World Council of Enterostomal Therapists

JOURNAL

THIS ARTICLE IS TAKEN FROM

VOL. 28 NO. 2

APRIL/JUNE 2008

REPRINT:

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Print Post No. 602669/00274

JOURNAL OF THE WORLD COUNCIL OF ENTEROSTOMAL THERAPISTS

AN ASSOCIATION OF NURSES

ISSN 0819 - 4610

Saving heels in critically ill patients

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ABSTRACT

Heel ulcers are an increasing nosocomial healthcare problem in critically ill patients. Because of the economic costs and patient morbidity, medical organisations concerned with quality of care have established guidelines and recommendations for reporting and preventing pressure ulcers. In October 2008, Medicaid and Medicare will no longer reimburse acute care hospitals in the USA at a higher rate for costs associated with the care of pressure ulcers that develop during hospitalisation.

A quick, easy, intuitive, effective, evidence-based algorithm for the prevention of heel pressure ulcers is presented. It requires five steps that include assessment of patient risks for heel ulcer development and interventions to protect the 'at-risk' heel. In addition, a model for identifying and preventing Achilles tendon contracture (foot drop) is presented as part of the overall care plan for the critically ill patient who is at risk for heel ulcers.

THE SCOPE OF THE PROBLEM OF PRESSURE ULCERS

Pressure ulcers are common in the acute and long-term healthcare setting worldwide. Heels are the second most common site of pressure ulcers, with the sacrum being the first. Prevalence rates for all pressure ulcers range from 4.94-25.1% in the acute care setting [1, 2]. In the US, the National Pressure Ulcer Advisory Panel (NPUAP) reported that the average incidence of pressure ulcers in hospitals is 7% [3]. Of these, about 30% are heel ulcers [4]. There is evidence that the frequency of pressure ulceration is increasing. Between 1993 and 2003, there was a 63% increase in the number of US hospital stays during which pressure ulcers were noted [5].

The costs associated with incident pressure ulcers are considerable. In a tertiary teaching hospital, hip fracture patients who developed pressure ulcers had a mean unadjusted hospital cost of US$37,288 compared to $13,924 for those who did not [6]. Costs of care for a pressure ulcer have been estimated to be as high as $70,000 for a complex full-thickness ulcer [7]. National costs in the US per year are estimated at $11 billion per year [8]. Drennan has proposed a simple formula to estimate costs related to heel pressure ulcers: numbers of heel ulcers × cost per ulcer (where the number of heel ulcers can be estimated as the number of hospital discharges × % acquired pressure ulcer prevalence × % heel ulcers) [9].

Some of the increased cost may be due to an increased length of hospital stay for those with pressure ulcers. In 2005, the average length of stay (LOS) for hospitalised patients in the US was 4.6 days [10]. During the 11 year period from 1993-2003, the mean LOS for primary treatment of pressure ulcers was 13 days, but LOS varied by patient age [5]. In patients with hip fractures, the mean LOS was 12.8 days for those without pressure ulcers and 30.4 days for those who developed pressure ulcers [6]. In a group of patients aged 18 and older, having a pressure ulcer led to a median excess LOS of 4.31 days [11].

In the US, the Institute for Healthcare Improvement (IHI) has made prevention of pressure ulcers part of its 5 Million Lives Campaign to reduce harm to hospitalised patients (www.IHI.org) [13]. This IHI initiative builds on the success of the 100,000 Lives Campaign by adding pressure ulcers as one of six additional interventions. The goal is to reduce the incidence of hospital-acquired pressure ulcers to zero by December 2008. IHI has several resources available to assist nurses in their efforts to reduce pressure ulcers. This includes a "How-to Guide" to prevent pressure ulcers which is available on their website (available at http://www.ihi.org/nr/rdonlyres/5ababb51-93b3-4d88-ae19-be88b7d96858/0/pressureulcerhowtoguide.doc).

Key strategies to reduce pressure ulcers can be found in Table 1. Two key components to minimising pressure include turning and repositioning at-risk patients every 2 hours to reduce or eliminate pressure [12]. Pillows and blankets may be used to assist in pressure reduction. Use the pillows under the calf to elevate the patient's heels off the bed surface and use cushioning devices between the legs and ankles to maintain alignment and prevent pressure on bony prominences. Specialised support surfaces can also be used to redistribute pressure over a greater area, thus reducing the amount of pressure over any one pressure point. Use lift devices or drawsheets to move a patient, and to minimise friction against skin over bony prominences [13].

Pressure ulcers are viewed as an indicator of the quality of healthcare and, as such, are a focus of attention in recent changes in state and federal regulations. As a signal of changes

to come, one US state requires a report within 3 working days of any stage III or IV pressure ulcers that develop during hospitalisation (not including patients with a stage II ulcer at admission that progresses) [14]. Federal regulatory changes will profoundly affect reimbursement. Starting in October 2008, the Centers for Medicare and Medicaid Services (CMS) will no longer reimburse providers at a higher rate for care of pressure ulcers that develop while a patient is in the acute care hospital [15].

PREVENTION

Critically ill patients are at particular risk for pressure ulcers and prevention should be geared toward identifying and addressing those risks. Patients in critical care units typically score poorly on general risk assessment tools such as the Braden, Norton, and Waterlow scales, and have a high incidence of risk factors specific to heel ulceration. Impaired oxygenation and perfusion render them even more vulnerable to the ischaemic effects of pressure [3].

Interventions to improve oxygenation and perfusion already form the core of critical care practice. Preventive strategies must also address the risk factors identified by the subscales of the Braden scale, i.e. sensory perception, mobility, activity, moisture, nutrition, and friction and shear (see www.bradenscale.com). Epidemiological studies have identified additional risk factors considered unique to the critical care population, e.g. use of vasopressors, comorbid conditions, severity of illness as measured by the APACHE scale, hypotension, or being too unstable to turn.

Several investigators have developed a pressure ulcer risk assessment tool for critical care. However, following a systematic review of this body of literature, De Laat and colleagues reported mixed results and concluded that there was no one specific risk factor that was consistently valid and discriminatory for this population [16]. The most effective assessment of pressure ulcer risk blends the results of general screening tools, such as the Braden scale, knowledge of individual risk factors common to the patient population, and nursing judgment.

Due to the special needs of critically ill patients, Blaszczyk and colleagues (1998) developed a Heel Pressure Ulcer Risk Assessment tool (HPURAT) from their medical intensive care unit (MICU) prevalence data, patient demographics, and pressure ulcer risk scales [17]. By identifying patients at risk for heel pressure ulcers and rigorously adhering to a risk stratified protocol, they were able to decrease pressure ulcers of the heels.

Table 1. IHI Key interventions for preventing pressure ulcers.

- Conduct a pressure ulcer admission assessment for all patients.
- Reassess risk for all hospitalised patients daily.
- Inspect skin daily.
- Manage moisture: keep the patient dry and moisturise the skin.
- Optimise nutrition and hydration.
- Minimise pressure with repositioning and support surfaces designed to redistribute pressure.

A number of strategies have been suggested to prevent pressure ulcers. These typically include early patient mobilisation, correct patient positioning on the bed or chair, and off-loading pressure sites. Black suggests interventions for patients with low Braden scores to reduce the risks of heel ulcers [18]. These interventions include elevating the heel and avoiding hyperextension at the knee for patients with immobilised lower extremities [18]. The best device is one that reduces pressure, friction, and shear; maintains heel suspension; prevents foot drop; and is comfortable and easy to use [18].

The use of an assessment tool, like the Braden scale, to identify high risk patients, combined with use of pressure-relieving heel boots, has proven effective in reducing heel ulceration rates. Walsh and colleagues found that patients with a Braden risk score of 16 or less, or patients with a score of 17-18 and any additional risk factor, benefitted from the use of pressure-relieving heel elevator boots. Patients in these risk groups who were given bilateral heel pressure-relieving devices had significantly fewer heel ulcers than the control group (χ^2=86.37/p<.01)[19]. In an observational study of high risk patients with Braden scores of 15 to 18, implementation of prevention with a heel pressure-relieving device reduced the incidence of heel ulcers by 95% during the intervention period [20]. In a small observational study of critical care patients with Braden scores of 18 or less or other risk factors, placing bilateral heel pressure-relieving devices prevented the development of heel ulcers over a 10 week observation period and led to significant healing in the 2 patients enrolled in the study with pre-existing heel ulcers [21].

Burdette-Taylor and Kass suggest assessing for perfusion, polysensory neuropathy/altered sensorimotor sensation, cognitive impairment, and nutrition and hydration to identify patients at risk [22]. They recommend heel protection interventions for these patients, including daily assessment, moisturisers, frequent turning, and pressure-relieving techniques, including use of pillows or a heel cushion/lift to reduce pressure on the heels [22].

Pillows have been used to relieve pressure on the heels, but the reports of outcomes conflict. Bale and others found that pillows, a foot stool, or a commercially available foot protector, are useful interventions that lead to improvements in the heel skin conditions [22, 23]. Others point out that it may not be possible to keep the heels of confused or restless patients on the pillows [17, 24]. Alford specifically notes that, although pillows are commonly used, little is known about how to effectively use them in practice [25]. Problems associated with their use include pillows that are too small to support both heels, not having pillows available for use, and pillow materials that do not provide adequate pressure relief [25] (Table 2).

UNIVERSAL HEEL ULCER PREVENTION ALGORITHM FOR CRITICAL CARE

Despite the introduction of guidelines for the prevention of pressure ulcers, it does not appear these have been effective in decreasing the overall rate of pressure ulcer formation [26]. Nonetheless, individual studies have shown, and articles have suggested, that intervention can be successful [7, 16, 17, 27-29]. A quick, easy, intuitive, effective, evidence-based pressure ulcer prevention initiative is clearly needed. Such an intervention can prevent the disability and pain from heel ulcers without interfering in other critical care objectives such as managing airway, breathing, and circulation (the ABCs).

A 5-step algorithm (Figure 1) developed by the authors that addresses prevention offers a simple, quick way to manage patients who are at risk for heel ulcers. Like any intervention, planning and practising the intervention is important in bringing the benefits to fruition.

Step 1: Primary stabilisation of airway, breathing, circulation, and drug infusions; elevate heels (ABCDEs)

When a patient is initially admitted to the intensive care unit, the first priority is stabilisation of primary physiologic functions. Although skin viability is not the first priority in this stabilisation process, it is important that skin care begin early. Elevation of the heels with a pillow placed under the full length of both calves as soon as possible after admission is the first step in protecting the vulnerable tissues of the heel. This simple step should be an automatic part of the admission routine, with extra pillows already available in the room when the patient arrives.

Table 2. Recommendations for heel ulcer prevention [17, 18, 22-24].

- Suspend the heel off the bed by elevating the patient's calf on a pillow, folded bath blanket or heel-lift device. Redistribute pressure over the length of the calf. Blankets or pillows folded under the Achilles tendon may cause more damage.
- Avoid hyperextending the knee or placing the pressure-relief cushioning under the Achilles tendon.
- Use moisturisers on the legs and feet.
- Use socks, dressings or heel protectors to reduce shear and friction.

Step 2: Secondary surveillance of skin and risk factors with special emphasis on the heels

Once the patient's ABC status is stabilised and drug infusions are titrated, a thorough assessment of the skin with a special emphasis on the heels should be conducted. The Braden scale should be done routinely upon admission to screen for general pressure ulcer risk. These assessments should be done before

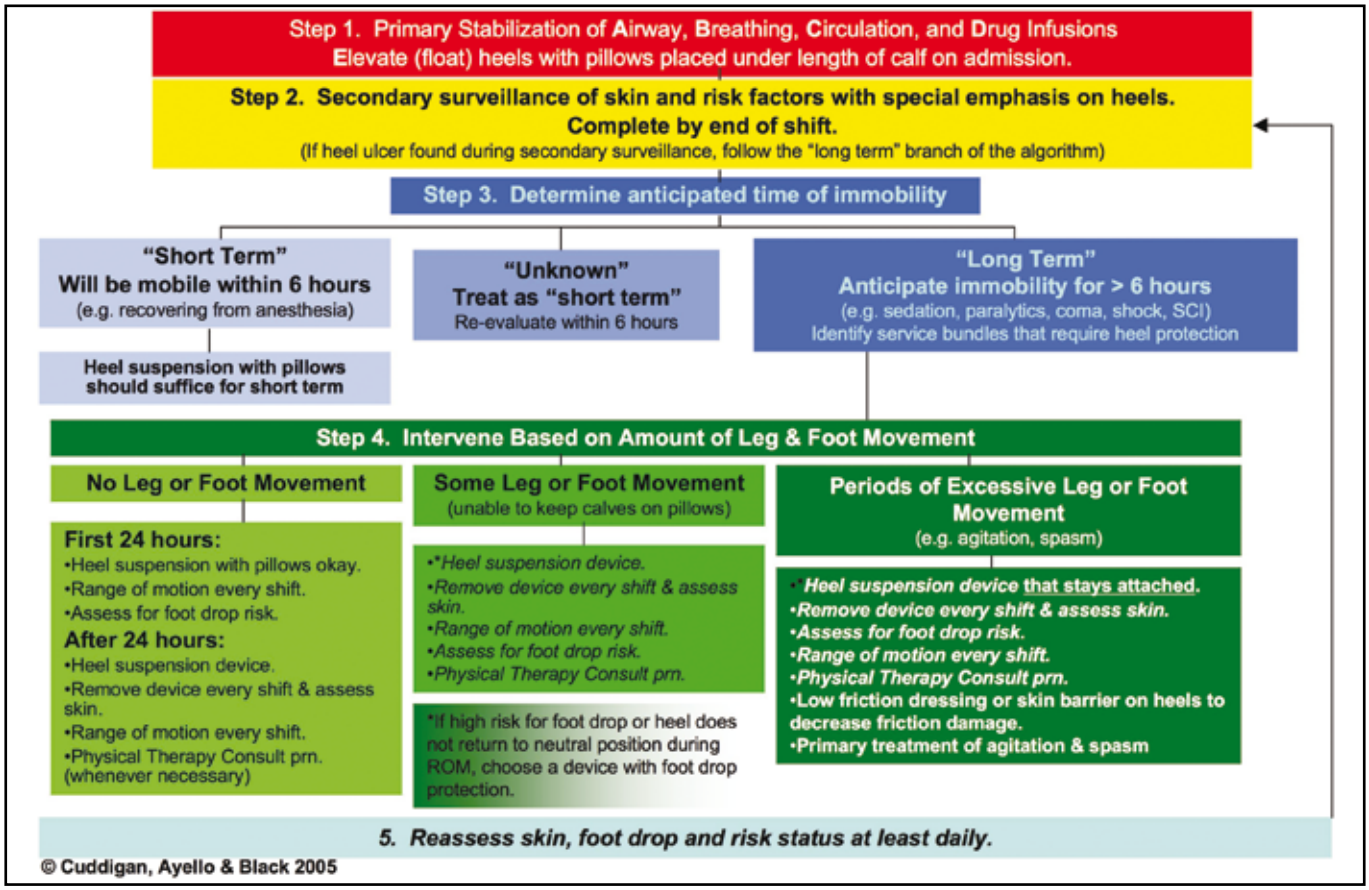

Figure 1. Universal heel pressure ulcer prevention algorithm for critical care.

the admitting nurse ends his/her shift. Assessment protocols can be found at www.bradenscale.com and in the ***Try This*** series: Predicting Pressure Ulcer (for the Hartford Institute for Geriatric Nursing) at www.ConsultGeriRN.org

Special attention should be given to the specific risks associated with heel pressure ulceration:

- Indications of poor perfusion, including a history of peripheral vascular disease, an ankle-brachial index of less than 0.75, a history of diabetes with circulatory impairment, current treatment with vasopressors, or feet that are cool to the touch and have weak or absent pulses at the foot or ankle.
- The presence of leg immobility and/or impaired sensation from neuropathy, sedation, paralytic medication use, coma, shock, spinal cord injury, stroke, or fracture of the hip or lower extremity.
- The presence of factors that increase friction or shear forces against the heel, including leg spasms or motor agitation.

Step 3: Determine anticipated time of immobility

The development of pressure ulcers is strongly associated with the intensity and duration of immobility [30]. Because of this, the choice of prevention strategies will be partly determined by the amount of time the patient will be immobile. If conditions are present that are likely to lead to long-term immobility (≥6 hours), then bilateral heel-suspension devices should be considered as part of the 'bundle' of preventive care measures typically done for such patients (e.g. ventilator bundle). If the time of immobility is difficult to estimate, approach the patient as if they will have short-term immobility, and then reassess the patient in 6 hours.

Short-term immobility interventions should include placement of pillows under the length of both calves to completely suspend both heels as an inexpensive, short-term intervention. Examples of patients who might require care for short-term mobility include those recovering from anaesthesia or short-term sedation. These patients should be reassessed after 6 hours and moved to long-term intervention if they remain immobile.

Long-term immobility interventions should be instituted if the patient will be or has been immobile for 6 or more hours. Patients in this category include (but are not limited to) those who are ventilator-dependent, sedated, immobilised by paralytics, in a coma, in shock, in traction awaiting hip surgery post fracture, or immobilised by a spinal cord injury or other trauma. Because a longer period of immobility is anticipated, these patients require more aggressive preventive management. The choice of preventive measures is determined in response to additional assessments of leg and foot movement, skin assessment, the presence of foot drop due to shortening of the Achilles tendon (Figure 2), and on-going risks. As noted previously, the institution may wish to make heel-suspension devices an automatic part of 'bundles' or services that are usually delivered together. For example, a patient on a ventilator will require mouth care products to prevent ventilator associate pneumonia, suction catheters, and heel-suspension devices due to immobility.

Step 4: Intervene to save heels – based on amount of leg and foot movement

Friction between the heel and the bed, linens, or other materials can cause direct tissue injury. Friction of the heels is commonly seen in confused or agitated patients and patients in pain as they move their legs in bed, abrading the heels on the linen. Heel friction can also occur with any immobilised patient, and can result from things as simple as pulling the patient up in bed if the heels drag. Lifting and turning the patient with a turn sheet may help reduce friction generated during turning and repositioning.

Patients with periods of agitation or spasticity are particularly prone to friction injury. Bots and colleagues found the use of self-adhesive hydropolymer foam dressings led to a nearly 77% reduction in heel ulcer formation in surgical patients [31]. Nakagami and fellow investigators found that shear forces were reduced with the use of low friction dressings, but that the use of such dressings alone did not substitute for the use of heel elevation in immobile patients [32]. Although there is a lack of published studies, the use of low friction topical agents (e.g. skin sealants, protective barriers, dimethicone containing topical agents) may also reduce friction.

With regard to leg and/or foot movement, if there is no movement, then ensure continuous suspension of the heels and prevention of heel cord shortening. During the first 24 hours, heel suspension with pillows under the length of the calves is often adequate.

Assess the patient in order to prevent foot drop from immobility (Figure 3). Foot drop can be defined as a significant weakness of ankle and foot dorsiflexion. However, the term 'foot drop' is a simple name for a complex problem. Foot drop can occur for several reasons – as a result of central nervous system disease or injury, spinal cord disease or injury, damage to the peroneal nerve (seen following orthopedic trauma to the lower leg and sometimes following knee replacement surgery), myopathy due to critical illness, or immobility that causes shortening of the

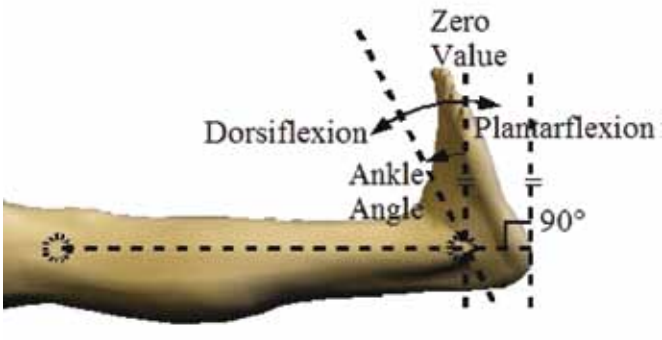

Figure 2. Anatomical picture of foot.

Achilles tendon (foot drop due to contracture). Diabetes can also lead to neuropathic changes in the foot, altering both sensation and motion. However, for the purpose of this article, we are restricting our discussion to foot drop caused by shortening of the Achilles tendon during immobility.

When the patient is supine, the toes are often extended. Prolonged periods of time in which the foot does not dorsiflex can lead to shortening of the Achilles tendon and subsequent foot drop. Risk factors for this type of foot drop include coma, pharmacologic sedation or paralysis, pre-existent neuromuscular disease resulting in leg weakness, diabetes, heavy tight bed linen that force the foot into plantar flexion (foot extension), and prolonged supine positioning. Plantar flexion also increases when the patient's feet do not touch the end of the bed or the floor when sitting in a chair.

Preventing foot drop from heel cord shortening begins with providing dorsiflexion to the foot. Range of motion (ROM) exercises should be done on the toes, ankle, and knee every shift. When stretching the joint, provide ROM for all motions and provide stretch until resistance is met. When stretch is applied to tight tendons or ligaments, resistance should be felt. It is not helpful to 'just maintain' ROM once it is lost, as the tendon will continue to contract.

Dorsiflexion of the foot is needed for ambulation. People with foot drop walk with a stepage gait due to the inability of the body to clear the foot during the swing phase of ambulation. This altered gait can increase the risk of falls. Boots for maintenance of a neutral foot position are imperative in high- risk patients and in patients whose foot does not achieve a normal ROM in order to avoid further loss of function. Early ambulation with the patient standing in shoes on the floor is ideal. When the patient is seated, be certain both feet are on the floor and the heels are touching the ground. Use foot rests as needed to prevent plantar flexion.

Physical therapists can assist with complex problems, especially those from neurological aetiologies. Braces to hold the foot at 90° are often needed for permanent problems. Stimulation of muscle groups may be needed. Surgery may be required in severe cases to lengthen the Achilles tendon. Complete proper ROM exercises every shift to prevent foot drop due to shortening of the Achilles tendon.

After 6 hours of no movement, most patients benefit from a device that suspends the heel. Such devices should definitely be used within 24 hours of no movement. If the patient is at risk for foot drop or the ankle cannot be placed in a neutral position during ROM exercise, then a device that also prevents foot drop should be used, and consultation with physical therapy should be considered. It is important to apply the device correctly and check the condition of the skin at least every shift for device-related pressure injury. Straps that are pulled too tightly on some devices can cause new pressure ulcers under the straps. Patients with a lot of oedema should be checked more frequently, as the oedema may increase, causing the device to fit too tightly. After ROM exercise, be sure to return the foot to a normal, neutral anatomical position (no external or internal rotation).

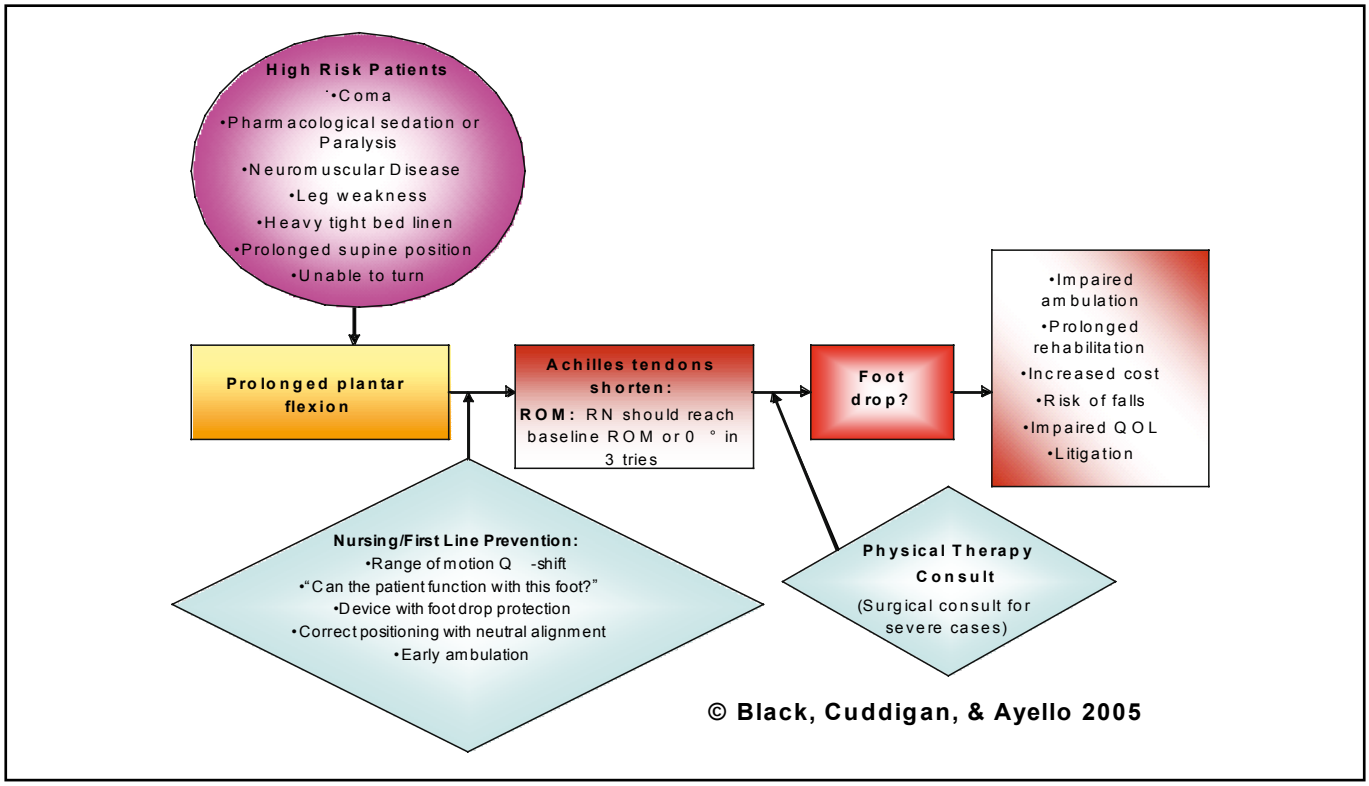

Figure 3. Preventing foot drop from immobility.

If there is some leg movement, then it is less likely it will be possible to keep a patient's heels suspended using pillows. For these patients, a heel-suspension device is a better choice. Protection with a heel-suspension device for foot drop may or may not be required, depending on the patient's ROM and risk for foot drop.

If the patient has periods of excessive leg movement from agitation or spasms, then the patient is at higher risk for friction-related skin damage (Figure 4). It is very unlikely it will be possible to keep the patient's heels suspended on pillows under these circumstances and using a heel-suspension device with or without foot drop protection will be more effective. It is helpful to attempt control of the movement with appropriate medical management of the underlying condition and behavioural management. In addition, consider skin barriers or low friction dressings to protect the areas that are at high risk for friction-related injury.

Step 5: Reassess the patient for skin changes, foot drop and risk status at least daily

Since a patient's condition and mobility status may change from day to day, it is important to reassess the patient at least daily, or preferably every shift in critical care units, to determine the adequacy of the intervention or the need for adjustments in the prevention approach. During the reassessment, note changes to the patient's oxygenation and perfusion status, responsiveness, activity level, skin moisture, nutrition, and whether or not they have undergone major surgery, as all of these alter the patient's risk [16]. Note whether new or changed friction or shear forces might be affecting the heel and if the current interventions are addressing these potentially injurious forces.

Assessment for foot drop can be done each shift at the time of the ROM exercises. Note if the ankle can be returned to a neutral position after the exercises. For most patients, the presence of a 90° angle between the long axis of the foot and the long axis of the leg is neutral. Some patients may have a slight (<10°) foot drop due to shortening of the Achilles tendon due to wearing high-heeled shoes. If there is significant resistance to passive dorsiflexion during the ROM exercises or the foot does not return to a neutral position after exercising, it is appropriate to consult physical therapy for an evaluation. The goal is to keep the patient's foot and ankle in a normal position to facilitate a return to baseline function such as walking or transferring to a chair (Table 3).

Figure 4. The 'at risk' heel.

Table 3. Easy steps to saving heels.

- Elevate (suspend) all heels on admission.
- Do secondary surveillance of skin prevention needs after ABCDs.
- Determine anticipated time of immobility.
- Intervene to save heels:
  - Suspend heels (devices or pillows under the length of the calves to 'float' the heels)
  - Prevent foot drop (that is foot drop due to shortening of the Achilles tendon)
  - Minimise friction
- Reassess at least daily.

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Remembering the steps

An easy way to remember the steps of the algorithm is with a mnemonic 'HEELS' (Table 4).

Table 4. 'HEELS' mnemonic.

- Have foot or leg movement?
- Evaluate heels and sensation.
- Evaluate foot drop risk.
- Limit friction.
- Suspend heels with devices as needed.

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CONCLUSION

Pressure ulcers on the heels are all too common, serious complications that may develop in immobile, critically ill patients. The heels are the second most frequently occurring site for pressure ulcers in adults. A hospital-acquired heel pressure ulcer can delay a patient's recovery and rehabilitation due to pain, difficulties in standing and walking, or falls. Stage IV wounds with bone exposed can lead to osteomyelitis and even amputation. Dorsiflexion of the foot is needed for ambulation. Additionally, people with foot drop walk with a stepage gait due to the inability of the body to clear the foot during the swing phase of ambulation; this altered gait can increase the risk of falls.

Prevention is paramount and may be facilitated by the use of an easy to use, easy to remember system for patient management.

The need for consistent preventive measures has taken on new urgency in the US with the introduction of a CMS policy that will deny higher reimbursement for any pressure ulcers acquired during the course of an acute hospital admission. The algorithm and model presented offer a quick, intuitive, easy to use, evidence-based strategy for reducing the risk of heel ulceration and foot drop due to Achilles tendon contracture.

ACKNOWLEDGEMENTS

The authors wish to thank Harriet Loehne, PhD, PT for her review and thoughtful critique. The authors would also like to recognise the medical writing and medical editorial efforts of Dr Donna Coffman and MedBio Publications. Development of this article was supported by an unrestricted educational grant from Sage® Products Inc.

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