Evaluation and MANAGEMENT of Problem Pressure Sores

Enzymatic Debridement as Part of Treatment

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Pressure sores have been described as a "deadly nuisance,"[1] for they can result in sepsis and death—not to mention millions of dollars in health care costs. Because of their complicated nature, the management of pressure sores frequently becomes a sequence of trial and error as health care providers strive to find a suitable treatment.

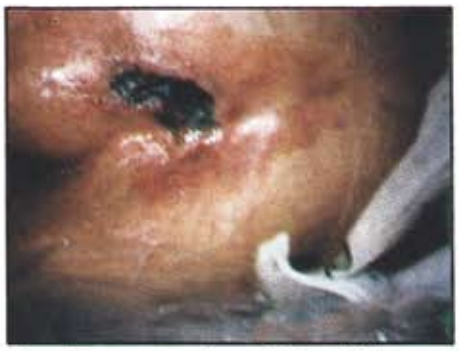
Despite vigorous intervention, pressure sores among the institutionalized elderly are often the most difficult to treat. This is tied to a high prevalence of dementia syndromes, urinary incontinence, immobility and nosocomial infection, as well as low staff-patient ratios. Additionally, the standard treatment of care is altered once tissue necrosis, cellulitis or wound debris (slough) occur. Therefore, among the institutionalized elderly, it is essential that providers strive to reduce high-risk conditions and improve diagnostic accuracy of the wound stage and associated clinical manifestations.

PRESSURE SORE EVALUATION

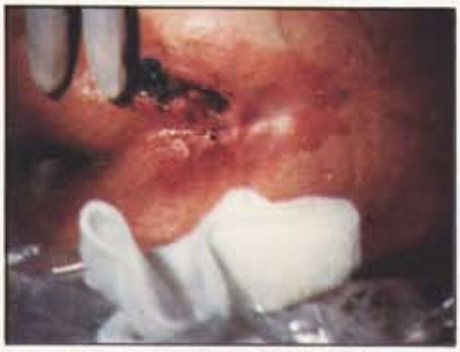
The first step in pressure sore treatment is to evaluate and determine the stage, size, location and number of sores. Once there is an impairment in tissue perfusion, a pressure sore can be defined according to the stage of progression. A Stage I wound is defined as an intact epidermis with a localized area of hyperemia. A Stage II wound extends beyond the epidermis and superficially involves the dermal layers. Once subcutaneous tissue is exposed, the pressure sore is considered Stage III. Stage IV pressure sores are those involving fascia, muscle and/or bone.

The size of a pressure sore is measured length by width by depth in centimeters. The depth of an open wound can be measured by inserting a clean cotton swab (moistened with saline) into the center point of the pressure sore. This maneuver can also aid in determining the presence of a sinus tract. The location and number of pressure sores provide important information about viable treatment options, which may vary if there are multiple sores within different clinical manifestations.

Pressure sores are considered "difficult to treat" if they fail to respond to standard



Dressing removed, used Panafil® in wound. *photos courtesy of Rystan Company Inc.*



Partial removal of used Panafil and exudate.

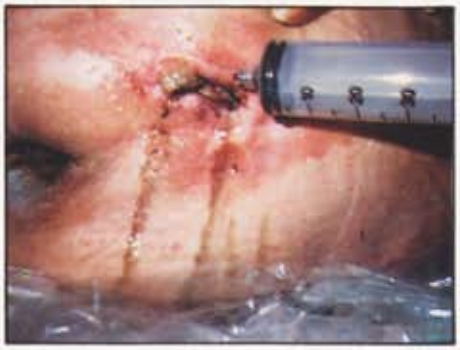
treatment modalities despite pressure relief. These problem wounds may arise from three potential sources or scenarios. First, among the elderly, nutritional and circulatory problems (peripheral vascular disease) may impede adequate tissue perfusion. Anemia, diabetes and protein calorie malnutrition, meanwhile, can result in decreased tissue oxygenation and subsequent paleness of the tissue. On examination, there is absence of healthy, beefy red granulation tissue. This clinical observation and medical diagnoses support the need for improved tissue oxygenation and/or nutrition. Unless medically contraindicated, supplemental oxygenation, calories and vitamins or minerals aid in treating these pressure sores.

Second, mismanagement of pressure sores through the application of caustic agents to healthy granulation tissue can result in altered wound healing. A classic example is the application of a topical solution like Dakin's solution (sodium hypochlorite) to what appears to be a stage II or stage III pressure sore. The solution can cause maceration of the healthy tissue surrounding the wound. The application of cleansing antimicrobial solutions has clear indications depending on the appearance of the wound. Topical cleansing agents with antiseptic properties can be used for wounds with infection. Irrigation of uninfected wounds at each redressing should involve saline or other non-cytotoxic solutions.

Third, the presence of cellulitis, wound debris and/or necrosis/eschar requires specific treatment measures. Pressure sores are considered "dirty" wounds once the epidermis is broken, since they are colonized by numerous aerobic and anaerobic bacterials. Common aerobe pathogens include *Proteus mirabilis*, staphylococcus species, *Escherichia coli*, *Klebsiella*, streptomonas species and Streptococci groups D and A. Common anaerobes include bacteroides such as *B fragilis*, clostridium species, peptococcus and peptostreptococcus.[2]

Clinical signs and symptoms of wound cellulitis indicate a need for antimicrobial treatment, which can include antiseptics or antibiotics. Recognized clinical signs of infection include warmth, redness, tenderness and/or purulent drainage from the wound. It is therefore important to palpate the tissue surrounding the wound to determine tenderness and/or increased warmth.

Cellulitis may be hard to diagnose in some older patients because of the atypical presentation of disease. There may be only slight increased warmth, redness or tenderness of the tissue. A febrile response or leukocytosis may not occur even in the presence of sepsis. For this reason, other signs of infection must be assessed, including: anorexia, malaise or change in level of consciousness. Once a wound has been affected by cellulitis, appropriate management includes topical and systemic anti-infective agents, and monitoring of the CBC and sedimentation rate (ESR). The ESR becomes an important marker for the presence of underlying deep infection.



Irrigation removal of remaining exudate.

Observation of signs and symptoms of wound infection cannot be overlooked as part of routine wound management. In one study, pressure sores that did not appear to be infected actually were associated with deep infections. In these patients, the majority had osteomyelitis beneath the pressure sore, confirmed by bone biopsy.[3] Wounds that heal slowly (after weeks or months of treatment) or not at all must be assessed for an underlying sinus tract to a deeper organ or chronic osteomyelitis. Diagnosis may be determined by an elevated sedimentation rate, X-ray, triple phase bone scan, gallium scans, CT scan and/or bone biopsy. Treatment involves antibiotic therapy and/or surgical intervention.

Bacteremia, sepsis and death have been reported as serious complications of pressure sores. In one study, bacteremia was documented in 16 of 21 patients. Mortality was 48% despite appropriate antibiotic therapy.[4] This finding underscores the serious nature of poorly healing or cellulitic wounds.

Slough or wound debris is characterized by a yellow, gray, green or thick exudate that typically covers the wound. Like eschar or necrosis, this substance impairs healing and debridement techniques should be initiated. Eschar appears as a blackened area of hard debris that covers the wound. It is impossible to accurately stage the pressure sore when the wound is covered by eschar. Necrosis may develop peripherally around the border and result in eschar if not removed.

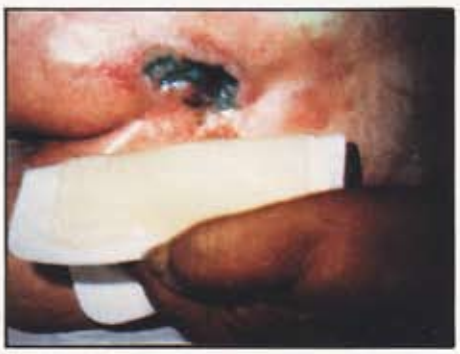
TREATING COMPLEX WOUNDS

Pressure-induced ischemia of the skin typically occurs between a bony prominence and an unyielding support surface, where the contact pressure exceeds capillary pressure (30 mmHg). In geriatric patients with compromised skin integrity, however, the critical pressure necessary to produce ischemia may be less. The area of compression and resultant ischemia is often cone-shaped, with the point of the cone at the skin surface and spreading out as it approaches the bone underneath.

It is common for clinicians to see patients with an apparent stage I or Stage II pressure ulcer that progresses to Stage III or Stage IV despite pressure relief intervention. In most cases, this is because tissue damage has already occurred. Shearing and friction forces can cause further damage, and the resultant dead tissue patterns cause tunneling and undermining of the open wound site. The apparent wound size usually increases before it decreases, as these damaged areas degenerate.

Necrotic skin tissue results from prolonged compression ischemia (usually 2 hours or more, but shorter times in those with reduced skin integrity). The cellular destruction unleashes a complex series of "clean-up" efforts by the body's defense and repair forces. These forces are dependent upon adequate nutrition, adequate arterial profusion and venous return, and pressure alleviation to prevent further damage. Additionally, adequate moisture is required to prevent dessication of new granulation tissue and permit migration of phagocytes into the wound area.

Eagelstein demonstrated in 1985 that a moist wound environment facilitates epithelial migration in superficial wounds and



New Panafil applied and new dressing (hydrogel type) ready to close.

induced granulation in chronic wounds. This landmark discovery led to further research and the development of occlusive and semiocclusive wound care dressings that foster the body's own autolytic debriding process. Under such dressings, the autolytic digestion of the necrotic tissue causes a foul smelling, purulent exudate. Certain hydrocolloid type dressings also "melt" or disintegrate in the wound site, causing further difficulties with rinsing and removal. Once infection occurs, autolytic dressings must be discontinued because they dramatically accelerate bacterial growth. The breakdown products of autodigestion are inflammatory to surrounding tissue, causing further tissue involvement, tenderness and inflammation.

Malodorous wound fluid discharge and slow debriding progress are negative considerations in choosing autodebridement, especially in individuals with impaired skin integrity or vascular supply.

For many decades, debridement has been accomplished by mechanical means using wet-to-dry gauze dressings. It is well known that cotton shrinks up to 30% upon wetting and drying, and in a wound site this process effectively entraps necrotic tissue that is extracted upon forcible removal. In addition to causing pain for the patient, the process effectively removes new granulation tissue, stunting the healing process with every application. Additionally, the frequency of wet-to-dry dressing changes is burdensome to caregivers and increases patient discomfort. Despite the widespread educational programs decrying the use of wet-to-dry dressings, they continue to be used, along with three damaging antiseptics (surgical scrub povidone-iodine, hydrogen peroxide and alcohol) known for their strong cytotoxic effect on new granulation tissue. In light of recent research, alternative dressing approaches featuring antibiotics and topical debriding treatments should be considered—and used routinely.

ENZYMATIC DEBRIDEMENT

The body responds to necrotic wound tissue as though it were foreign. If the wound site has been allowed to dry out (either by intention or omission of proper moisture-retentive dressings), this dead tissue will harden, darken and take on the appearance of leather. This eschar further impedes the healing process (unlike a scab) by obstructing the migration of cells and promoting occlusion and subsequent infection. If the necrotic wound site has been kept moist, it may develop infection because the decaying tissue is an ideal culture medium. Obviously, it would be ideal to remove the necrotic tissue rapidly, selectively and thoroughly.

Surgical debridement is indicated when the patient is a good candidate for the pro-

TOPICAL ENZYMATIC PREPARATIONS

Enzymatic Debriding Agent	Actions	Indications
Papain (proteolytic enzyme derived from the fruit of carica papaya) *Brand Names:* Panafil® Ointment (Rystan): contains standardized papain 10%, urea 10% and chlorophyllin copper complex 0.5% in hydrophyllic base. Panafil® White Ointment (Rystan): indentical to Panafil ointment except that the chorophyllin copper complex is omitted.	Digests necrotic tissue and liquifies fibrinous, purulent debris. Keeps the wound clean and promotes normal healing. Normally applied daily or twice daily. Longer intervals (2 or 3 days) between dressing changes have proved satisfactory.	Topical use as a debriding agent in acute and chronic lesions such as varicose, diabetic and decubitus ulcers, burns, postoperative wounds, pilonidal cyst wounds, carbuncles and miscellaneous traumatic or infected wounds.
Sutilains (proteolytic enzyme derived from *Baccillus subtilis)* *Brand Names:* Travase® Ointment (Boots Pharmaceuticals): composed of sutilains in hydrophobic ointment containing 95% white petrolatum 5% polyethylene.	Selectively digest necrotic soft tissue. Normally applied 3 or 4 times a day.	Removes necrotic material from second- and third-degree burns, decubitus ulcers, ulcers secondary to peripheral vascular disease, traumatic and pyogenic wounds.
Collagenase (enzyme derived from fermentation of *Clostridium histolyticum)* *Brand Names:* Santyl® Ointment (Knoll Pharmaceuticals), Biozyme-C Ointment (Armour): contains collagenase in base of white petrolatum.	Digest both denatured collagen and undernatured collagen; will not debride collagen in healthy tissue or newly formed granulation. Normally applied once daily.	Removes necrotic tissue from burns and ulcers.
Fibrinolysin and deoxyribonuclease (fibrinolysin derived from bovine plasma: deoxyribonuclease derived from bovine pancreas) *Brand Names:* Elase® Ointment (Parke-Davis): contains fibrinolysin, deoxyribonuclease and thimerosal in ointment base of liquid petrolatum and polyethylene.	Fibrinolysin dissolves fibrinous exudates and clots; deoxyribonuclease hydrolyxes deoxyribonucleic acid (DNA). Normally applied once daily up to 4 times a day.	Topical use as debriding agent in general surgical wounds, necrotic ulcers, second- and third-degree burns, following circumcision and episiotomy, intravaginally for cervicitis and vaginitis, as irrgant for infected wounds and otorhinolaryngologic wounds, and superficial hematomas.

cedure and the wound site is suited to such treatment. Often, it is desirable to minimize patient trauma and bleeding by using an enzyme debriding agent to soften and loosen the necrotic tissue mass for a few days prior to surgical debridement.

The presence of infection may also contraindicate an invasive procedure that could further spread infective organisms. Enzyme debriding, by contrast, selectively debrides the necrotic tissue and can be used during infection. Some debriding ointments can be used in conjunction with antibiotics for combined effect, either simultaneously or alternately (day/night).

Where adequately trained personnel are available and the necrotic tissue involvement does not threaten muscle, nerves or bone, surgical debridement offers a rapid and effective means of necrotic tissue removal. In inexperienced hands, however, it can produce significant tissue damage, nonselectively removing live and dead tissue and resulting in bleeding and pain. Stopping short of cutting into live tissue is desirable, but may leave some necrotic tissue behind. To thoroughly remove the remaining dead tissue after a conservative surgical debridement, enzyme debridement can also be used. This approach is also valuable where the wound is undermined or tunneling is present. If the enzyme ointment specifically targets necrotic tissue and does not attack live tissue, it can be applied "out of sight" and its enzymatic digestive action will remove the dead tissue selectively.

Except where immediate necrotic tissue removal is needed, enzyme debridement is the treatment of choice. It is obviously slower than excision, but has the advantage of being more selective, more thorough, less painful and more cost-effective. Not all enzyme debriding ointments are created equal, however. Some must be applied only to necrotic tissue (an indication of their less specific nature) and one, Panafil® ointment (Rystan Company Inc.), is not only specific but has an additional ingredient (chlorophyllin copper complex) to promote healing, deodorize the wound and help minimize inflammation of surrounding tissue by necrotic tissue breakdown products (Panafil ointment package insert). Two ointments, Panafil and Collagenase Santyl® ointment (Knoll Pharmaceuticals), contain enzymes that specifically attack collagen,[5] which constitutes to at least 75% of dry skin weight.[6] The papain in Panafil digests collagen with the assistance of its additional active ingredient, urea.[7]

DRESSING THE WOUND

A moist wound environment supports the cellular processes of healing, and is important to efficient functioning of the debriding enzymes as well. Moisture retention, however, is not the only criteria for choosing a dressing. The dressing contact surface must also be nonadherent, to minimize accidental removal of fragile granulation tissue. The dressing should have a high degree of absorbancy to remove the exudate generated by enzyme digestion. Hydrogel dressings are ideal because they satisfy all of these criteria.

Depending on the enzyme debriding agent selected, the dressing will need to be changed as frequently as the active enzyme "life" requires. Some products (Elase® ointment, Parke-Davis/Fujisawa and Travase® ointment, Boots Pharmaceuticals) recommend as many as three dressing changes per day. Prescribing information for Collagenase Santyl recommends one dressing change per day, while the prescribing information for Panafil recommends daily or twice daily dressing changes. Panafil's prescribing information also states that satisfactory results can be obtained with dressing changes as infrequently as 2 or 3 days, because of its wound-activated mechanism of action.

With all enzymatic debriding ointments, the full prescribing information should be reviewed to understand limitations and capabilities.

CONTRAINDICATIONS

Each brand of enzyme debriding agent contains a different enzyme or enzyme combination.[7] See the chart accompanying this article for information on these enzymes and other active ingredients. Adverse reactions may include mild, transient pain or burning sensation. Paresthesias, bleeding and transient dermatitis are listed as possible adverse reactions to Travase. Side effects severe enough to warrant discontinuation of therapy have occurred occasionally with Travase use, according to its prescribing information. Panafil use, meanwhile, is occasionally associated with irritation caused by profuse exudate. In such cases, dressings should be changed more frequently until exudate diminishes. This problem may be minimized with the use of modern dressings such as hydrogels.

CLINICAL OUTCOME

Whether enzyme debriding agents are used before, after or instead of surgical debridement, they can positively influence the clinical outcome by improving the selectivity and thoroughness of debriding. Panafil has demonstrated additional healing benefits as a result of the chlorophyll derivative included in the ointment. "Chlorophyllin copper complex adds healing action to the cleansing action of the proteolytic papain-urea combination," Panafil's package insert states. "The basic wound healing properties of chlorophyllin copper complex are promotion of healthy granulations, control of local inflammation and reduction of wound odors."

Specifically, chlorophyllin copper complex inhibits the hemagglutination and inflammation properties of protein degradation products in the wound, providing an additional protective factor, the Panafil literature states. The incorporation of chlorophyllin copper complex permits continuous use to help produce and maintain a clean wound base and to promote healing. This means that Panafil can not only be used for debriding but right through to wound healing and closure. When covered with an appropriate dressing, Panafil ointment produces rapid, selective and thorough debriding and promotes a beefy red granulation and healing. The papain enzyme is self-limiting when there is no more necrotic tissue, while the chlorophyllin copper complex operates to promote continuous healing.[8,9]

The treatment of complex dermal wounds and ulcers requires a full assessment of the patient's skin integrity, pressure alleviation, nutritional status, vascular sufficiency, medication and general health. In cases of pressure sores and other wounds that are difficult to treat, enzyme debridement may offer a rapid, safe and effective first choice or an adjunct to surgical debridement.

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