Venous leg ulcers: Impact and dysfunction of the venous system

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Management of chronic venous leg ulcers (VLU) can be frustrating for both patient and practitioner. It is a significant source of disability and cost of care. Before the practitioner enters the management phase of VLU care, it is helpful to understand the impact of VLUs. Additionally, it is essential to understand the structure and function of the venous system and manifestations indicative of a dysfunction of the system. This article focuses on the epidemiology, structure, and function of the venous system as well as clinical manifestations and prevention. (J Vasc Nurs 2015;33:54-59)

INTRODUCTION

The Society for Vascular Surgery® and the American Venous Forum published guidelines for the management of venous leg ulcers (VLU) in August 2014.[1] The goal of this article is to introduce and summarize the guidelines that will affect the nursing practice of vascular nurses. This discussion is presented in 2 parts. This article addresses the epidemiology and financial impact of venous ulcers, venous structure and function, clinical manifestations, and prevention of VLUs. A second article in this issue addresses diagnosis and treatment recommendations from the guidelines published jointly by the Society for Vascular Surgery and the American Venous Forum.

IMPACT OF VLU

Epidemiology

VLUs are reported to be present in 0.06%-2% of the population worldwide, but represent 70% of leg ulcer development.[1] Studies of prevalence have been done in England, Poland, France, Germany, and United States over the past several years with similar results. Most recently, the National Venous Screening Program sponsored by the American Venous Forum conducted a survey in 2006 that included 83 survey sites that reported ulcers in 0.5% and an additional 1.5% with a healed ulcer among the 2,234 individuals who attended a screening.[2] Individuals with a healed ulcer are at high risk for developing an additional ulcer in the future, so those numbers are included in the ulcer findings reported here.

Vascular nurses need to be aware that a significant percentage of the population has leg ulcers that are being treated in the community, in addition to individuals treated in the hospital. Hospital treatment typically results from the need to establish a means to treat infections or monitor after the intervention that cannot be accomplished on an outpatient basis.

Financial impact

The cost of treating VLUs has risen over time. In the United Kingdom, the estimated annual cost for treatment of leg ulcers rose from £300 to £600 million over a 5- to 10-year period, although treatment of poorly healing ulcers was the focus of one of these studies.[3,4] Olin et al[5] explained the origin of the direct costs for venous ulcer treatment: "In the ambulatory setting, the direct cost of this care is related to (1) technical (facility) costs and professional reimbursement (physicians)[2]; labor costs (nurses and paramedical personnel) for wound care treatments, which are the major driver of costs[3]; and medications as well as specialized wound dressings and compression garments." The size of the ulcer, length of time to healing, and possible recurrence all affected cost in providing treatment. The estimated direct care cost per month per patient was $2,500 in 1995.[5]

A study of actual costs for 84 patients by O'Donnell et al[1] was reported in the guidelines article to show a mean actual cost over a 6-month period of $15,732. For the 60% of patients whose wound healed, the costs were significantly lower (mean, $10,563; range, $430-$50,967). Wounds that did not heal in 6 months averaged 3 times as costly for medical treatment, about the same for superficial surgical treatment, and twice as costly for outflow obstruction treatment.[1] During medical treatment of open wounds, the outpatient facility costs and nursing services in the home averaged >$10,000 each during the 6-month study duration.[1] The actual costs did not seem to include loss of income when the individual or family members were unable to work full or even part time owing to care needs and incidental costs for travel and other needs not covered by insurance. Vascular nurses work as or with case managers to assist individuals and their

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TABLE 1

REVISED VENOUS SYSTEM NOMENCLATURE[6]

Venous system	*Old terminology*	*Revised terminology*
Deep system	Superficial femoral vein	Femoral vein
Superficial system	Greater or long saphenous vein	Great saphenous vein
	Lesser or short saphenous vein	Small saphenous vein
Perforators	Hunter's and Dodd's perforators	Perforators of the femoral canal
	Boyd's and Sherman's perforators	Paratibial perforator
	Cockett's perforators	Posterior tibial perforators (lower, middle, upper)
	Mary's or Kuster's perforators	Ankle perforators

families in meeting the obvious and hidden costs of venous ulcer treatment.

STRUCTURE AND FUNCTION OF THE LOWER EXTREMITY VENOUS SYSTEM

Knowledge of the anatomy and physiology of the venous system is essential to understanding venous insufficiency, its subsequent manifestations, and treatment options. Two main functions of the venous system include the transportation of deoxygenated blood back to the heart and facilitation of hemostasis of cardiac volume. These functions are accomplished through a number of internal and external venous forces, such as the influence of gravity, especially when we are upright. The venous system has the potential to act as a large reservoir to decrease return of venous blood to the heart when needed. In addition to venous structure, pressure changes in the cardiac, respiratory, intra-abdominal, and skeletal muscles systems also influence venous return (VR).

Structure of the venous system

In the past, a discussion of the venous system was confusing owing to the evolution of multiple names used for the same venous structure. In 2001, a consensus statement updating the official anatomic nomenclature, *Terminologia Anatomica*, was developed by an international interdisciplinary committee through the International Union of Phlebology and the International Federation of Anatomical Associations.[6] The statement formulated approved terminology for the deep veins, superficial veins, and perforators. Perforator terminology changes were more reflective of the anatomic locations (Table 1). Adoption of the new terminology has been slow to take hold and remnants of the old terminology are still in use. Use of this nomenclature is recommended as best practice in the recently published clinical practice guidelines for management of VLUs.[1]

The major transportation of VR is accomplished by the deep veins of the lower extremities. These include the tibial veins, which transport venous blood to the popliteal vein, to the femoral and common femoral veins, to the iliac veins, and into the vena cava. The veins of the deep system are found within the fascial muscle compartments and run essentially parallel to the arterial vessels.[7]

Large, superficial veins of the legs are the major contributors of venous blood to the deep system veins. These superficial veins, through multiple tributaries of accessory and reticular veins, collect capillary blood, transporting it to the deep system veins. A visual analogy of this system is the concept of the ocean and river systems throughout our country. This system is composed of many small, trickling streams that collect water sources through surrounding sources and transport it to the larger, rapid-moving rivers that transport the water to the huge ocean. Water flows from higher to lower levels (sea level) as it reaches the ocean. The superficial veins consist of 2 large venous structures, the great saphenous vein (GSV) and the small saphenous vein (SSV), and are found in the superficial compartment below the dermis.[7] The GSV is located on the medial side of the leg with the proximal GSV initiating at the junction of the GSV and femoral vein, commonly known as the saphenofemoral junction, and extending to the distal GSV at the medial malleolar (ankle) region. Conversely, the SSV is located on the lateral leg with the proximal SSV initiating at the saphenopopliteal junction and extends to the lateral malleolar region.

Perforators are small, bridging veins that connect the superficial veins to the deep system (Figure 1). These perforators are identified and labeled in groups and the anatomic position. Prominent perforator groups are listed in Table 1.

Valves are an important structure of the veins, aiding in the function of the venous system—to propel blood against gravity to the heart—by providing for unidirectional flow of blood and preventing reflux of blood back to the distal lower extremities. Figure 1 demonstrates the unidirectional flow of venous valves. An increasing number of valves are found in the lower extremities with the greatest number in the veins below the knee. Valves can be found in all venous structures from the larger veins to the venules to the perforators. However, the common iliac vein and vena cava are essentially void of venous valves.[7,8]

Influences of venous pressure

Multiple factors influence VR, such as low pressures in the right atrium (4-7 mmHg) and higher pressures at the venous end of the capillary bed (12-18 mmHg), creating a pressure gradient and promoting forward movement of blood toward the right atrium.[7] Another significant influence of VR is the