS image of a focal stenosis of the left iliac vein (arrow). The 45º and 60º oblique films delineate the stenosis better than the AP view. The IVUS image is conclusive. The adjacent artery is marked with an arrow. The black circle within the vein is the IVUS catheter

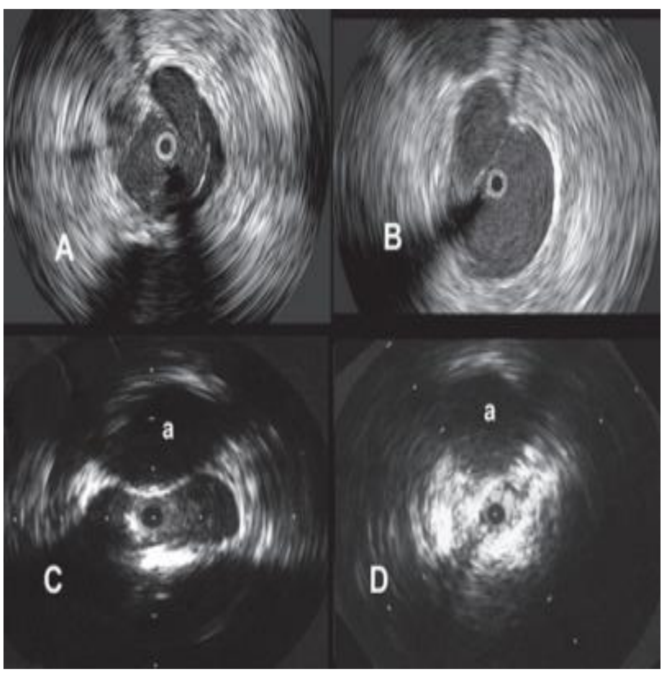


Fig 1.14 Images obtained by venous intravascular ultrasound (IVUS). A. Trabeculation with multiple lumina. B. Intraluminal septa. C. Moderate compression by the artery of a thin-walled vein. D. Severely compressed vein with sclerotic thick wall. The black circle inside the vein represents the inserted IVUS catheter and the a marks the artery

Treatment of Iliac Venous Obstruction in Chronic Venous Disease

Until a decade ago open venous bypass surgery was the only available intervention. It was unattractive for several reasons and restricted to a minority of patients with severe disabling symptoms. The introduction of endovascular treatment with percutaneous stenting drastically changed the treatment and view on venous outflow obstruction. Iliac venous stenting has already largely replaced surgery as the "method of choice" for treatment of venous blockage.

OPEN SURGICAL RECONSTRUCTION

Open surgical bypasses can be performed to alleviate severe venous outflow obstruction. The operations most frequently used are femoro-femoral crossover or unilateral ilio-caval bypass for proximal iliofemoral vein occlusion. Reconstruction with sapheno-popliteal bypass for distal femoro-popliteal obstruction is today of historical note only. Right iliac artery transposition and iliac vein patch angioplasty have been used in selected patients with focal iliac vein compression syndrome, but are now abandoned.(21) The open operation constitutes major surgery and to keep it patent it often is combined with temporary or permanent arteriovenous fistula and life-long anticoagulation with inherent risk of complications. Strict criteria for surgery, including severe disabling symptoms and markedly increased venous pressure levels, are used and only in minority of patients with chronic venous disease (CVD) are selected. The outcome of open surgery has not been so convincing as to make a major impact on the routine treatment outflow obstruction and has been limited to a selective group of patients with the most severe clinical condition. The results following open reconstructions usually are presented in series with small numbers of treated limbs and rarely are cumulative patency and success rates given. The general problem with bypass grafting is relatively poor long-term patency. The reasons for this are several. The grafts tend to clot because the area of insertion has low velocity flow, external compression of the low pressure bypass may occur, non saphenous graft material is inherently thrombogenetic, and the distal inflow is often poor due to extensive distal disease. The saphenous vein must be unaffected by any disease in order to be utilized. Inadequate size, phlebitic obstruction, or valve incompetence are factors often precluding the use of the autogenous vein. Best result with inline bypasses has been achieved with large-diameter PTFE graft (10 mm) with external support (ringed), adjunct use of an arteriovenous fistulae, and meticulous perioperative anticoagulation.(88)(89) The arteriovenous fistula is left in place and anticoagulation continued as long as no side effects occur and the bypass stays patent. Lifelong anticoagulation is usually necessary to keep the bypass open. If the graft suddenly occludes with a functioning fistula, symptoms of pain and swelling are accentuated and the fistula has to be disconnected.

THE CROSS-OVER BYPASS

The cross-over bypass can be constructed either by using the contralateral saphenous vein or a prosthetic graft. The donor vein is exposed and then rotated at the saphenofemoral junction to cross to the other side (classic Palma technique (90)) or used as a free femoro-femoral graft. This free saphenous graft appears to do better than rotation of the vein avoiding kinking at the saphenofemoral junction.(91)The autogenous cross-femoral venous bypass appears to be less thrombogenetic with better cumulative patency rate than prosthetic grafts (at 2 years, 83% and 54%, respectively).(92) The cross-over reconstruction has been reported to be durable with good symptom relief, so called "clinical" and venographic patency ranging from 44 to 100% with a follow-up of five years.(93)(94)(91)(95)(96)(92) Most series have small numbers of patients with inconsistent clinical and venographic follow-up (see Tables 1.5 and 1.6). Halliday et al.

performed the only cumulative analysis existing showing a 75% cumulative venographic patency rate at five years.(97) This excellent result has not been reproduced elsewhere. Clinical improvement is unfortunately not necessarily related to graft patency. Superior results are achieved if the inflow channel is normal. Despite remaining patent the saphenous grafts may give poor symptom relief owing to its small cross-cut area and relatively large resistance to flow. It has been shown that at least a 4.0 mm diameter vein is necessary to adequately relieve the iliac vein outflow obstruction. (98)This is the reason for recommended size of a 10 mm PTFE graft for femoral cross-over bypass as an alternative to the absence or an inadequate size of the saphenous vein.

Table 1.15 Results of Saphenous Vein Femoro-Femoral Bypass

Author	No. limbs	Duration of follow up months	Clinical success %	Patency %
Husni(99)	78	7-144	74	73
Hutschenreiter et al. (100)	20	6-28	69	44
O'Donnell etal(96)	6	24	100	100
Halliday etal(97)	47	60	89	75
AbuRahma etal (93)	24	66	88	75

Table 1.6 Results of Prosthetic Femoro-Femoral Bypass

Author	No. limbs	Duration of follow up months	Clinical success %	Patency %
Eklof et al.(88)	7	2-31	86	17
Yamamoto et al.(95)	5	1-18	60	60
Comerota et al.(94)	3	40-60	67	67
Gruss and Hiemer (101)	32		85	85

THE IN-LINE BYPASS

Anatomic in-line bypass reconstruction can be used in the femoro-ilio-caval axial outflow axis with segmental obstruction in the presence of a sufficient venous in- and outflow of the graft. Most frequently a PTFE-graft is used, but spiral saphenous graft may also be used, if available. As with cross-over bypasses, the in-line reconstructions, especially when starting in the groins, are constructed with a concomitant arteriovenous fistula, and lifelong anticoagulation is usually necessary for patency. Patency rates during follow-up from 1 to 150 months vary from 29 to 100%(seeTable 60.3). (102)(103)(104)(105)(106)(107)(108) The only cumulative study by Jost et al. shows a secondary patency rate of 54% at two years for prosthetic in-line bypass.(92) This should be compared to 83% for saphenous vein femoro-femoral cross-over bypass in the same study. Early patency for caval reconstruction with excision of the cava and interposition graft for malignant disease is better than in-line bypasses for postthrombotic obstruction.(109)

Table 1.7 Results of IN-LINE BYPASS

Author	No. limbs	Duration of follow up months	Clinical success %	Patency %
Husfeldt et al(105)	4	4-30	100	100
Dale et al(103)	3	1-30	100	100
Ijima et al(106)	5	22-36	60	60
Eklof et al(88)	7	2-31	86	29
Plate et al(108)	3	1-11	67	33
Okadome et al (107)	4	17-48	100	100
Gloviczki etal(104)	12	1-60	67	58
Alimi et al(102)	8	10-45	88	88
Jost et al(92)	13	1-150	49	54

STENTING OF THE ILIO-FEMORAL VEIN

Venous stenting has been used to successfully treat iliac vein obstruction of various etiologies such as postthrombotic occlusion, iliac vein compression syndrome, and malignant obstruction. The complication rate related to the endovascular intervention is minimal and comprises mostly cannulation site hematoma. A minimal number of acquired arteriovenous fistulas when the cannulation site is distal on the thigh have been observed, and a few cases of retroperitoneal hematoma requiring blood transfusions have been described.(25)(85) The utilization of ultrasound guided cannulation and closure of the cannulation site with collagen plugs largely have abolished these problems. The mortality has been nil. Studies of venous stenting in peer review publications have often similar shortcomings as reports for open surgery. Most studies are case reports and few are sizable; the follow up is short-term, and patency not reported in cumulative fashion, stented sites in the upper and lower extremities are mixed, and the majority of the reports' series have not differentiated between etiologies or in management of acute and chronic conditions. An unveiled proximal chronic obstruction of the iliac vein following thrombectomy or lysis is known to decrease future patency if not treated. Stenting of the stenosis after clot removal will improve iliofemoral patency from 27 to 44%, to 86 to 93%.(67)(110)(111) It appears that the patency rates after stent placement following immediate removal of acute thrombosis and in treatment of chronic postthrombotic disease are similar. It also has been shown that limbs treated with ilio-caval stent placement after lysis of acute deep vein thrombosis have a greater one-year patency as compared to limbs undergoing only balloon angioplasty (74 and 53%, respectively).(112) Successful stenting of malignant lesions are gratifying since relief of symptoms is immediate. The long-term outcome appears to depend largely upon the progress of the tumor rather than stent properties per se.

STENT PATENCY OF MIXED ETIOLOGY GROUPS

There are several smaller studies of iliofemoral stenting for mixed patient groups of different etiology and with or without adjuvant surgical thrombectomy or lytic clot removal. Most results are not analyzed cumulatively a.m. Kaplan-Meier. These studies are summarized in Table 1.8. Nazarian et al. found in such a mixed-etiology group of patients that only a few occlusions occurred after six months and that the patency rate remained the same at one and four-year follow-up.30 Lamont et al. presented cumulative result. After stent insertion in 15 limbs (9 following acute DVT removal), a cumulative secondary patency rate of 87% at 41 months as measured by duplex ultrasound was achieved.(113)

STENTING OF CHRONIC NONMALIGNANT OBSTRUCTION

A few studies describe stenting of nonmalignant chronic obstruction with no adjuvant therapy in patients with chronic venous disease. Blättler and Blättler reported in 1999 treatment of chronic venous and neurogenic claudication due to pelvic venous blockage and achieved 100% patency in 11 successfully stented limbs with a mean follow-up of 15 months (range 1–43 months).(114) A group of 18 patients were reported by Hurst et al. (25) twelve limbs were treated for chronic obstruction. The primary patency rates at 12 and 18 months were 79% and 79%, respectively. Hartung et al. has reported the result after stenting of 44 patients with chronic disabling ilio-caval obstruction. Cumulative primary, assisted-primary, and secondary patency rates were 73, 88, and 90% at 36 months.(45)

Several reports have been published by author describing results after stenting of pelvic and caval veins in patients with chronic nonmalignant occlusions without any pretreatment of acute deep vein thrombosis.(115)(12)(85)(116)(117) Cumulative patency rates based on venographic findings as defined by reporting standards of SVS/ISCVS,(52) frequency of in-stent recurrent stenosis, clinical results assessing pain, swelling and ulcer healing, and limited quality-of-life data are available. The obstructive lesion in these reports was considered post-thrombotic when the patient had a known history of DVT or when post-thrombotic changes was found on venography or ultrasound at any level of the lower extremity. The remaining limbs were considered nonthrombotic (primary). No obstructions due to malignancy were included.

The published material (115)(118)(85) recently has been updated and the most recent results are given here. There is no alteration of the basic material but merely a longer follow-up. The results appear to be remarkably stable even with longer follow-up. One or several transfemoral venograms were performed after treatment in 565/789 limbs, which underwent iliac vein stenting between 1997 and 2004. Cumulative primary, assisted-primary and secondary patency rates at five years were 75, 94, and 96%, respectively. The stented limbs with nonthrombotic disease appeared to fare significantly better than did those with thrombotic disease (primary, assisted-primary, and secondary cumulative patency rates of 94, 100, and 100%, and 60, 88, and 91% at 36 months, respectively). The lowest patency rates were seen in 35 patients with long occlusions, which had to be bluntly recanalized and sequentially dilated before stenting was possible (primary and secondary patency rates at 48 months, 58 and 71%, respectively).

Although some degree of in-stent recurrent stenosis (ISR) is common (only 23% were completely free of any stenosis at 42 months)(118) severe in-stent recurrent stenosis, that is, >50% diameter decrease on single plane anterior-posterior venogram, is infrequent (only 13–14% present in 36–48 months).(118) (119)Several factors, which may potentially influence the development of ISR, were analyzed. Gender and sidedness of limb involvement did not affect outcome. Cumulative higher rates of severe IRS occurred with treatment of thrombotic than in nonthrombotic limbs (24 and 1%, respectively) at 48 months, and in the presence of thrombophilia (18 and 12%, respectively). The data concerning the length of stented area and extension of stent system to below the inguinal ligament appear intimately connected. Length of stented area 13–35 cm and extension of stent to below the inguinal ligament had a cumulative rate of severe ISR of 25% at 36 months and 40% at 24 months, respectively.

CLINICAL OUTCOME AFTER STENTING

The reports referred to earlier describing patency rates indicate clinical improvement in most patients (>80%). (114)(13) Hurst et al. showed resolution or substantial improvement in 72% of limbs.(25) However, five remaining patients continued to have pain despite resolved swelling and widely patent stents on venogram. In addition to assessment of ulcer healing, Raju and Neglén have evaluated pain, swelling, and quality-of-life. Median follow-up 789/993 limbs in the updated material was 11 months (range: 1–88 months). The degree of swelling was assessed by physical examination (Grade 0: none; Grade 1: pitting, not obvious; Grade 2: ankle edema; Grade 3: obvious swelling involving the limb), the level of pain was measured by the visual analogue scale method and quality-of-life by a questionnaire, validated for assessment of chronic venous insufficiency. The incidence of ulcer healing after iliac vein balloon dilation and stent placement in 41 limbs with active ulcer was 68% and the cumulative ulcer recurrence-free rate at two years was 62%.44 The updated data show a cumulative freedom of ulcer recurrence of 60% at four years in 96 stented ulcerated limbs. During the observation period no additional surgery was performed to treat any concomitant reflux.

Median swelling and pain severity scores decreased significantly (grade 2 to 1 and 4 to 0, respectively). The frequency of limbs with any swelling decreased significantly from 82 to 48% and limbs with any pain fell from 78 to 21% (updated result). The improvement of pain and swelling was significant in both ulcerated and non ulcerated limbs, indicating that the ulcer was not the only cause of pain and swelling. The cumulative rate of maintained relief of pain and swelling in patients who achieved complete pain and swelling relief after stenting was better in regard to pain as compared to swelling at 4.5 years (70% and 36%, respectively) (Figure 60.8). Using a quality-of-life questionnaire assessing subjective pain, sleep disturbance, morale and social activities, routine and strenuous physical activities, the patients indicated significant improvement in all major categories after venous stenting.(117) Hartung et al. have shown a significant improvement of median venous clinical severity score (VCSS) and venous disability score (VDS) after stenting (8.5 [range: 4–18] and 2 [range: 0–9], present vs. 2 [range: 2–3] and 0 [range: 0–2] post stent, respectively).(119) The clinical outcome is favorable in the intermediate to long term. The results clearly indicate significant symptom relief after balloon angioplasty and stent placement to treat iliac venous outflow obstruction.

TABLE 1.8 Results of iliac vein stenting

Author	No. interventions	Duration of follow up months	Primary patency %	Secondary Patency %
Nazarian et al., 1996 (120)	56	4 years	50	73
O’Sullivan et al., 2000 (13)	34	1yr	79	N/A
Patel et al., 2000(121)	10	6-36 months	60	100
Hurst et al., 2001 (25)	18	1.5 yr	79	N/A
Juhan et al., 2001(67)	15	5-25 months	87	93
Lamont et al., 2002(113)	15	14 months	N/A	87
Schwarzbach etal (122)	20	0.5-77	80	90
Hartung et al(119)	44	27	73	90
Lin et al(123)	98	12	68	N/A
Hartung et al(119)	29	63	79	86
Neglen et al(124)	141	12	61	98
Alhadad et al(125)	114	6.2	84	N/A

Methodology

Present study is a prospective, non-randomized and single centre study conducted at Jain Institute of vascular science, Bhagwan Mahaveer Jain hospital, Bangalore. The primary objective of study was to find prevalence of ICVO in patients with C4, C5 and C6 disease. 422 patients suffering fromC4, C5 and C6 disease were advised MR venography but only 60 patients underwent it. Majority of patients refused MRV because of personal financial problem and others were comfortable to continue compression stockings and return at later date for MRV. 60 patients involving 69 limbs with advance chronic venous disease, during March 2012 to May 2014 meeting the following inclusion criteria were included in the study. Power calculation were done using Egret sample size module V2.0.3 (statistics and epidemiology research copy, Seattle Wash; Cyttel software corporation, Cambridge, USA). Analysis of available clinical data on population worldwide suffering from CVI class 4, 5 and 6 which gave a minimum sample of 60 patients with 80% power of study.(126)

<u>Inclusion criteria</u>

- C4a: Pigmentation and/or eczema
- C4b: Lipodermatosclerosis and/or atrophie blanche
- C5 : Healed ulcer
- C6 : Active ulcer
- AGE : 18yr-90yr
- Limbs : right, left and bilateral
- Both primary and secondary varicose vein with C4, C5 and C6 stage were included.

Exclusion criteria

- C1 : Telangiectasia/Reticular veins.
- C2 : Varicose Veins.
- C3 : Edema.
- Any pelvic mass causing extrinsic compression on IVC or iliac veins.
- Pregnancy.
- Diabetic with Chronic kidney disease.
- Patients refusing MRV
- Patients with metallic implants.

All patients who presented to either our inpatient or outpatient department and satisfying above mentioned inclusion and exclusion criteria were evaluated with detail history, physical examination and venous duplex. Then patient underwent contrast enhanced MR venography at Clumax diagnostic centre Bangalore. Patient information, including age, gender, medical co-morbidity, ulcer location, etiology, duration, size, and type of treatment were collected and maintained in a proforma sheet. For patients with bilateral disease, each limb was entered into the database and considered separately in all statistical evaluations.

Statistical methods

Accumulated data are expressed as means SD. Patient demographics and risk factors were compared to the presence of chronic ilio-caval venous obstruction (ICVO) generally be described as a blockage of the outflow of venous blood from the lower extremity. Statistical analysis was performed using SPSS version 12 (SAS Institute Inc, Cary, NC). The dependent variable for these analyses was the presence or absence of iliac stenosis.

RESULTS AND ANALYSIS

Total no of patients were n = 60 with 69 limbs

Mean age of presentation was 50yrs (range=25-81 yrs)

Male and female ratio was 49/11= 4.5

Side

SIDE	No. (%) n=66
Right	15 (25)
Left	36 (60)
Bilateral	9 (15)

FIGURE 5.1 sides commonly affected

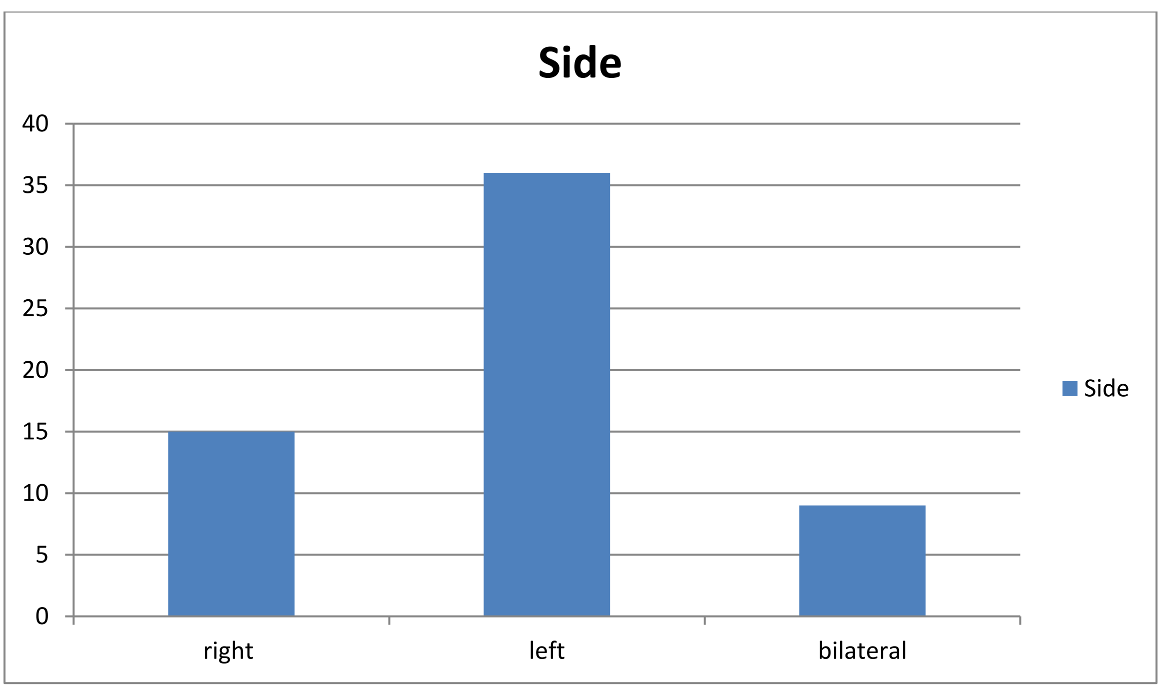
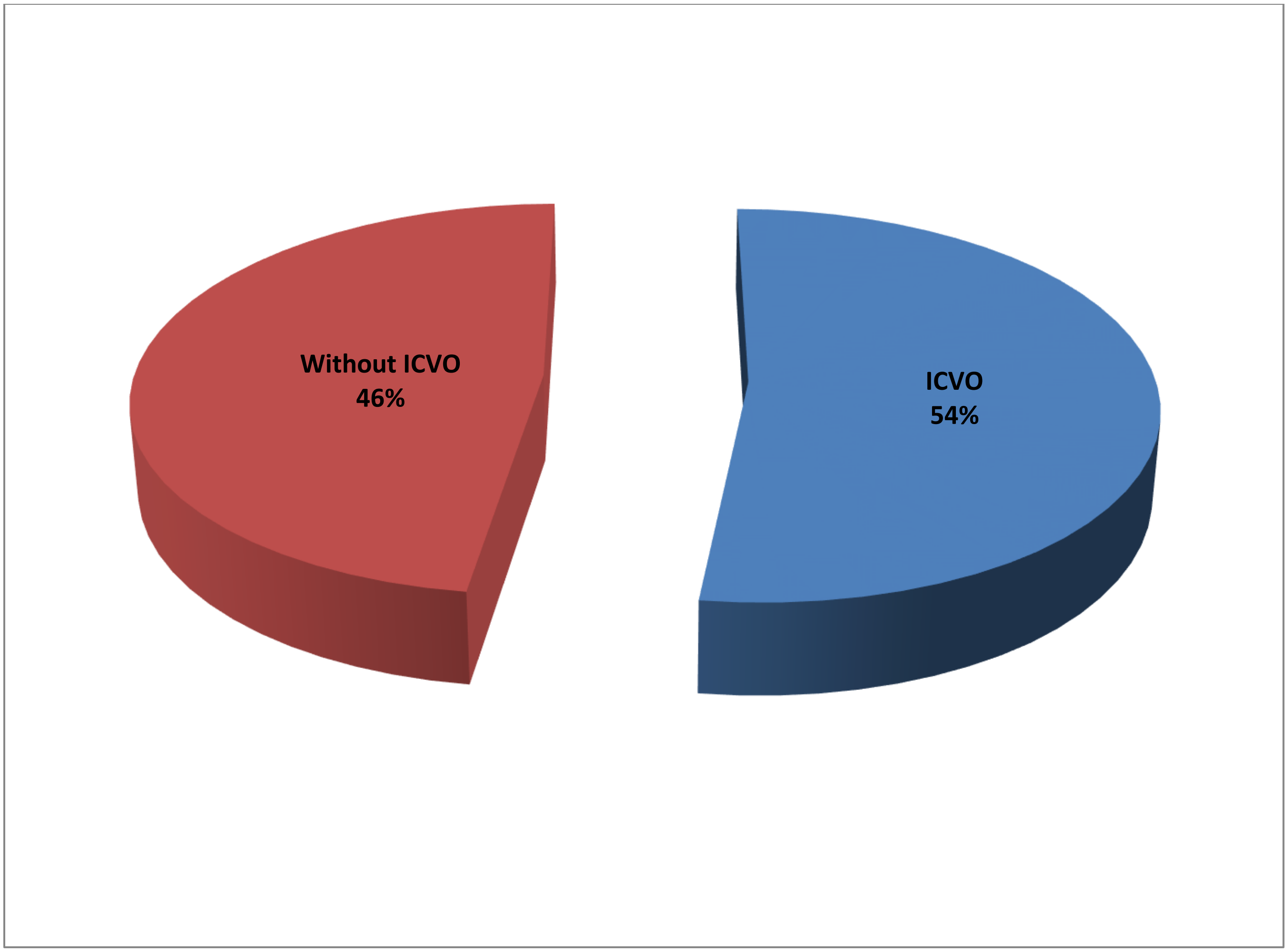
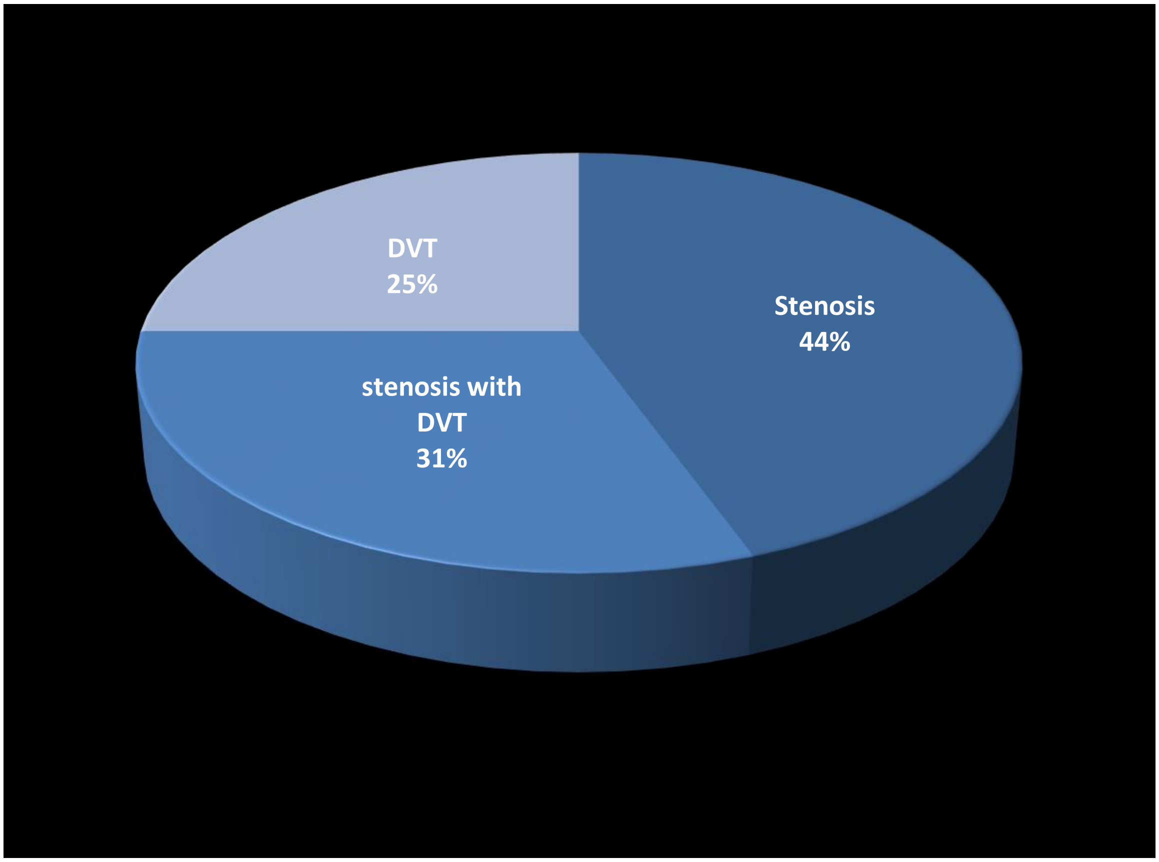


Fig 5.2 Distribution of patients with and without ICVO



Of 69 limbs 36 limbs (52%) were positive for proximal ilio-caval obstruction and 33 limbs (48%) were negative on MR venogram.

Figure 5.3 Etiology of CVI on MRV



Of 36 limbs with ICVO 16(44%) limbs had only stenosis or external compression, 9 (25%) had DVT only and 11(31%) had stenosis and DVT on MRV.

Figure 5.4 Age distribution of patients with and without ICVO

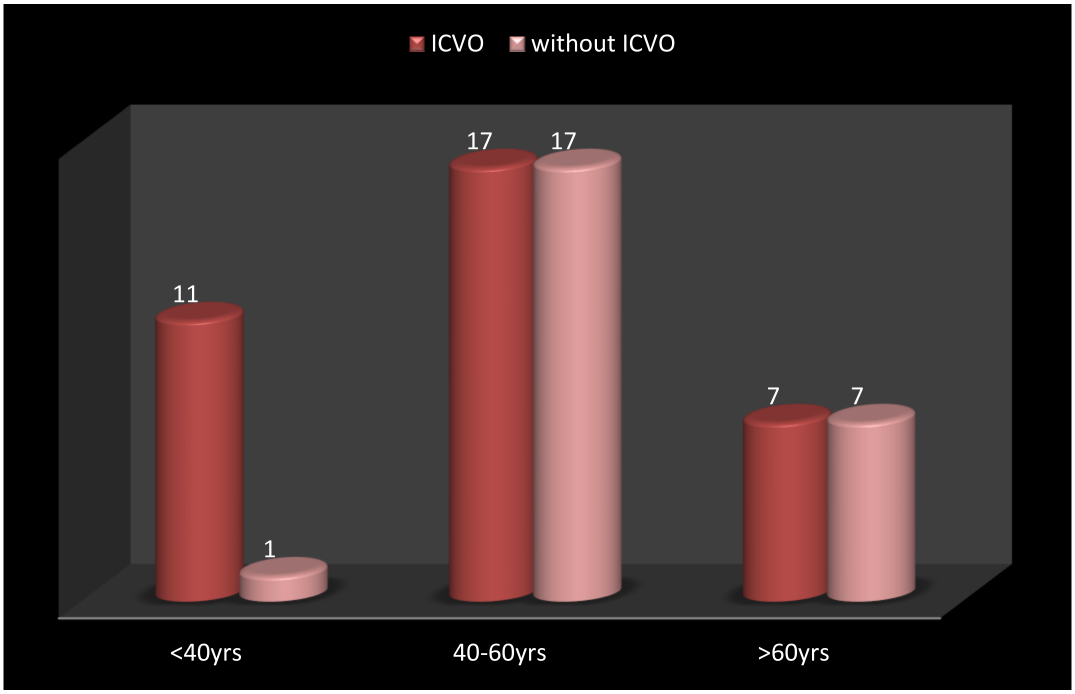


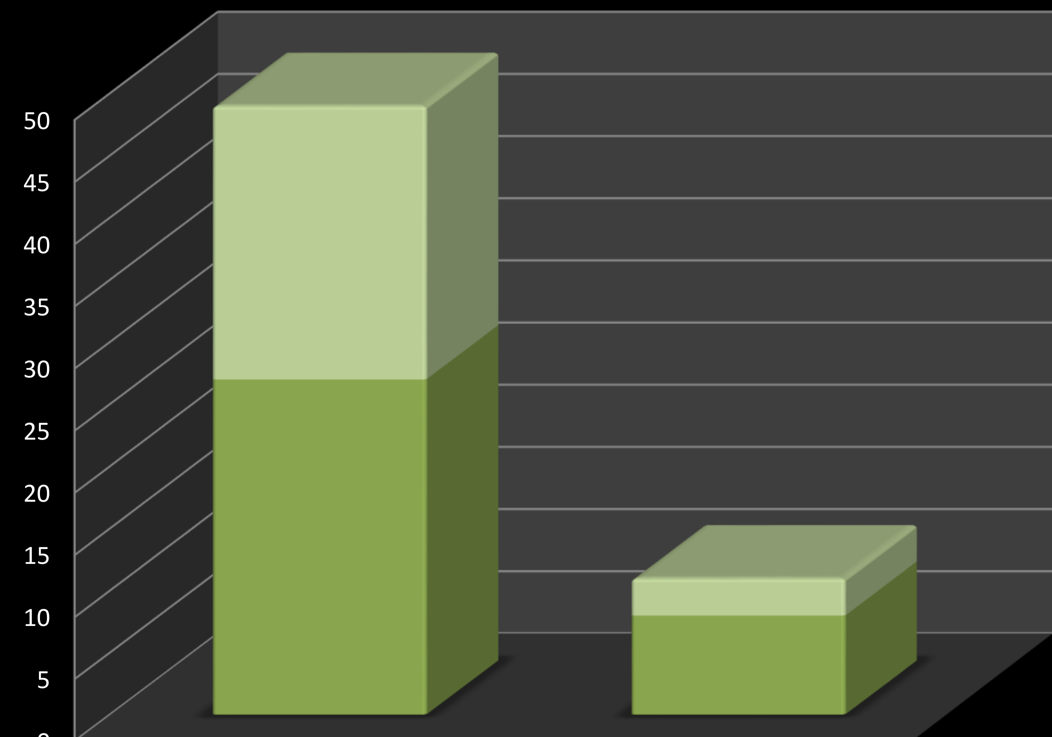
Table 5.1

	ICVO	Without ICVO
MEAN(M)	**46.89**	**54.08**
Standard deviation (SD)	14.00	10.21
Standard error of mean(SEM)	2.37	2.04
Total number (N)	35	25

The two-tailed P value equals 0.0329.

By conventional criteria, this difference is considered to be statistically significant.

Figure 5.5 Gender difference



	Male	Female
Without ICVO	22	3
ICVO	27	8

Fisher's exact test

The two-tailed P value equals 0.3324

The association between rows (groups) and columns (outcomes) is considered to be not statistically significant.

Figure 5.6 Side distribution

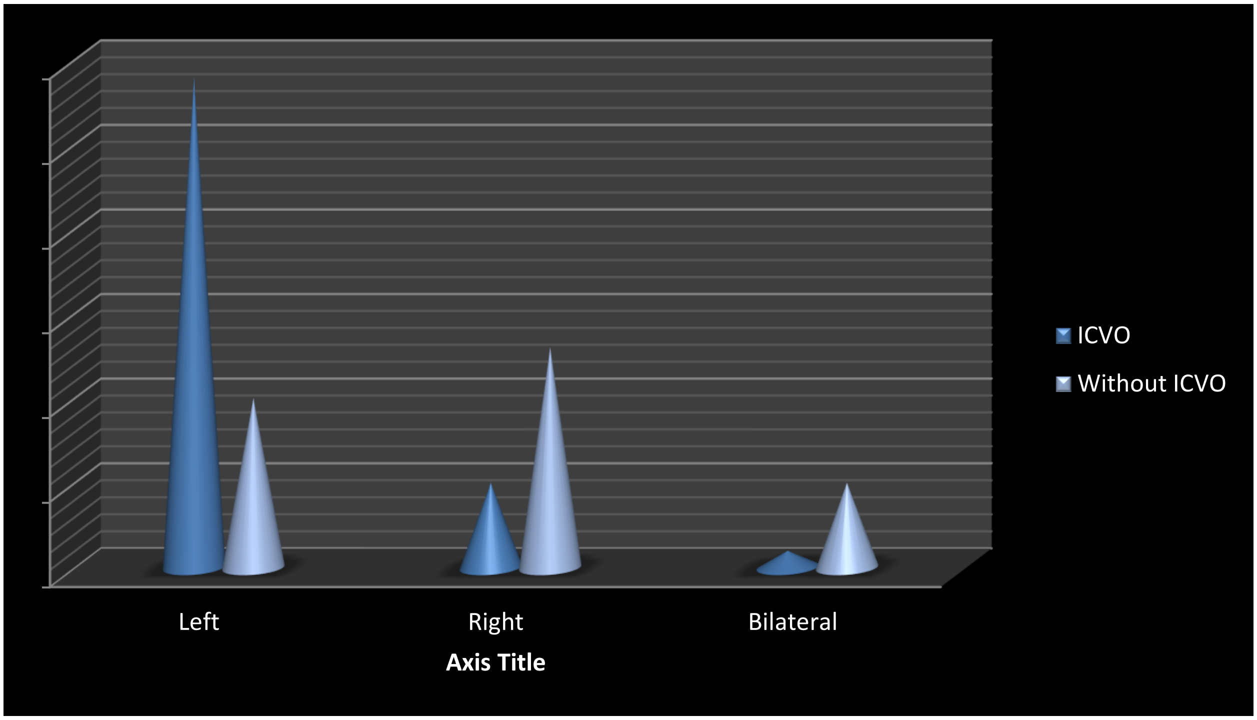


Table 5.2 Side distribution

	ICVO (%) n=36	Without ICVO (%) N=33	P value
Left	29 (81)	10 (30)	0.013
Right	5 (14)	13 (40)	
Bilateral	1 (5)	5 (30)	

Chi-square with Yates correction

Chi squared equals 6.159 with 1degrees of freedom. The two-tailed P value equals 0.0131

The association between rows (groups) and columns (outcomes) is considered to be statistically significant.

Table 5.3 Demographics

Variables	ICVO n=36 (%)	Without ICVO n=33 (%)	P value Fishers test
Pain	26 (72)	20 (60)	0.32
discomfort	30 (83)	21 (63)	0.099
swelling	31(86)	22(67)	0.09
dilated veins	12 (33)	16 (48)	0.23
ULCER	22 (61)	16 (48)	0.33
Skin pigmentation	35(97)	30 (90)	0.32
bleeding	0	4 (12)	0.05
itching	15 (41)	7 (21)	0.08
Diabetes	3(8)	3(9)	1
HTN	4 (11)	6 (18)	0.5
use of stocking	24 (67)	16 (49)	0.14
previous surgery/endovenous ablation on superficial veins	**13 (36)**	**2 (6)**	**0.003**

There was no significant difference between Symptomatology and co-morbid condition between these two groups. However recurrence after superficial venous surgery or endovenous ablation was significantly (P value= 0.003) more in patients with ICVO.

Figure 5.7 Clinical class of CEAP

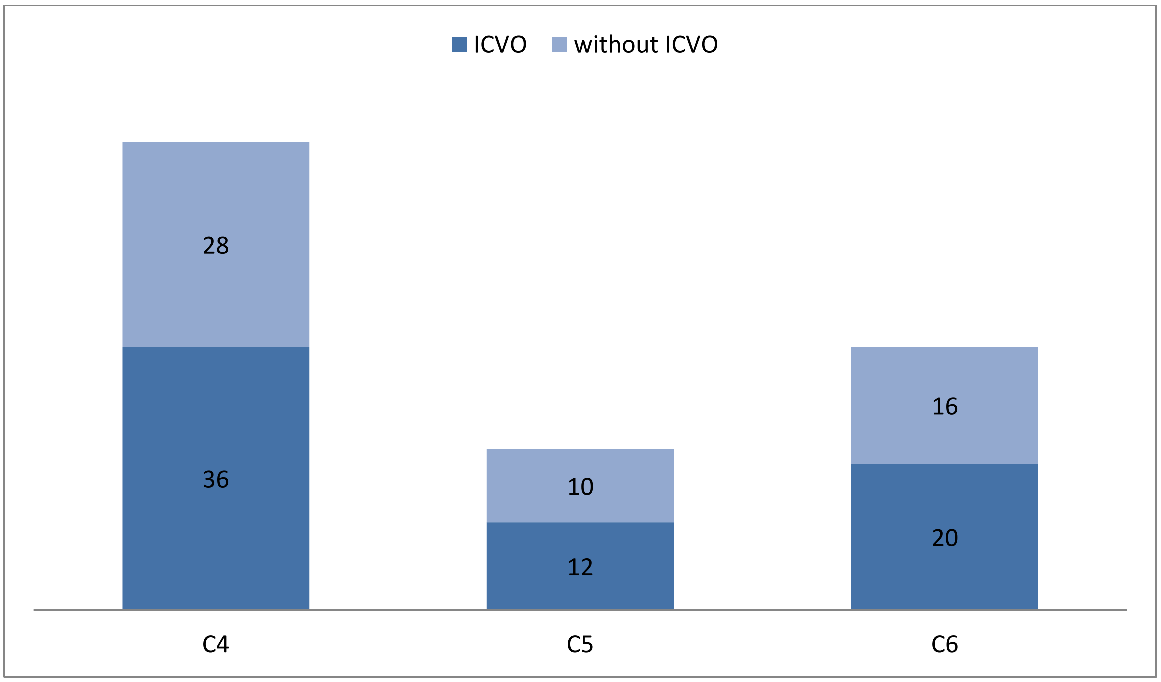


TABLE 5.4

Variables	ICVO n=36 (%)	Without ICVO n=33 (%)	P value Fishers test
C4	**36(100%)**	**28(85%)**	**0.021**
C5	12(33%)	10(30%)	0.80
C6	20(56%)	16(49%)	0.63

There was statically significant distribution (P value=0.002) of C4 disease in ICVO group. However there was no difference in C5 and C6 disease.

Table 5.5 Duplex findings

Duplex findings	ICVO n= 36 (%)	Without ICVO n=33 (%)	P value
SFJ reflux	18(50)	15 (45)	0.81
SPJ	6 (16)	5 (15)	1
IPV	31 (86)	31 (93)	0.43
DVR	**24(67)**	**9 (27)**	**0.002**
SSV	5 (14)	2(6)	0.43

No statistical difference was found for superficial vein, but deep venous reflux was significantly more in patients with ICVO group. DVR was present in 67% of patients with ICVO.

Venous ulcer size

Ulcer size greatest at one dimension was taken for calculation. There were 20 (range 1-12cm) ulcerated limbs in ICVO group and 16 (range 1-11cm) in without ICVO group.

Table 5.6

Group	ICVO	Without ICVO
Mean	4.65	3.44
SD	3.08	2.97
SEM	0.69	0.74
N	20	16

The two-tailed P value equals 0.2414. There was no significant statistical difference between two groups.

Vcss score

Table 5.7 VCSS score

	ICVO	Without ICVO
Mean	13.39	11.33
SD	4.22	3.04
SEM	0.70	0.53
N	36	33

The two-tailed P value equals 0.0245. Conventionally shows significant statiscal difference.

Discussion

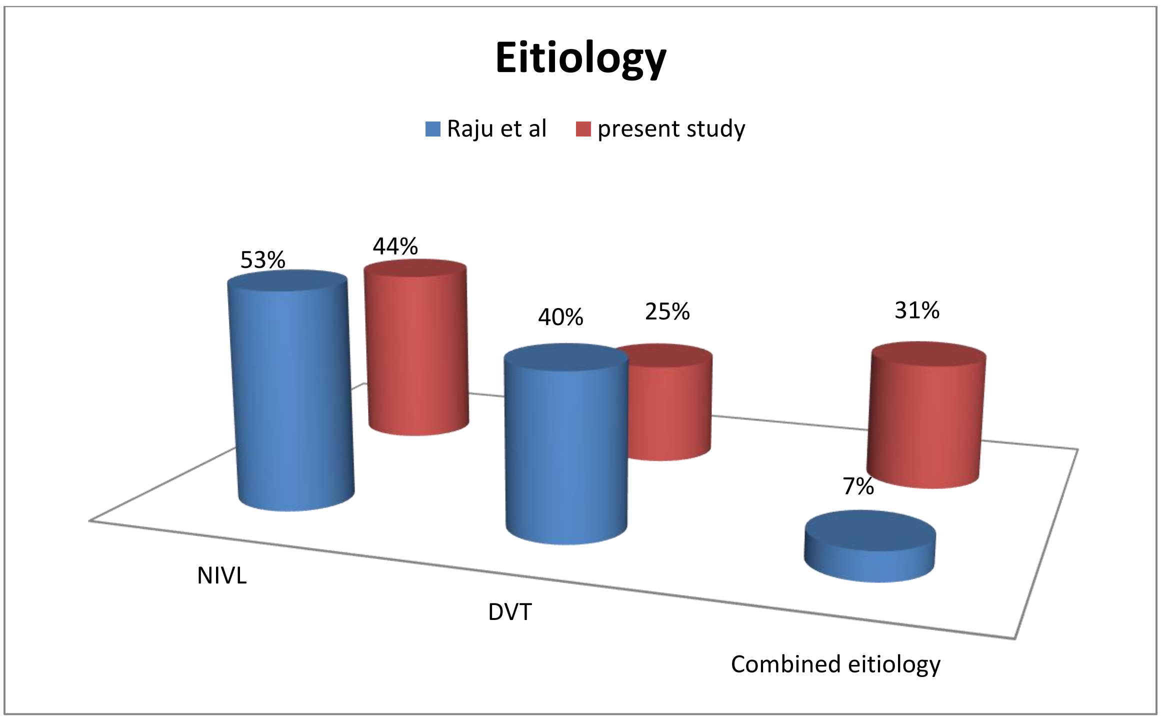
The late results of venous hypertension from obstruction and/or reflux may result in severe complications such as ulceration. Although numerous studies have reported on methods of treatment for ilio-caval obstruction, little information is available concerning the prevalence of this problem in patients with venous insufficiency.

In present study 54% (36 out of 66 limbs fig.5.2) had ICVO in patients with advanced chronic venous insufficiency (C4, C5 and C6 disease) on MR venogram. However, only one report by Seshadri Raju and Peter Neglen showed that high prevalence of NIVL (53%) in severe symptomatic CVD using IVUS with sensitivity 90% (6) . (Table 6.1 and fig 5.2)

Author	Clinical class of CEAP	Diagnosis	Incidence /prevalence
McMurrich1908 (16)	- NA	Cadaver dissection (107 limbs)	33%
May –Thurner1957(2)	NA	Cadaver dissection (430 limbs)	28%
Wolpert (77) 2002	AS	MR venography (24 limbs)	37.5%
Kibbe et al (4) (2004)	AS	CT venography	24%
Neglan and Raju (6) 2006	C1 to C6	IVUS	54%
Chung et al 2004(38)	S(acute iliofemoral DVT)	CT venography	80%
Present study	S (C4, C5 and C6)	MR venography	54%

As per report published Seshadri Raju and Peter Neglen (68), the etiology of obstruction was classified as NIVL in 493 limbs (53%), as post-thrombotic disease (PTS) in 377 limbs (40%), and as mixed in 68 limbs (7%) by IVUS. In present study of 36 limbs with ICVO 16(44%) limbs had only stenosis or external compression, 9 (25%) had DVT only and 11(31%) had stenosis and DVT on MRV.

Fig 6.1 Comparison of present study (MRV) with Raju et al (IVUS)



In present study there more patients with combined etiology (31% vs. 7%), this is because IVUS provide more accurate intraluminal details than MRV and is more sensitive than MRV (95% vs. 66%).(49)(68) In present study more patients in combined etiology (31%) than DVT (25%) possibly reflects that there is incomplete recanalization in presence of persistent stenosis.

Age:

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Mean age of presentation for patients with ICVO was 47 yrs with range of 25-75 where as that for patients without ICVO was 54 yrs with range of 32-81 which had statically significant difference with P value of 0.003. There were 11 (31%) patients in age group of less than 40 yrs compared 1 (4%) without ICVO. This reflects that ICVO affected more working (earning) populations compared without ICVO, thus leading to loss of working hours and decrease quality of life.

William Marston et al (127) in his study of 64 limbs in C5 and C6 patients found average age of patient to be 59 yrs with SD of 12.8 on CT and MR venography.

Raju et al(68) reported average age of patient to be 54 yr (range of 18-90) in 319 limbs ranging from clinical class C1 to C6 using IVUS.

This difference could be due to population difference between Indian and western (ICVO affecting Indian population earlier than western) or use of more sensitive imaging modalities like IVUS.

Gender:

There was no statically significant difference between genders of both groups.

Male dominated both the group with 27 (77%) patients in ICVO and 22 (88%) without ICVO.

In review of literature there were more numbers of females with ICVO (with female male ratio of 3-4/1) ranging from asymptomatic to (symptomatic C1-C6).(71)(17)(68)(77)

In study reported by William Marston et al(127) on 64 patients with C5 and C6 disease with CT venogram showed that were 36(56%) males and 28(44%) female with minimal male preponderance.

In present study there were more males because less number (11/204) of female who were advised MR venography underwent it.

Side:

In present study there was statically significant difference (P value= 0.013) between left and right side with more number of left sided limbs (29 limbs i.e. 43%) in ICVO group. In patients without ICVO there were 10 (15%) left sided, 13 (19%) right and 5 (8%) bilateral limbs. There was one patient with bilateral limb in ICVO group with IVC thrombosis. 3 out of 5 patients in ICVO group with right limb were purely DVT and 2 had DVT with compression. In ICVO group left to right ratio was 5.8/1.

This study showed 81% (29/36) limbs were left and this result was consistent with results in literature for left sided (70-80%) predilection of ICVO.(38)(37)(75)(25)(49)(6)

A recent study done by Raju et al(68) on 332 patients using IVUS had 236 (73%) left sided limbs and 91(27%) right side with left to right ratio of 2.6/1.

Demographics

There was no significant difference between symptomatology and co-morbid condition between these two groups. Bleeding from varicose vein was present in 4 patients without ICVO and none in patients with ICVO but it failed to reach level of statistical significance of P value< 0.05.

However recurrence after superficial venous surgery or endovenous ablation was significantly (P value= 0.003) more in patients with ICVO. In ICVO group there was 36% (13/36) of recurrence as compared to 6% (2/33) without ICVO. 12 out of 13 patients in ICVO group underwent SFJ ligation, GSV stripping and stab avulsion were as one patient underwent endovenous laser ablation with distal foam sclerotherapy. 13 out of 13 patients with recurrence in ICVO had incompetent perforator, 6 (46%) had deep venous reflux, 2 (15%) SFJ and 4 (30%) had SPJ reflux. This signifies persistent upstream (66) pressure leading incompetence of perforator and deep veins.

Clinical class of CEAP

C4 stage was significantly (P value=0.0021) more prevalent in patients with ICVO than without ICVO. Whereas there was no difference in C5 and C6 disease as venous reflux is associated with more ulcers (26) and reflux was present in both groups.

In present study there were 36(100%) limbs with C4, 12 (33%) with C5 and 20 (56%) with C6 disease. Study published by Raju et al (68) similarly had patients with C4, 69 (21%); C5, 6 (2%); and C6, 39 (12%) with less number of ulcers. But this also included C1 to C3 stage and patients with NIVL only.

Venous Duplex

This study did not find any difference in superficial or perforator incompetence in patients with and without ICVO. However deep venous reflux was present in 24 (67%) limbs with ICVO compared to 9(27%) limbs without ICVO with significant statiscal difference (P value=0.0016). this results were comparable with report published by William Marston(127) where author found DVR in 72% of limbs with C5 and C6 stage. Similarly Raju et al had 52% limbs (C1 to C6) with DVR.

Out of 20 DVT diagnosed on MRV 14 (70%) were diagnosed on duplex. 45 (75%) venous Doppler out of 60 were done in our institute by 4 radiological consultant and one vascular technologist. 15 venous dopplers were done outside our institution and there was inconsistent reporting of feature of proximal obstruction like loss of phasic flow during respiration.

Venous clinical severity score

In 35 patients with ICVO the average VCSS score was 13.39 (range 5-24, SD=4.22) and in 25 patients without ICVO it was 11.33 (range 6-18, SD=3.04). There was significant statiscal difference between two groups indicating patients with VCSS 13 or more likely to have ICVO.

12 (33%) out 36 limbs having ICVO underwent conventional venography at JIVAS out of which 4 (33%) had no lesion on multiple projection and in 1(8%) patients intra-op angio was a not possible because wire not negotiable beyond long segment occlusion. 8 (22%) were stented and 9 (25%) limbs had extensive chronic DVT extending from calf vein to iliacs were put on compressive stockings. Rest 15 (42%) limbs were advised stenting.

CONCLUSION

ICVO is a frequent and underappreciated contributor to venous hypertension in patients with advanced chronic venous disease. ICVO has significantly high prevalence in advanced chronic venous disease (C4, C5 and C6) affecting working population of country. Therefore C4, C5 and C6 disease patients with left lower limb, recurrence after superficial venous intervention, deep venous reflux, diagnosed chronic iliofemoral DVT (on venous doppler) and venous clinical severity equal to 13 or more should routinely undergo MR venogram at dedicated centre to allow correction of this potentially treatable condition.

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SUMMARY

This study was endeavored to find the prevalence of Ilio-caval obstruction in patients presenting at Jain institute of vascular sciences, Bangalore with C4, C5 and C6 venous disease using Magnetic resonance venography and to identify risk factor associated with it.

60 patients with 69 limbs with C4, C5 and C6 clinical class of CEAP classification were included in this prospective study. 36 (54%) of limbs were detected with ilio caval venous obstruction on MRV done at Clumax diagnostic centre Jayanagar, Bangalore.

Mean age of patients with ICVO was 47yr which were younger than without ICVO (54yrs). There were 11 (31%) patients in age group of less than 40 yrs compared 1 (4%) without ICVO. Left side limb were more common in patients with ICVO (29 limbs i.e. 43%) compared to 10limbs (15%) in limbs without ICVO.

Recurrence after superficial venous surgery or endovenous ablation was significantly (P value= 0.003) more in patients with ICVO. In ICVO group there was 36% (13/36) of recurrence as compared to 6% (2/33) without ICVO.

C4 stage was significantly (P value=0.0021) more prevalent in patients with ICVO than without ICVO. Whereas there was no difference in C5 and C6 disease as venous reflux is associated with more ulcers(26) and reflux was present in both groups.

Deep venous reflux on venous Doppler was present in 24 (67%) limbs with ICVO compared to 9(27%) limbs without ICVO with significant statiscal difference (P value=0.0016).

In patients with ICVO the average VCSS score was 13.39 (range 5-24, SD=4.22) and in 25 patients without ICVO it was 11.33 (range 6-18, SD=3.04). There was significant statiscal difference between two groups indicating patients with VCSS 13 or more likely to have ICVO.

There was no statiscal difference in symptomatology, clinical findings, superficial venous reflux or ulcer size in these two groups.

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PROFORMA

Name: ***Age/Sex:*** ***Reference***

OPD No: **JIVAS No:**

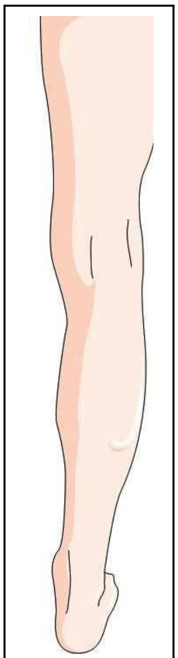
Chief complaints:	**Right side**	**Left side**	**Description**
Pain	☐	☐	
Discomfort	☐	☐	
Swelling	☐	☐	
Dialated veins	☐	☐	
Ulcer	☐	☐	
Skin pigmentation	☐	☐	
Bleeding	☐	☐	
Itching			

Previous therapies:

Previous surgeries:

Co-morbidities:

Local examination:



RIGHT

Dialated veins

Induration

Thrombophlebitis

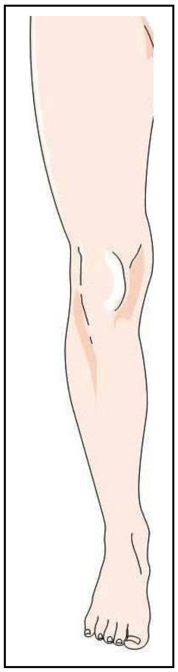
Tenderness

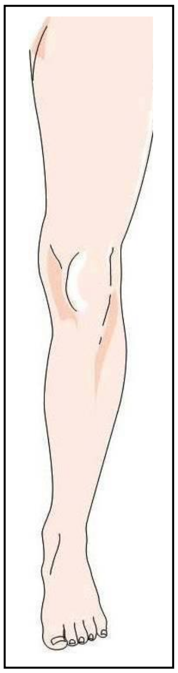
Skin changes

Oedema

Ulcer

Others





LEFT

Dialated veins

Induration

Thrombophlebitis

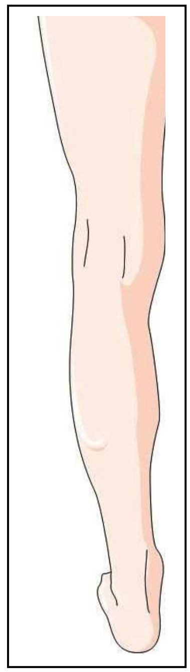
Tenderness

Skin changes

Oedema

Ulcer

Others



Investigations:

Duplex scanning: **Right side** **Left side** **Other reports**

	Right side	Left side
SFJ reflux	☐	☐
GSV reflux	☐	☐
SPJ reflux	☐	☐
SSV reflux	☐	☐
CFV Reflux	☐	☐
SFV Reflux	☐	☐
Incompetent perforators	☐	☐

Thrombophlebitis

DVT

MR venogram Clumax ID NO:

Intraoperative venogram

<u>Treatment done/advice:</u>

1) Conservative – compression stocking Yes No
2) Trendel Berg + Striping of vein
3) Radiofrequency ablation +/- foam sclerotherapy
4) Endovenous ablation +/- foam sclerotherapy
5) Iliac/ IVC stenting

<u>Photos and images;</u>

Ethics committee has approved for above thesis.