EVALUATION AND TREATMENT ALGORITHM FOR PRESSURE ULCERS BASED ON THE DIP PRESSURE ULCER CLASSIFICATION

Abstract
Pressure ulcers (PUs) continue to represent a significant cause of morbidity and expense, as well as a therapeutic challenge across medical settings. While there are several staging systems for PUs, and considerable efforts have been made to develop strategies for their prevention, there is a scarcity of research and clinical guidelines to help select therapeutic interventions for wounds of varying depth and severity. An algorithm based on the depth, infection and perfusion (DIP) classification is hereby presented to aid the clinician in the initial evaluation, classification and management of PU.

Key words: decubitus ulcer ■ evaluation ■ pressure-related injury ■ pressure ulcer ■ treatment ■ wound ■ wound care ■ wound healing

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Pressure ulcers (PU) are a common healthcare problem affecting patients across hospital and community settings. Despite increasing interest in developing risk assessment tools and prevention strategies, their evaluation and management continues to be largely based on personal experience and poses a significant challenge for healthcare providers. An algorithm was created to guide clinicians in the initial evaluation and classification of PU. It also provides general management guidelines for every grade and stage of the depth, infection and perfusion (DIP) classification.

Evaluation and classification of PUs

The first step in the algorithm (Fig 1) is to identify people at risk of developing a PU, such as those with reduced mobility, urinary or fecal incontinence, and those who are malnourished.[1] Once identified, a risk assessment tool such as the Braden Scale for Predicting Pressure Ulcer Risk[2] or the Norton Pressure Sore Risk-Assessment Scale Scoring System[3] can be used to assess their risk level. Appropriate primary or secondary prevention interventions to reduce their risk of developing a first or new PU should be undertaken for every patient based on their risk level; this may include frequent mobilisation, support surfaces, nutritional consultation and continence assessment and care.[4]

All subjects found to be at risk of developing a PU should have a thorough head-to-toe inspection to detect non-blanchable erythema, maceration, and areas of skin breakdown. Special attention must be paid to areas overlying bony prominences, such as the sacrum, heels, ischial tuberosities and occiput. Patients with risk factors but with no evidence of skin damage or patients whose PUs are now closed (grade 0) should be reassessed periodically.

If the physical examination reveals the presence of a PU, it should be classified into grades 1, 2 or 3 according to wound depth, or X if wound depth cannot be evaluated due to the presence of suspected deep tissue injury (SDTI), eschar or slough. It should be further classified into stages A, B, C or D depending on whether they show signs of infection, ischaemia, both or neither, respectively.

Studies to determine reliable signs and symptoms of PU infection are scarce; however, data on other hard-to-heal wound infections can be extrapolated. Table 1 shows suggested criteria for the identification of local and systemic wound infections as well as hospitalisation criteria based on those described by Lipsky et al. for diabetic foot

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Fig 1. *Evaluation and treatment algorithm for pressure ulcers*

At risk for PU
Physical examination
Correct risk factors:
• Mobilisation
• Surfaces
• Nutrition
• Continence
No active ulcer (0)
• Primary or secondary prevention
• Reassess periodically
Ulcer is present
Classify according to wound depth, signs of infection and ischemia
1A, 2A, 3A
Wound bed preparation
1B, 2B, 3B
Debridement, wound culture, empiric antibiotic, wound bed preparation
Management according to infection classification
1C, 2C, 3C
Maintain dry wound bed
Vascular consultation
1D, 2D, 3D
Surgical debridement, wound culture, empiric antibiotic, maintain dry wound bed, vascular consultation
Management according to infection classification
Non-gradable (X)
Signs of ischaemia?
YES
NO
Signs of infection
YES
Immediate debridement possible?
YES
Debride and regrade
NO
NO
XC: Maintain dry wound bed, vascular consultation
Signs of infection and ischaemia (XD): wound culture, empiric antibiotic, vascular consultation and referral for debridement
No signs of infection or ischaemia (XA): referral for debridement
Signs of infection (XB): wound culture, empiric antibiotic and referral for debridement

*For all grade 3 pressure ulcers, work up for osteomyelitis and consider NPT and/or surgical consult

infections.[5] Additionally, an increase in wound pain reported by the patient has been found to have a high positive predictive value for wound infection.[6]

Unlike PU in other areas, those located in extremities may be subjected to ischaemia due to peripheral arterial disease (PAD). The skin should be examined for signs of arterial disease such as paleness, coolness or dryness, hair loss and muscle atrophy. Peripheral pulses, especially on lower extremities, should be palpated during the initial physical examination and an ankle–brachial index (ABI) obtained, if possible. An ABI of 0.9–1.4 is considered normal. Lower values suggest PAD, while higher values are considered indicative of non-compressible blood vessels due to calcification.[7]

General management of PUs according to wound grade and stage

Non-gradable wounds (Grade X)

Non-gradable ulcers (grade X) do not allow for proper evaluation of depth. This is, therefore, in most cases, a temporary state that will change once the ulcer is debrided and proper evaluation becomes feasible.

When faced with a grade X ulcer located in a

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Table 1. Suggested criteria for the identification of local and systemic PU infections (modified from Lipsky et al., 2012[5])

Clinical manifestations	Severity of infection	Care modality
Presence of at least two of the following: ■ Local swelling or induration ■ Erythema ■ Local tenderness or pain ■ Local warmth ■ Purulent discharge	Mild local infection	Outpatient treatment
Local infection (as described above) with erythema >2cm or infection that involves structures deeper than the skin or subcutaneous tissue No systemic inflammatory response signs (as described below)	Moderate local infection	Inpatient treatment if systemic comorbidities, such as diabetes, severe peripheral arterial disease (PAD) or patient unable to comply. Otherwise, outpatient treatment
Local infection (as described above) with signs of SIRS, as manifested by ≥2 of the following: ■ Temperature >38°C or <36°C ■ Heart rate >90 beats per minute ■ Respiratory rate >20 breaths/minute or $PaCO_2$ <32mmHg ■ White blood cell count >12,000 or <4000 cells/μl or >10% immature forms	Severe (systemic) infection	Inpatient treatment

limb with signs of ischaemia (XC), debridement should be postponed until vascular evaluation can be completed. In the meantime, the wound should be kept dry to reduce the risk of infection.

For all other grade X wound stages (XA, XB and XD), debridement should be carried out as soon as possible and the wound regraded. If for any reason debridement is not possible at the time of initial evaluation, they may be managed as follows:

XA: Referral for debridement. In some cases, clinicians are faced with a wound with a stable eschar in a very old or terminally ill patient. The decision to remove a stable eschar from a non-ischaemic heel should be based on patient goals and prognosis.

XB: Obtain wound culture and initiate empiric antibiotic therapy. Refer for debridement.

XD: Obtain wound culture, initiate empiric antibiotic therapy, obtain vascular consultation. Refer for debridement.

Suspected deep tissue injury (SDTI) requires especial consideration. Since SDTI is a relatively new term, few studies have addressed its natural history and no consensus has been reached on its ideal management. SDTI classified as XA may be debrided and reclassified or it may be managed conservatively to prevent further damage, depending on physician and patient goals and preferences. If SDTI is associated with ischaemia, it should be classified as XC and managed according to the algorithm.

Gradable wounds

Grade 0: implement appropriate primary or secondary prevention and reassess periodically depending on patient risk level.

Grades 1A, 2A, 3A: debride necrotic tissue, use appropriate dressings to maintain moist wound bed and fill dead space as needed.

Grades 1B, 2B, 3B: debride necrotic tissue, obtain sample for wound culture, start empiric antibiotic therapy and use appropriate dressings to maintain moist wound bed and fill dead space as needed.

Grades 1C, 2C, 3C: maintain dry wound bed to reduce risk of infection. Obtain vascular consultation.

Grades 1D, 2D, 3D: Debride necrotic tissue, obtain sample for wound culture, consider topical antimicrobial therapy, start empiric systemic antibiotic therapy, maintain dry wound bed and obtain vascular consultation.

For all grade III PUs, consider using negative pressure wound therapy (NPWT) as it may reduce costs and time to closure.[8]

Grade 3 PUs and osteomyelitis

All grade 3 PUs should be considered at risk for osteomyelitis and worked up accordingly. The wound should be inspected to detect obvious signs of infection. A survey to the Emerging Infections Network of the Infectious Diseases Society of America showed that most infectious disease experts consider visible bone at the ulcer base and a positive probe-to-bone test as strongly indicative of osteomyelitis in stage IV (NPUAP) PUs.[9] Although not tested in PUs, studies on diabetic foot ulcers (DFUs) have shown that a positive probe-to-bone test has a sensitivity of 87% and a specificity of 83% for the detection of osteomyelitis.[10]

Workup may include blood tests and imaging to support the clinical suspicion of osteomyelitis, but bone histology remains the gold standard

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for diagnosis. A bone biopsy should be obtained regardless of imaging results to effectively rule out infection.[11,12]

Blood tests may reveal leukocytosis and elevated C-reactive protein but are neither sensitive nor specific for the diagnosis of osteomyelitis. Plain films of affected bone show periosteal reactive changes, bone destruction, sclerosis or cortical thickening and have a reported sensitivity and specificity for the diagnosis of osteomyelitis in PUs of 88% and 32%, respectively.[11,12] Magnetic resonance imaging (MRI) may show cortical bone erosion, abnormal signal of the marrow, deep collections or heterotopic new bone. It has a reported sensitivity and specificity of 98% and 89%, respectively, making it a useful tool to rule osteomyelitis out.[13]

If osteomyelitis is confirmed, infectious disease and surgical consultations should be obtained to initiate appropriate antibiotic therapy, carry out debridement of non-viable soft and bone tissue and consider surgical reconstruction of the wound.[11]

Reclassification of evolving wounds

Wound healing is a dynamic process, and every intervention may lead to a change in wound grade and depth. Therefore, clinicians should continually reassess and reclassify wounds to reflect their status. Once the wound has been reclassified, the algorithm can be used to guide subsequent treatment.

Conclusions

The treatment of PU remains challenging for healthcare providers and systems. While there is little doubt that the use of pressure-relieving surfaces and frequent repositioning are necessary to allow PU to heal, there is little consensus on wound-specific management strategies and their treatment continues to rely heavily on personal experience. Our algorithm provides a simple approach to evaluation and classification of PUs and general guidelines for their use. ■

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