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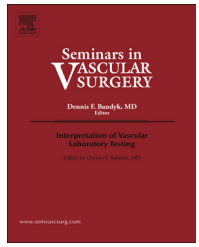

Algorithm-based approach to management of venous leg ulceration

*Himanshu Verma, and Ramesh K. Tripathi**

Narayana Institute of Vascular Sciences, Level I, B Block, NH-Mazumdar Shaw Medical Centre, Narayana Healthcare, 258-A, Bommasandra Industrial Area, Hosur Road, Bangalore 560099, India

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ABSTRACT

Management of venous ulceration has evolved tremendously during the last 2 decades. There has been considerable progress in our understanding of the pathophysiology, hemodynamics, venous imaging, and therapeutic options for venous ulcers, including endovenous ablation, iliac vein stenting, and vein-valve repair techniques. Details of these procedures are described in this issue of *Seminars*. With so many permutations and combinations of venous disease, including superficial and deep vein abnormalities, that produce venous ulceration, as well as a plethora of diagnostic and therapeutic tools at our disposal, it is important to have an algorithm for venous ulcer management. Also important is knowledge about risk factors that can influence poor outcomes, despite interventions for venous ulcers. In the end, authors also discuss the gray areas of venous ulcer management, which do not have common consensus and that treatment could be individualized based on patient needs.

1. Introduction

Venous ulcers are a major socioeconomic health burden. Standard compression therapy has been the cornerstone of venous ulcer management, and many other modalities have emerged in last 2 decades [1–3]. Because there are so many options to treat venous ulcers, it is essential to have an algorithmic approach for ulcer management. The Society for Vascular Surgery recently published guidelines for venous ulcer management [4]. Because the algorithm in the Society for Vascular Surgery guidelines is a lesion-based approach (reflux *v.* obstruction), there might be advantages to further subcategorizing patients based on real-world experience and common clinical scenarios. In our clinical practice, we group patients into two types: those with first time venous ulcer and those with recurrent venous ulcerations.

2. Risk factors for inferior clinical outcomes after intervention in patient with venous ulcer

Before attempting any interventional treatment for venous ulcer, one must exclude the presence of comorbid factors that can lead to poor outcomes, despite correction of venous reflux or obstruction.

- Arterial insufficiency must be determined by ankle brachial index or toe brachial index and, if present, should be treated before embarking on venous intervention. Standard compression therapy is safe when ankle brachial index is >0.8. However if ankle brachial index <0.5, even compression therapy is also contraindicated [4,5].
- Other causes of leg ulcers, for example, vasculitis, autoimmune anemia, drug use must be ruled out. If required,

* *Corresponding author.*
E-mail address: ramesh.tripathi@vascularsurgeon.org (R.K. Tripathi).

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Fig. 1 – Extremes of venous ulcers. (A) 3-week-old venous ulcer in a patient who is compliant to compression therapy and ulcer edges show evidence of healing. (B) 5-year-old large exudating venous ulcer in a patient with previous iliofemoral deep venous thrombosis. Patient's compliance to compression is low.

ulcer edge biopsy should be done in selected group of patients to rule out vasculitis as well as any concern of malignancy [6].

- Limited mobility/fixed contractures: Fixed contractures or conditions such as disabling stroke that limit mobilization should be considered as contraindication for any venous intervention [7].
- Large size, full-thickness venous ulcer: Large size (>3 cm) and deeper (>2 cm) venous ulcers heal much slower despite interventions. Also larger ulcers are associated with other risk factors, for example, calf pump dysfunction, decreased range of ankle movements etc [4,7].
- Poor calf pump: Poor calf pump function is associated with increased severity of chronic venous insufficiency. It also predicts poorer outcomes after any venous intervention in comparison to those patients who have good calf pump function [8,9]. The Society for Vascular Surgery guidelines recommend selective assessment of calf pump by plethysmography in patients with nonconclusive duplex study [4]. Range of ankle movement is an easily available clinical alternative to access dysfunction of calf muscle pump. Restricted ankle joint movement is associated with severe calf pump dysfunction [9,10]. In such patients, delayed ulcer healing, even after any intervention, and need for calf pump augmentation adjunctive therapies should be explained.
- Obesity: Obesity is also associated with increased severity of chronic venous insufficiency [7]. Although it should not be considered as a contraindication for venous intervention, increased risk of recurrence should be explained to patients. Also simultaneous encouragement for weight reduction should be done.
- Thrombophilia: If there is history of unprovoked deep venous thrombosis, or if imaging is suggestive of post-thrombotic etiology, especially in young patients, a full thrombophilia workup should be done [4,11]. The main impact of having thrombophilia is on postoperative plan for anticoagulation, especially when deep venous intervention is performed.

3. Adequacy of compression therapy

Compression is the oldest modality of treatment and has the best evidence from current literature for venous ulcer healing. Most of patient who seek help form vascular surgeons already have received a minimum of 2 to 3 months of compression treatment. Therefore, the majority of patients that present to vascular centers have ulcers that have either persisted or recurred while on compression therapy or their compliance to compression has been very poor [1–4].

4. First-ever ulcer vs recurrent ulcer

Clinical preactice guidelines from the Society for Vascular Surgery define venous ulcer as "an open skin lesion of the leg or foot that occurs in an area affected by ambulatory venous hypertension" [4]. However, in real-world scenarios, venous ulcers can range to extremes (Fig. 1). A patient who has background varicose veins and dermosclerosis can develop post-traumatic ulcer, which takes more time than usual to heal, or they develop a tiny ulcer from spontaneous bleeding from a varicosity. Obviously, these ulcers have a much milder course and tend to subside with compression alone in comparison to longer existing or recurrent recalcitrant venous ulcers, which are large-sized, heavily exudating, and have either failed or responded poorly to compression therapy. Therefore, when considering an algorithmic approach, it is very important that first-ever ulcer be differentiated from chronic or recurrent venous ulcers.

Compression treatment is an integral part of all interventions for venous ulcers, therefore, it is appropriate to give a period of compression therapy (1 to 3 months, depending on the patent's preference and wound-healing trend) before considering patients for intervention.

Therefore, in our algorithm, a patient is included for intervention only after adequate duration of compression therapy. However, in patients with healed ulcers (C5 disease),

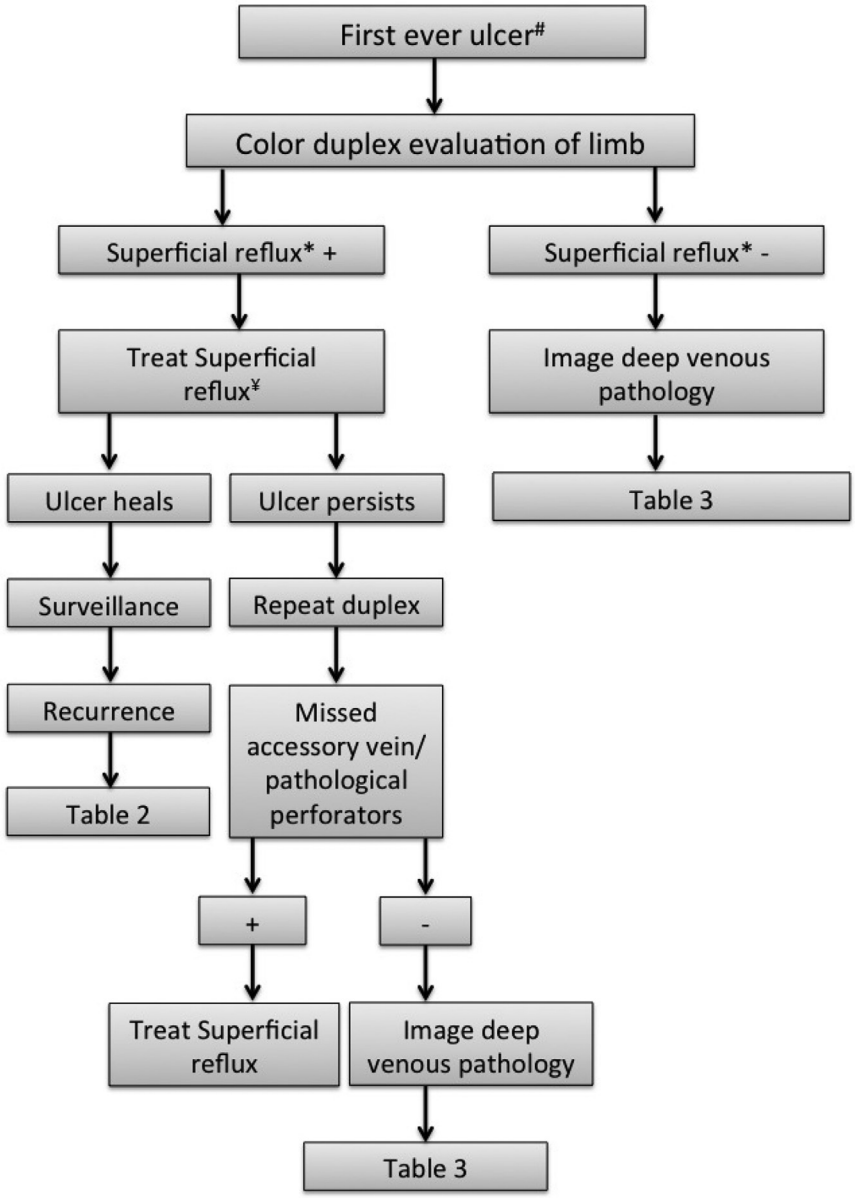

Fig. 2 – Management protocol of first-ever venous ulcer.

significant superficial reflux should be treated to avoid recurrence [4].

An approach for first-ever venous ulcer is provided in Figure 2, and an approach for recurrent venous ulcerations has provided in Figure 3.

4.1. *First ever-venous ulcer*

This is first open skin lesion of the leg or foot that occurs in an area affected by venous hypertension. There is no history of any previous venous intervention.

All such patients should undergo extensive duplex assessment of superficial venous system. Any significant superficial junctional reflux (saphenofemoral or saphenopopliteal junction reflux >0.5 s) or pathological perforator reflux (outward flow of >500 ms duration, with a diameter of >3.5 mm located beneath or associated with the ulcer bed) should be treated by either endovenous or surgical ablation of reflux [4,12]. After ablation, patients should be kept on compression therapy and reassessed by clinical examination. Ulcers that heal should be monitored for any recurrence and, if case of recurrence, should be managed as indicated in Figure 3.

For those ulcers that do not heal after superficial reflux correction, a repeat duplex should be performed after 4 to 6 weeks of compression therapy and the limb should be assessed for adequacy of index procedure. Any missed reflux in accessory saphenous vein or any pathological perforator, if present, should be treated [13–15]. Deep venous imaging should be obtained in patients with persistent ulcer with adequately treated superficial reflux (Fig. 4).

4.2. *Recurrent venous ulcer*

Patients with recurrent venous ulcer can be further categorized into three types: those who had no previous venous

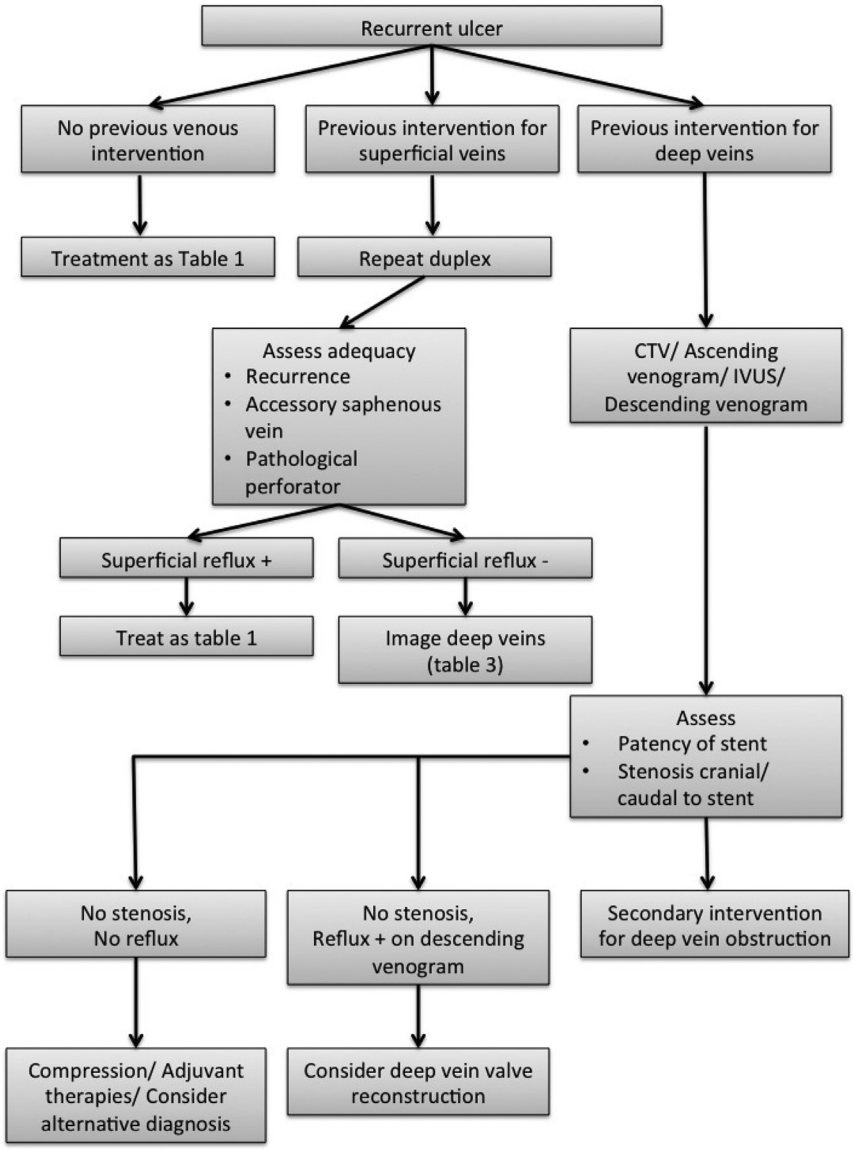

Fig. 3 – Management protocol for recurrent venous ulcer. CTV, computed tomography venogram; IVUS, intravenous ultrasound.

intervention, those who had previous intervention for superficial venous reflux, and those who had previous intervention for deep vein obstruction or reflux. Those who had no previous intervention should be managed as per Figure 2.

Those who have recurrent ulcer with history of previous intervention for superficial reflux should be reassessed with Doppler examination (Fig. 2). Additionally, they should also be assessed for any recanalization of previously ablated great saphenous vein (GSV), or reflux in Giacomini vein transmitting into short saphenous vein [16–18]. Superficial reflux, if detected, should be treated appropriately. If ulcer has recurred after previous iliac vein stenting, a repeat computed tomography/magnetic resonance venogram should be done to look for stent patency as well as any progression of obstructive disease cranial or caudal to stent. For cases in which computed tomography/magnetic resonance venogram is inconclusive, formal ascending venogram should be performed and, if required, a secondary intervention should be performed (Fig. 3).

5. Imaging deep venous pathology

All venous ulcers with either absent or adequately treated superficial reflux should undergo deep venous assessment [4]. Intravenous ultrasound has been reported to be the most sensitive and specific modality for deep vein obstructive disease [11,19–20], however, it is not widely available, and up to 10% of significant stenotic lesions could be impervious to intravenous ultrasound and require trial balloon angioplasty to unmask stenosis [21,22]. Computed tomography/magnetic resonance venogram could be done on an outpatient basis and provided a fairly accurate idea about deep venous obstructive pathology [23,24].

Any occlusion or stenosis of iliocaval segment, as well as presence of collaterals and target sign, should be investigated. In case of previous femoropopliteal deep venous thrombosis, degree of axial transformation of profunda vein

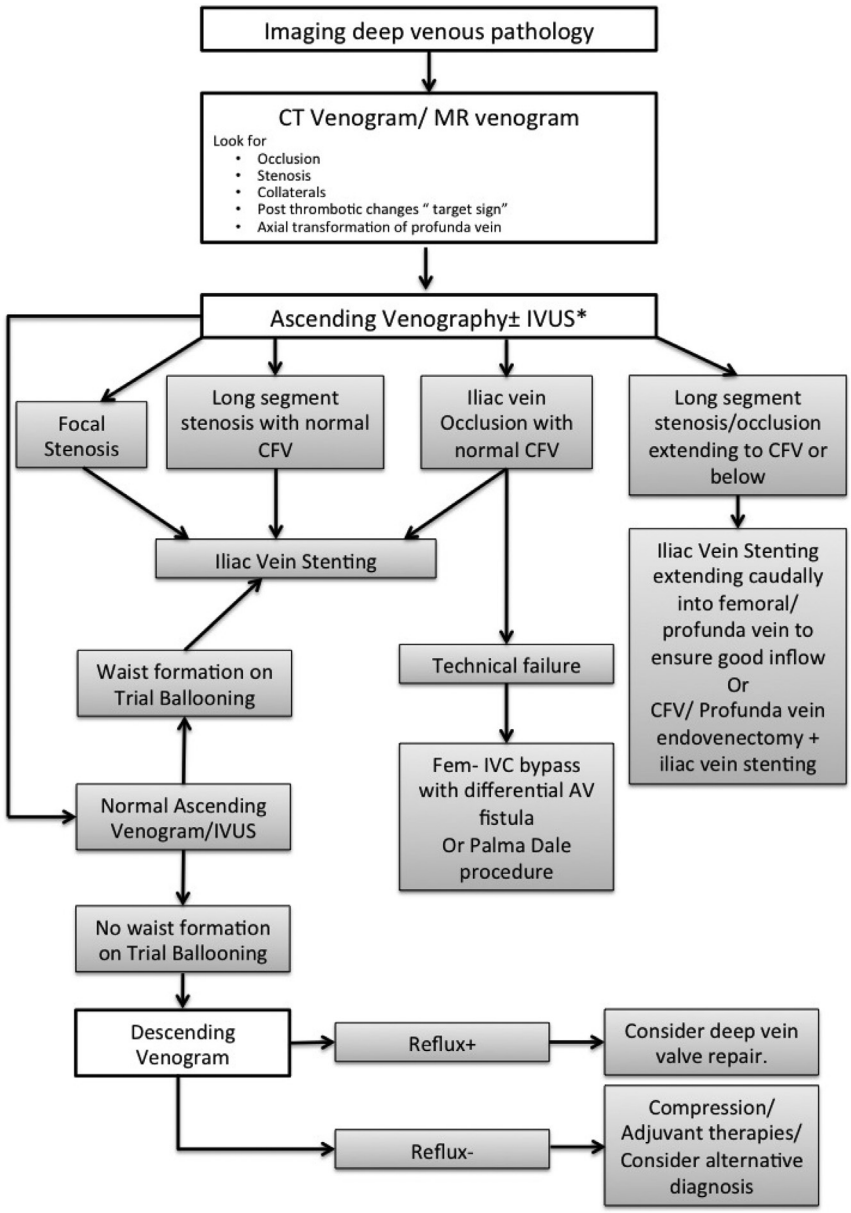

Fig. 4 – Protocol for deep venous imaging. AV, arteriovenous; CFV, common femoral vein; CT, computed tomography; IVC, inferior vena cava; IVUS, intravenous ultrasonography; MR, magnetic resonance.

should also be determined. Digital subtraction ascending venogram should be done after computed tomography/magnetic resonance venogram. Venographic findings can be grouped into normal, stenosis, and occlusion.

Stenosis, as well as occlusion involving iliocaval segment with healthy common femoral vein, d should be stented after angioplasty with an adequate-sized balloon [4,25]. Principles of iliac vein stenting are described elsewhere in this issue.

In conditions where obstructive pathology extends below the inguinal ligament, caudal extension of stents into profunda or femoral vein should be done to ensure good inflow in the stent [26]. Another option in such a scenario would be a hybrid approach, where common femoral vein endovenectomy, to ensure good inflow from profunda and femoral vein, can be combined with iliac vein stenting [27].

In chronic total occlusion of the iliocaval segment where the lesion could not be crossed, a surgical bypass option (cavofemoral bypass with differential fistula or Palma-Dale procedure) should be considered [4,28,29].

Normal-looking segments on the venogram should be examined with trial balloon angioplasty using an appropriate-sized semi-compliant balloon to unmask any area of stenosis, which become evident as "waist" [21,22,30] (Fig. 5).

In instances where no obstructive pathology is found on ascending venography, intravenous ultrasound, and trial ballooning, descending venography should be performed [31]. If primary deep vein reflux is detected, expertise for deep vein valve repair should be sought.

In venous ulcers with no superficial or deep venous pathology identified, multiple adjuvant therapies could be

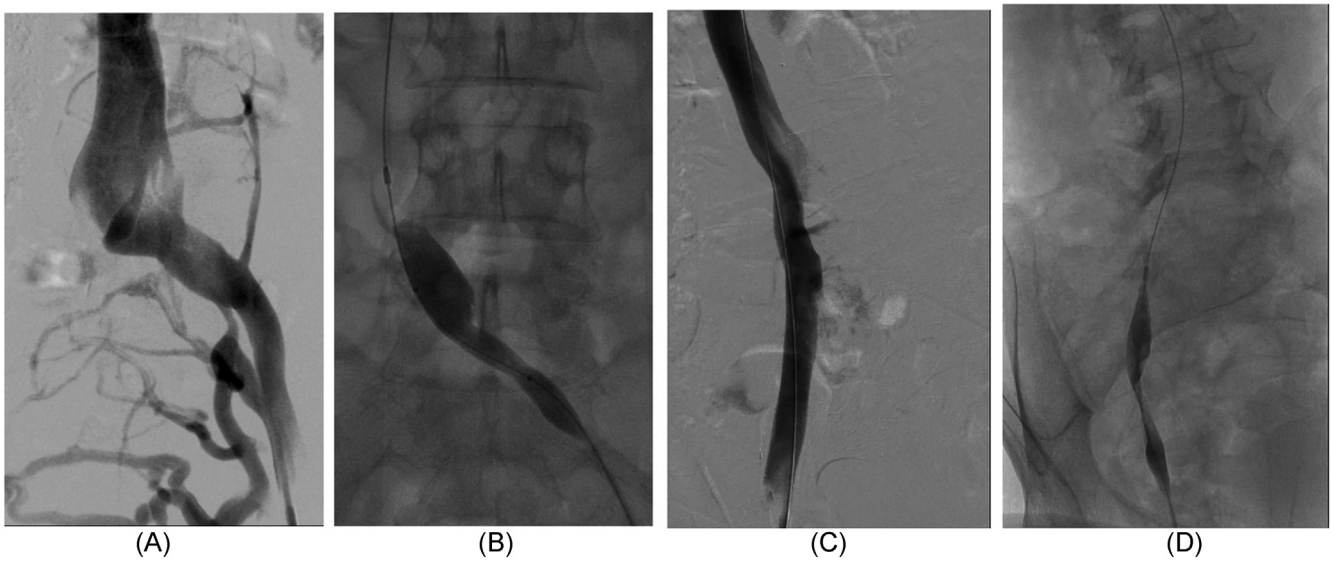

Fig. 5 – Trial ballooning involves gentle inflation (<1 atm) of an appropriate-sized semi-compliant balloon in areas of suspected stenosis and observing for any waist formation. Waist formation might be observed not only in cases with venographic stenosis (A, B), but might also unmask stenoses in otherwise normal-looking venogram (C, D).

combined with compression therapy. Importantly, an alternative diagnosis should also be considered and ulcer biopsy becomes mandatory at this stage.

5.1. *Gray areas in decision making*

Because every ulcer is different and one must try to individualize treatment, there are gray areas where we would deviate from the procedures mentioned in order to meet the needs or choices of individual patients.

5.2. *Early GSV ablation without trial of 3 months of compression*

GSV ablation in C6 disease to prevent recurrence has been recommended by the Society for Vascular Surgery practice guidelines (grade 1; level of evidence B) [4]. Therefore, patients with C6 disease who have significant superficial reflux should be considered for early GSV ablation, rather than waiting for 3 to 4 months of compression therapy first. Compression could be continued in the postoperative period.

5.3. *Iliac vein stenting and GSV ablation in same sitting*

In our experience, we have seen that in patients with large ulcers, which are decreased in size with superficial vein ablation, deep vein obstruction requires treatment in the form of iliac vein stenting for complete ulcer healing. Neglén et al also recommends simultaneous treatment of superficial reflux as well as iliac vein stenting at the same time, to hasten ulcer healing [32]. However cost of combined procedures might be a limiting factor in majority of third world countries.

5.4. *How aggressive to be*

Venous ulcers, although not life-threatening to the patient, have a considerable impact on quality of life. Quality of life is a matter of individual appreciation, which depends on socioeconomic status and the patient's self-motivation about disease treatment. Therefore, the aggressiveness with which ulcers are managed must be determined after much discussion with the patient. Once given all choices, some patients might opt for aggressive treatment, including early interventions, and others might prefer conservative modes of treatment.

6. Conclusions

Compression therapy is the first line of treatment for venous ulcers. Significant superficial reflux, if present, should be treated to hasten ulcer healing and prevent recurrence. In case of recurrence, adequacy of superficial reflux ablation should be reassessed. When superficial reflux is either absent or adequately treated, deep venous imaging should be obtained to look for obstructive pathology. Iliac vein stenting should be performed if obstructive pathology is detected. Close surveillance is required after deep venous intervention to maintain ulcer healing. Surgical options for deep veins should be kept reserved for recalcitrant ulcers.

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