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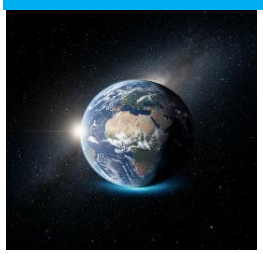

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Therapy Effectiveness of Venous Leg Ulcer Treatment Methods - A Comparative Review

1. Patryk Gadziński, ORCID https://orcid.org/0009-0000-4207-0611

E-mail patryk.gadzinski1@gmail.com

Regional Specialist Hospital in Wrocław, Kamieńskiego 73a, 51-124 Wrocław

2. Marta Czechowicz, ORCID https://orcid.org/0009-0003-2655-8643

E-mail martaczechowicz23@gmail.com

4th Military Clinical Hospital with Polyclinic SPZOZ, Weigla 5, 50-981 Wrocław

3. Joanna Madoń, ORCID https://orcid.org/0009-0007-7496-3239

E-mail joannamadon1@gmail.com

4th Military Clinical Hospital with Polyclinic SPZOZ, Weigla 5, 50-981 Wrocław

Corresponding Author
Czechowicz Marta, E-mail martaczechowicz23@gmail.com

Abstract

Background

Venous leg ulcers are a common health problem for patients suffering from chronic venous insufficiency. Despite the notable advances in prevention and treatment made during the past years, up to a third of VLUs still display significantly delayed or no healing, with an insufficient response to mainline therapy alone.

Aim

This literature review aims to showcase the available treatment methods of venous leg ulcers, their individual and, when possible, comparative effectiveness, as well as identify which patients would likely benefit from additional solutions and adjuncts, in order to improve healing outcomes and reduce recurrence.

Materials and Methods

This article reviews the existing literature on venous leg ulcer treatment, with a particular focus on studies directly comparing the outcomes and effectiveness of the available methods. Original studies, reviews, and studies available in the Cochrane, PubMed, and Google Scholar

databases were included. The literature review and article selection process concluded in November 2025.

Results

Data pooled from the available studies shows that compression therapy, paired with suitable lifestyle interventions, such as exercise aimed at improving the function of the calf muscle pump, remains the backbone of venous leg ulcer treatment. Adjuncts such as pentoxifylline, wound dressings, and artificial skin grafts display a sufficiently well-established effectiveness in increasing healing effectiveness. Surgical endovenous ablation significantly reduces recurrence rates. The lack of high-quality studies comparing individual products and substances within each wider category largely limits the potential to formulate specific recommendations and should be viewed as a potential area for future research.

Conclusions

While the findings back up the effectiveness of the standard treatment for venous leg ulcers, consisting primarily of compression therapy, available adjuncts show potential to improve outcomes, particularly among patients with a high risk of delayed healing or those dealing with frequent recurrences, and should be considered when the appropriate indications are present.

Keywords: venous leg ulcers, venous insufficiency, ulcer, compression

Introduction

Venous leg ulcers pose both an increasing public health concern and a significant treatment challenge. Despite considerable heterogeneity in measurement methods and classification criteria, results of recent meta-analyses show a pooled prevalence of 0,32% and a pooled incidence of 0.17%, although the rates are much higher among the elderly, who face an annual prevalence rate of 1.69 [2]. Overall, they represent the most common etiology of chronic leg ulcers, serving as the dominant causative factors in 47.6% of cases, along with a further 17.6% where a combined venous and arterial insufficiency was present [3]. Primarily, VLUs emerge as a complication of persisting venous insufficiency, resulting from a combination of venous hypertension and stasis [4], typically affecting patients with an already high disease burden, among whom roughly around 90% have at least one chronic illness, 66.2% have arterial hypertension, 49.2% deal with obesity, and 23.6% with diabetes [5]. Psychological questionnaires and interviews reveal a considerable impact of VLUs on patients' health-related quality of life, stemming from several common symptoms - pain (80.5%); itching (69.4%); altered appearance (66.7%); loss of sleep (66.6%); functional limitation (58.3%); and disappointment with treatment (50%). Interestingly, the ulcer size and duration were found not to correlate with the HRQoL, which was instead negatively impacted by a patient's older age and a higher degree of experienced pain [6]. Across all populations, despite proper treatment, approximately 30% of venous leg ulcers remain unhealed after a period of 24 weeks, up to 59% in those previously identified as at high risk of delayed healing [7]. Considering such a high percentage of suboptimal results, this review aims to showcase the available treatment methods, their individual and, when possible, comparative effectiveness, as well as identify the groups that would likely benefit the most from each solution.

Compression Therapy

Compression methods are a well-established solution in the treatment of venous leg ulcers, narrowing the widened blood vessels, improving the function of the calf muscle pump, and decreasing the reflux emerging from valve insufficiency [8]. Overall, studies clearly indicate their effectiveness compared to no-compression regimens, with an average healing rate of 61% to 39% resulting in a RR of 1.55 [9]. Far more uncertainty exists in terms of individual method selection. Generally, three-component systems containing an elastic element have been found preferable to their non-elastic counterparts (RR 1.83), while compression stockings were associated with better outcomes than short-stretch bandages (RR 1.62) [10]. Four-layer bandages, despite a faster average healing time, showed a similar rate of complete healing as SSBs at their respective study endpoints [11]. Another analysis of available studies found no significant difference in outcomes between compression stockings and compression bandages (RR 1.05) [12], therefore, with the lack of strong recommendations, the choice between them should be assessed individually and include patient preference, education, and method availability in order to minimize non-compliance.

It is important to keep in mind that even in studies carried out under optimal conditions; only around half of the patients correctly apply compression. The most common errors include slippage, failure of the bandage to extend to just under the knee (55.8%), a tourniquet effect (21%), failure of bandaging starting at the base of the toes (37.2%), and failure to cover the heel (53.5%) [13]. Seeing as it requires multi-week, often many month-long regimens, such therapy is often a source of significant discomfort for patients, who most commonly experience subjective concerns such as difficulty putting on footwear or unacceptably high cost of treatment, as well as numerous adverse effects, chiefly skin irritation, pain, excessive warmth, and lymphoedema [14]. Effectiveness will also largely depend on aspects outside of a physician’s control, such as patient exercise, which, when done regularly and targeting the muscles of the calf, is associated with greatly improved outcomes [15].

Wound Cleansing

Guidelines, such as those of the Society for Vascular Surgery and the American Venous Forum, suggest that ulcers be cleansed initially and at each dressing change with a neutral, nonirritating, nontoxic solution, performed with a minimum of chemical or mechanical trauma [16]. For now,

however, there is a notable lack of studies that compared cleansing with no cleansing, or that explored comparisons between different cleansing techniques; therefore, [17] recommendations are based primarily on clinical practice, similarly as in the case of debridement, i.e. the physical removal of necrotic tissue and excess bacterial growth, though the available literature does seem to indicate positive outcomes of the individual applied methods [18].

Pharmacotherapy

Medication is often used as an adjunct to first-line treatment, or, in certain cases where serious contraindications to compression therapy exist, as the primary applied method. For most drugs used in clinical practice, little evidence currently exists to undoubtedly prove their effectiveness. Trials involving ifetroban, sulodexide, and zinc failed to show a statistically significant benefit compared to placebo. While aspirin and flavonoids showed potential to serve as effective adjuncts, any extrapolations from their trials were severely limited by methodological shortcomings and potential bias [19].

At present, pentoxifylline remains the most well-examined drug used in the treatment of VLUs. In patients affected by venous insufficiency, it improves blood flow through a reduction of platelet aggregation and thrombus formation, as well as an anti-inflammatory effect. There is established evidence to support the usage of pentoxifylline in a number of clinical situations – it is more effective than placebo as an adjunct to compression therapy (RR 1.56), and even more so in the absence of compression (RR 2.16) [20]. Recent studies confirm the previous findings, further showing that PTX administration was associated with a significantly higher likelihood of complete ulcer healing (OR 2.56) [21]. Pentoxifylline is, however, associated with notable potential side effects, primarily gastrointestinal disturbances (RR. 2.29), but also thrombocytopenia, gastrointestinal bleeding, damage to the cardiovascular, or central nervous systems [22].

Dressings

Wound dressings are defined as materials placed over the affected area to promote healing and prevent the risk of infection. Optimal dressings additionally possess the ability to absorb and contain exudate without leakage or strike-through, provide thermal insulation, allow permeability to water, but not bacteria, and optimize the wound's pH environment. They are commonly used in combination with compression therapy to achieve optimal clinical results. Currently, there are numerous dressing types available on the market, including, but not limited to: absorbent dressings, foam dressings, hydrocolloid dressings, capillary-action dressings, and silver-impregnated dressings. Despite such a range of materials, most available comparisons are currently limited to single RCTs with a relatively low number of participants, making any extrapolations of relevant data significantly difficult. Therefore, it is not possible to recommend any single type of dressing as unquestionably preferable over the others, and additional research into the subject would be required. For now, decisions regarding the choice of dressing should be left to the individual physician and account for clinical conditions, price, and availability. There is, however, limited evidence that silver dressings may increase the probability of venous leg ulcer healing compared with nonadherent dressings [23][24][25].

Skin grafts

Skin grafts are occasionally used to stimulate healing in patients with difficulties attaining therapeutic results with primary treatment. They work by replacing lost or damaged tissue, bridging gaps in chronic wounds where normal epithelial migration fails, stimulating host healing responses via cellular and biochemical signaling, enhancing neovascularization and immune cell recruitment [26]. Grafts are further subdivided into autografts – taken from the patient's own uninjured skin and treated as preferential due to a lower risk of autoimmune complications, allografts - applied as a sheet of bioengineered skin grown from donor cells, and xenografts - preserved skin from other animals. Findings show that bilayer artificial skin, used in conjunction with compression bandaging, increases venous ulcer healing compared with a simple dressing plus compression (RR 1.51). Further research is needed to assess whether other forms of skin grafts increase ulcer healing, and currently, there is not enough evidence to issue a clear recommendation for their usage [27].

Surgery

As written above, venous leg ulcers develop primarily as a result of venous insufficiency. Most of the previous methods function merely as symptomatic treatment; however, while the underlying cause persists, making recurrences common even after a successful intervention. Surgical treatment, in the case of VLUs, is mostly restricted to superficial endovenous ablation techniques, which help greatly reduce the effect of venous reflux. While the link between surgical interventions and the proportion of ulcers healed at particular cut-off points is debatable, with results differing between the available studies [28][29], there is high-certainty evidence that combined endovenous ablation and compression compared with compression therapy alone, or compression with deferred endovenous treatment, improves time to complete ulcer healing [30]. The primary benefit of surgical treatment is evidenced in the ulcer recurrence rates, which, when measured after a four-year follow-up, were 56% for patients treated with compression alone and 31% for the compression plus surgery group. For patients with isolated superficial reflux, recurrence rates were 51% for the compression group and 27% for the compression plus surgery group. For patients who had superficial and segmental deep reflux, they measured 52% for the compression group and 24% for the compression plus surgery group, while for patients with superficial and total deep reflux, the recurrence rates amounted to 46% for the compression group and 32% for the compression plus surgery group. Additionally, patients treated with both compression and surgery experienced a greater proportion of ulcer-free time than those treated with only compression [31].

Conclusions

Data pooled from the available studies shows that compression therapy, paired with suitable lifestyle interventions, such as exercise aimed at improving the function of the calf muscle pump, remains the backbone of venous leg ulcer treatment. Adjuncts such as pentoxifylline, wound dressings, and artificial skin grafts display a sufficiently well-established effectiveness in increasing healing effectiveness. Surgical endovenous ablation significantly reduces recurrence rates. The lack of high-quality studies comparing individual products and substances within each wider category largely limits the potential to formulate specific recommendations and should be viewed as a potential area for future research.

DISCLOSURES

Author's contribution:

Conceptualization: PG, MC, JM

Methodology: PG, MC, JM

Formal analysis: PG, MC, JM

Investigation: PG, MC, JM

Writing - rough preparation: PG, MC, JM

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