

Identifying Best Practices for Pressure Ulcer Management

Katherine R. Jones, RN, PhD

Abstract

- **Objective:** To provide a review of the management of pressure ulcers, starting with pressure redistribution and nutritional support and progressing to wound cleansing, debridement, dressings, bacterial management, and adjunctive therapies.
- **Methods:** Review of the literature.
- **Results:** Pressure ulcers occur frequently in the health care system despite available clinical practice guidelines and evidence-based tools to assess risk and establish prevention protocols. Once they occur, pressure ulcers seriously interfere with the individual's quality, and sometimes quantity, of life. The management of chronic pressure ulcers is both costly and complex. Although the basic principles of chronic wound management are known, the evidence supporting current best practices to achieve pressure ulcer healing is weak and inconsistent. Clinical practice guidelines and systematic reviews are used as the source for the recommended practices. The many gaps and inconsistencies in the knowledge base are also pointed out.
- **Conclusion:** More rigorous studies related to the common therapies associated with pressure ulcer management as well as the development of comprehensive databases that systematically collect data on routine pressure ulcer management practices and their outcomes are needed.

Pressure ulcers continue to be a major health care problem, affecting approximately 1.3 to 3 million adults and costing more than \$11 billion per year to treat [1,2]. An increasing amount of attention is being paid to identifying best practices to prevent the occurrence of pressure ulcers, given their inclusion in the list of health system-acquired conditions with reduced reimbursement (www.cms.hhs.gov/hospitalacqcond) and their appearance on numerous quality report cards and lists of quality indicators. Unfortunately, pressure ulcers are increasingly common in U.S. hospitalizations. In 2006, there were 503,300 total

hospital stays with pressure ulcers noted as a diagnosis—an increase of 80% since 1993 [3]. In FY 2007, the Centers for Medicare and Medicaid Services reported 257,412 cases of preventable pressure ulcers as secondary diagnoses [4]. Given the pain and discomfort associated with pressure ulcers, along with longer lengths of stay, increased nursing care hours, and higher risk of life-threatening infections and death, greater attention must be paid to effectively managing these ulcers, regardless of whether they are present on admission or health system-acquired. Unfortunately, pressure ulcers are very difficult to heal [5]. As few as 13% of pressure ulcers heal by 2 weeks in hospital settings [5]. In nursing homes, healing rates for stage 3 pressure ulcers may reach 59% after 6 months of treatment, while only a third of stage 4 pressure ulcers heal over this same time period [5].

Treatment Principles

Pressure ulcers are regions of localized damage to the skin and underlying tissues that result from prolonged periods of uninterrupted pressure or pressure combined with the mechanical forces of friction and shear [6]. Pressure ulcers are usually located over bony prominences such as the sacrum, coccyx, ischium, iliac crest, lateral foot, lateral malleolus, trochanter, and heel [5], and most often occur in persons over age 65 years [7]. Treatment strategies for pressure ulcers can be both costly and complex [8]. Successful management practices include preventing additional pressure ulcers; reducing pressure, friction, and shear forces; restoring circulation; managing the wound; and addressing related disorders such as urinary incontinence and malnutrition [9,10]. Local wound management practices include initial and weekly assessments of wound characteristics, wound cleansing and controlling bacteria and infection, debriding devitalized tissue, selecting the optimal dressing that promotes a moist wound environment, keeping pressure off the wound through use of turning, repositioning, and support devices [9], and

From the Frances Payne Bolton School of Nursing, Case Western Reserve University, Cleveland, OH.

considering adjunctive therapies. Development of the treatment plan, however, is complicated by the need to select from among hundreds of different wound care products (support surfaces, cleansing agents, dressings, debriding agents, adjunctive therapies), few of which have been validated in clinical trials or other high-quality research studies [8].

The next section of this article will discuss optimal strategies for managing pressure ulcers. Relevant clinical practice guidelines, systematic reviews, and articles were identified by searching PubMed, Cochrane Database of Systematic Reviews, National Guidelines Clearinghouse, and TRIP-Database using as keywords "pressure ulcers" and "management/treatment." Web sites of specific organizations were also reviewed, including the Wound, Ostomy, and Continence Nurses Society (WOCN), American Medical Directors Association, and National Pressure Ulcer Advisory Panel (NPUAP). In addition, wound care textbooks were reviewed for relevant information.

Best Practices—General

Nutritional Support

Protein, carbohydrates, vitamins, minerals, and trace elements are required for wound healing [11]. Clinicians should therefore ensure that patients with pressure ulcers are receiving sufficient nutritional support. If intake is found to be inadequate, optimal support can be accomplished through the provision of nutritional supplements and administration of multivitamins and mineral preparations [12]. Although nutrition is considered a significant factor in both the prevention and treatment of pressure ulcers, there is little evidence documenting the efficacy of specific nutritional therapies for pressure ulcer healing [11]. A recent systematic review [8] identified 7 randomized controlled trials (RCTs) that evaluated the benefits of nutritional supplements. One study found better ulcer healing rates in subjects receiving a collagen protein supplement compared to subjects receiving a placebo. No benefits were noted in several studies that examined the benefits of receiving vitamin C supplementation. Routine administration of nutritional supplements to promote healing is not supported by the evidence [13]. Instead, nutritional support should be given only to patients with identified nutritional deficiencies [11,13]. The most recent systematic review [14] concluded that nutritional supplementation reduces the number of new pressure ulcers but was unable to draw conclusions about the effect of enteral and parenteral nutrition on the prevention or treatment of pressure ulcers.

Pressure, Friction, and Shear

An individual's risk of developing a pressure ulcer needs to be assessed using both informal and formal assessment

processes performed by trained personnel with appropriate documentation so that all members of the interdisciplinary team are aware of the risk [13]. Pressure ulcer damage is believed to be caused by a combination of factors including pressure, shear forces, friction, and moisture [15]. Pressure must therefore be managed by proper positioning, turning and repositioning to relieve and redistribute pressure on a regular schedule, and employing appropriate transferring techniques. The head of the bed (HOB) should be maintained at the lowest degree of elevation consistent with medical conditions and other restrictions [11,16]. Keeping the HOB at 30 degrees or less reduces pressure, friction, and shearing forces on the sacrum. Other measures to minimize friction and shear include keeping the skin dry; using lift sheets, turning devices, and heel and elbow protectors; and employing overhead trapeze bars [6,17]. One way of reducing load on tissue, especially vulnerable tissue covering bony prominences, is to regularly reposition the individual. Scientific evidence, however, is limited regarding optimal frequency of repositioning and which positions are best for maximum pressure reduction [18]. Positioning needs should be determined by results of skin inspection and patient comfort, ability, and general state [13]. Use of pressure reducing devices has become increasingly common [5]. Devices can be defined as pressure relieving or pressure reducing, with the majority being pressure reducing [5]. Pressure-reducing devices are either nonpowered (static) or powered (dynamic), with dynamic devices being more costly. Static surfaces are stationary and work to distribute local pressure over a larger body surface. Examples include foam mattresses and devices filled with water, gel, or air. Dynamic devices use a power source to produce air currents and promote uniform pressure distribution over body surfaces. Examples include alternating pressure pads, air suspension devices, and air fluidized surfaces. Pressure-reducing surfaces have been found to be superior to a standard hospital mattress in reducing the incidence of pressure ulcers [5,11]. The results of studies comparing static with dynamic surfaces, or comparing surfaces within one of these categories, have been inconsistent [8].

Specialized support surfaces work by redistributing the patient's weight over skin and subcutaneous tissues as it presses against a bed or chair surface [19]. Patients with stage 1 or 2 pressure ulcers, or who are at high risk of pressure ulcer development, should be placed on a high-specification foam mattress or cushion with pressure redistributing and reducing properties and closely observed for skin changes [13,20]. For stage 3 or 4 pressure ulcers, or multiple pressure ulcers, an alternating pressure mattress or overlay, low air loss or air fluidized bed, air flotation, or viscous fluid device may be indicated [11,13]. The use of

foam rings, donuts, and sheepskin should be avoided [17], but medical grade sheepskin has been associated with a decrease in pressure ulcer development [20]. Ring cushions and donuts increase venous congestion and edema [11]. When using special mattresses or overlays, be careful not to elevate a patient to an unsafe height in relation to the bed rails, and make sure the recommended weight range is not exceeded. Also, the benefit of using any dynamic air mattress or flotation system is lost if the head of the bed is elevated to 30 degrees [5]. Costs, including those associated with equipment failures, as well as noise and comfort, need to be considered when selecting a pressure reducing device. Alternating pressure mattresses may be more cost-effective than alternating pressure overlays [20].

Best Practices—Local Wound Care

Wound Assessment and Reassessment

A comprehensive initial assessment of the pressure ulcer is vital to optimal management and begins with staging the pressure ulcer using the NPUAP classification system [19]. The initial pressure ulcer assessment also includes documenting its location(s), area (length and width), odor, pain, sinus tracts/undermining/tunneling, type and amount of exudates, type and amount of necrosis, local signs of infection, appearance of wound bed, exposed bone, granulation tissue, epithelialization, condition of surrounding skin, and wound edges [12,17]. To improve communication about pressure ulcer status over time and across disciplines and settings, the involved clinicians need to consistently use a valid wound assessment tool. Evidence-based tools used to monitor healing progress include the Pressure Sore Status Tool (PSST) [21]; Pressure Ulcer Scale for Healing [22]; Sussman Wound Healing Tool [23]; Sessing Scale [24]; and the Wound Healing Scale [25]. No evidence strongly supports the use of any 1 tool over the others [13]. The pressure ulcer should be reassessed weekly and during each dressing change to determine progress in wound healing and effectiveness of the selected treatment plan. If no improvement is noted, the treatment approach should be re-evaluated and altered as necessary. Patient adherence to the treatment plan should also be assessed [12,17].

Wound Cleansing

The pressure ulcer needs to be cleaned to remove devitalized tissue and to decrease bacterial burden [9]. The wound should be cleaned initially and with each dressing change using a noncytotoxic cleanser that does not traumatize the ulcer [11]. Pressure ulcers should not be cleaned with skin cleansers or with antiseptic agents such as povidone/iodine, iodophor, sodium hypochlorite, hydrogen peroxide, acetic acid, chlorhex-

amide, or cetrimide, which are all toxic to healthy granulation tissue [11]. Instead, normal saline solutions (0.9%), sterile water, Ringer's lactate, or noncytotoxic cleansers can be used [12]. The method for delivering the cleaning solution must provide enough pressure to remove debris without causing trauma to the wound bed [9]. An effective irrigation pressure stream for removing bacteria is about 8 psi [26] and should not exceed 15 psi [11]. In a recently published systematic review, only 3 studies addressed cleansing of pressure ulcers [27]. One noted a statistically significant improvement in healing for wounds cleansed with saline spray containing aloe vera, silver chloride, and decyl glucoside when compared with isotonic saline solution. Overall, there was not good trial evidence to support use of any particular wound cleansing solution or technique for pressure ulcers.

Debridement

Necrotic tissue is laden with bacteria [9,11] and forms a physical barrier to movement of epithelial cells striving to form new epidermis over the wound [28]. The presence of devitalized tissue on the surface of the pressure ulcer also impairs the body's ability to fight infection and promotes the growth of pathologic organisms [9,11]. Therefore, yellow and grey slough and black eschar (types of necrotic or devitalized tissue) need to be removed. Debridement removes nonviable tissue as well as protects against critical bacterial colonization and eliminates wound dead spaces that harbor bacteria [29]. Maintenance debridement is required to maintain the appearance and readiness of the wound bed for healing [11]. Surgical debridement is the fastest and most effective method for removal of large amounts of necrotic tissue, and is considered essential when cellulitis or sepsis is suspected [5,9]. Conservative sharp debridement is considered by many to be the most effective method, and involves the removal of layers of necrotic tissue using a laser, scissors, forceps, or curette. Nurses are able to perform sharp debridement with appropriate training. Sterile instruments should be used, and associated pain managed [12,16] using EMLA cream as a local anesthetic [28].

Autolytic debridement stimulates natural enzymatic activity, using the body's own endogenous enzymes to digest necrotic tissue. Moist interactive dressings allow natural wound fluid and its endogenous enzymes to soften and liquefy slough and promote granulation [11]. Semi-occlusive or occlusive dressings such as transparent films, hydrocolloids, and hydrogels are used in this process [9]. Autolytic debridement takes longer than other methods, but is painless and less stressful for the patient and the wound [9]. It is not recommended for infected wounds or very deep wounds that require packing [11,12,16].

Enzymatic debridement uses exogenous proteolytic enzymes to remove necrotic tissue. It is a slower method than surgical or sharp debridement and is labor intensive and expensive due to the need for once or twice a day applications. A 2008 systematic review concluded that enzymatic debriding agents are effective alternatives for removing necrotic tissue from pressure ulcers—for both adherent slough and eschar [30]. However, penetration of enzymatic agents may be limited in eschar, requiring either softening of the eschar by autolysis or cross-hatching by sharp incision prior to application [5]. Enzymatic debridement may be the primary technique in certain cases, such as when alternative methods (surgical or conservative sharp wound debridement) are not feasible due to bleeding disorders or other considerations [30]. Combined therapy (initial sharp debridement followed by enzymatic debridement) may also be effective for many patients [30]. Several enzymatic debriding agents are available commercially. Kravitz [29] concluded that Papain-urea is better for use on wounds with excessive necrotic tissue or eschar, and collagenase is better for wounds with excessive fibrous tissue; for mixed wounds of granulation, fibrous, and necrotic tissue; and for maintenance debridement.

The method least supported by evidence is mechanical debridement using wet-to-dry dressings or whirlpool treatments. Saline soaked gauze is applied to the wound and removed when it dries. This results in physical removal of slough and necrotic tissue from the ulcer. This approach is painful as well as nonselective, leading to removal of healthy, newly formed granulation tissue at the same time devitalized tissue is removed [11]. Another mechanical debridement approach is the use of high or low pressure streams or pulsed lavage, which removes loose necrotic tissue. However, excessive pressure may cause trauma to the wound bed [11]. Whirlpools may be used initially to loosen and remove debris, bacteria, exudates and necrotic tissue, but prolonged use and periods of wetness may macerate tissue or be associated with bacterial contamination [11]. High pressure fluid irrigation using Versajet is actually a form of sharp debridement, with the jet of water acting as a scalpel and able to be targeted at precise areas of the wound. Anderson [28] believes that this approach may help reduce the risks associated with surgical/sharp debridement.

Dry black eschar on heels that is nontender, nonfluctuant, nonerythematous, and nonsuppurative should not be debrided [17]. Only specially trained and experienced clinicians should attempt debridement using a scalpel. Surgical debridement is contraindicated if there is lack of expertise in this method, inadequate vascular supply to the wound, or in the absence of systemic antibacterial coverage in sepsis

[11]. Surgical and sharp debridement is contraindicated in patients with clotting disorders or malignant wounds and those receiving anticoagulant therapy [28]. Enzymatic debridement may cause skin irritation, a burning sensation, and erythema, and may actually harm healthy tissue [5].

Dressings

The principal function of a chronic wound dressing is to provide a moist healing environment [5], which is necessary for granulation and reepithelialization of tissue [11]. Moist wound dressings should keep the ulcer bed continuously moist and eliminate dead space while at the same time control the exudates to prevent desiccation of the ulcer bed and maceration of the periwound skin [11]. Selection of the specific dressing also requires consideration of ulcer location, risk of infection, healing phase, required dressing change frequency, where and by whom the dressing will be changed, and product availability and cost. Dressing removal should not traumatize the wound bed nor cause excessive pain [12]. The goal of care when selecting a dressing is “use the right product on the right wound at the right time” [9]. As the wound characteristics change over time, so should the choice of dressing [9]. Wound care algorithms are available to assist in the selection of the optimal dressing given the stage and characteristics of the ulcer [31]. For example, transparent film, hydrocolloid, and hydrogel dressings are appropriate for nondraining wounds while foam, alginate, and collagen dressings are appropriate for draining wounds. There is a professional consensus that an optimal wound healing environment is created by using modern dressings in preference to gauze dressings [32]. “Modern” dressings include hydrocolloid, hydrogel, hydrofiber, foam, film, alginate, collagen, and soft silicone dressings. Unfortunately, the evidence base related to specific dressing types and products remains weak. A 2007 systematic review [33] found hydrocolloid dressings to be superior to saline gauze or paraffin gauze for wound healing. These authors concluded that only weak level evidence exists on the clinical efficacy of any modern dressings with the exception of hydrocolloid dressings. A 2008 systematic review [8] found 54 RCTs that evaluated wound dressings. Five of the 7 highest quality studies found no difference in wound healing with the products they compared.

Occlusive dressings should not be used if an anaerobic infection is suspected or cultured [12]. Gauze dressings can impair wound healing because they lower wound temperature and impede fluid evaporation [9]. Infection rates were higher in wounds where gauze was used compared to wounds covered with transparent films or hydrocolloid dressings [34]. Collagen dressings should not be used for

patients with sensitivity to bovine products. Hydrogel dressings should not be used with heavily draining wounds, and transparent films should not be used on any exuding wounds [31]. Hydrocolloid dressings should not be used on infected wounds or for wounds with undermining, tunneling, or sinus tracts [31].

Best Practices—Controlling Bacteria and Infection

Colonization with bacteria is common and unavoidable in pressure ulcers [5]. The presence of microorganisms alone does not indicate an infection. The diagnosis must be based on clinical signs—erythema, edema, odor, fever, or purulent exudates [5]. If there is suspected infection in a debrided ulcer, or if contraction and epithelialization from the margin are not progressing within 2 weeks of debridement and relief of pressure, a tissue biopsy or validated quantitative swab technique can be performed to determine the type and level of infection [11]. Treatment of wound infection is managed by wound cleansing, topical antimicrobials that are effective against gram-negative, gram-positive, and anaerobic organisms (silver sulfadiazine, Iodosorb), and debridement [12]. Some guidelines recommend a 2-week trial of topical antibiotics for clean pressure ulcers that are not healing or that continue to produce exudates after 2 to 4 weeks of treatment.

The use of topical antibiotics in wounds should proceed cautiously and selectively [17]. For ulcers with a bacterial burden of $\geq 10(6)$ colony-forming units/g of tissue or any tissue level of beta hemolytic streptococci following debridement, the bacterial level should be decreased using a topical antimicrobial [11]. Once in bacterial balance, the use of topical antimicrobials should be discontinued to minimize possible cytotoxic effects or bacterial resistance [11]. Topical antibiotics are effective when used against sensitive organisms. Mupirocin ointment is effective against gram-positive organisms while topical metronidazole is effective for anaerobic organisms [5,35,36]. The topical antimicrobials neomycin and bacitracin should be avoided in chronic wounds given their significant potential to induce contact sensitivity [35]. Selected topical antiseptics may also have a role, although controversy persists in the literature regarding their efficacy and safety [8]. A modified Dakin's solution (concentration, 0.025%) is said to elicit antimicrobial effects without harming tissue [35]. Cadexomer iodine may be applied to promote absorption of fluid, exudates, debris, and bacteria from the wound bed while facilitating the release of iodine [35]. Silver ions are believed to be efficacious against gram-negative bacteria and antibiotic-resistant organisms such as methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci [35]. Silver has been

incorporated into many wound care dressings and products for prophylactic and therapeutic defense against harmful organisms, including gauze, hydrocolloid, alginate, and foam dressings as well as creams and gels [35]. A disadvantage of silver is that it causes irritation and skin discoloration. Unfortunately, there is a lack of robust data guiding clinicians in decisions about which bacteria silver is likely to be effective against and which delivery systems are suitable for which wound types [37]. However, the use of newer topical antimicrobials, particularly silver and iodine products, is increasingly being recommended as one component of management of wounds with problematic or increasing bacterial burden [38]. Clinicians need to be aware of contraindications to specific products and that overuse of silver or iodine may lead to bacterial resistance [38]. A recent meta-analysis [39] concluded that using silver dressings in wound management improves wound healing and patient quality of life. Systemic antibiotics should be used only for patients with documented bacteremia, sepsis, advanced cellulitis, or osteomyelitis [17]. The routine use of cytotoxic antiseptics to reduce bacteria in the wound is not recommended [12].

Adjunctive Therapies

Many adjunctive therapies have been proposed to facilitate wound healing. The WOCN clinical practice guideline recommends use of growth factor, noncontact, normothermic radiant heat, electrical stimulation, or topical negative pressure for recalcitrant stage 3/4 pressure ulcers [17]. Although emerging evidence suggests a potential benefit of adjunctive therapies for pressure ulcer healing, there are no studies that demonstrate their superiority over more traditional wound care approaches [8,11]. Only 1 clinical trial has supported the advantage of topical negative pressure therapy over saline gauze dressings in wound healing [13]. There is no evidence to support the use of ultrasound [40] or electromagnetic therapy [41] in chronic wound healing. Of 21 RCTs that evaluated adjunctive therapies [8], the highest quality studies showed no benefits to the tested interventions, including electrotherapy, laser, ultrasound, or hyperbaric oxygen.

Conclusion

Pressure ulcers are complex wounds for which there is no gold standard for treatment [5]. The basic principles of treatment include determining the stage, reducing pressure, friction, and shear forces on the wound, optimizing local wound care, managing bacterial contamination, and correcting nutritional deficiencies [5]. Unfortunately, the state of the science in wound care research does not provide clear support for many of the therapy decisions that must be made. There is an urgent need for high-quality clinical trials and other

types of studies to establish the efficacy and safety of commonly used treatments [8] and that utilize appropriate treatment comparisons and outcomes. There is also a need for construction of pressure ulcer databases to determine what works best in routine practice with typical patients—in other words, the generation of practice-based evidence under more typical clinical circumstances, supporting outcomes-based clinical management. Until these 2 goals are accomplished, clinicians will need to make decisions regarding pressure ulcer care based on fundamental wound care principles, cost, practicality, and patient preferences [8].

Corresponding author: Katherine R. Jones, RN, PhD, Sarah Cole Hirsh Professor, FPB School of Nursing, CWRU, 10900 Euclid Ave., Cleveland, OH 44106, katherine.jones@case.edu.

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