Pressure Ulcers
REDDUCING INCIDENCE AND SEVERITY BY MANAGING PRESSURE

Interface pressure is the measure used to estimate the magnitude of the pressure being applied to the soft tissue over a bony prominence. There are concerns about the reliability of the techniques that are used to record interface pressure, however, as well as uncertainty regarding how the values should be interpreted in a clinical population.

Researchers continue to debate the value for interface pressure that best represents the threshold for tissue viability. Although the average arteriolar capillary pressure of 32 mm Hg often is cited as the upper limit for tissue viability, arteriolar capillary pressures as low as 12 mm Hg have been recorded in persons with peripheral vascular disease (Bennet, 1984). In this example, the value of 32 mm Hg would not be a safe estimate of tissue viability. A value of 32 mm Hg, which might be a safe upper limit for some patients, may not be a safe threshold for estimating tissue viability for all patients. This variability in arteriolar capillary pressure among people makes it difficult for nurses to interpret the clinical significance of interface pressure.

Complicating the task of interpreting interface pressure is the debate concerning what physiologic parameter should be considered when setting an acceptable upper limit for interface pressure. Although arteriolar capillary pressure is commonly used, Leung (1989) suggested that diastolic blood pressure be used to establish a safe upper limit for interface pressure. Other investigators suggested that venous or lymphatic pressures may represent tissue vulnerability to pressure injury better than arteriolar capillary pressure (Hol-

INTRODUCTION

It is not surprising that the term pressure ulcer has widely replaced the term decubitus ulcer. Pressure is the key factor contributing to the etiology of pressure ulcers. High pressure maintained over a short span, as well as low pressure maintained for a prolonged period, can cause soft tissue ischemia and necrosis (Kosiak, 1961). When predicting a patient’s risk for developing pressure ulcers and planning interventions to decrease pressure, the nursing staff must estimate the magnitude of the pressure that is being applied and the amount of time that will elapse before the pressure is relieved. They must assess both the intensity and duration of pressure.

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stein, 1979; Krouskop, 1983). There also is evidence that pressures in soft tissues at the junction between muscle and bone where many pressure ulcers originate are significantly greater than corresponding interface pressures (Khanh, 1984; Scott, 1980).

Given the controversy and uncertainty surrounding the use of interface pressure as an index of tissue viability, nurses may wonder what value this measure has for clinical practice. Until some of the interface pressure issues being debated are resolved, or a reliable and valid measure of tissue viability is provided, patient care would best be served if nurses used interface pressure readings as relative rather than absolute values.

Interface pressure readings can be used to identify bony prominences that are routinely subjected to high pressure and estimate the extent to which an intervention is likely to decrease pressure ulcer risk. Because interface pressures do correlate with pressures in deeper tissues, the lower the interface pressure, the lower the risk of soft tissue injury secondary to pressure. The extent to which the pressure must be lowered will depend on the general condition of the patient and how long the pressure will be applied.

Although it is difficult for nurses to assess the parameter of pressure intensity, nurses can readily assess pressure duration. By assessing a patient's level of mobility, the nurse can estimate the amount of time that a bony prominence is likely to be exposed to sustained pressure. (Mobility refers to the extent a patient is both capable of making and maintaining significant changes in position and is motivated to do so [Braden, 1989].) When assessing mobility it is important to focus on the patient's ability and motivation and not how often a caregiver is or should be repositioning the patient. The less capable or motivated the patient, the longer the pressure will be applied and the greater the risk of soft tissue ischemia and necrosis.

Factors that can affect a patient's level of mobility can be divided into three categories. There are those factors that actually affect the ability to reposition oneself. These may be related to the disease and include paralysis, fatigue and muscle weakness, or they may be related to such interventions as being in traction, intubated and tethered to a mechanical ventilator, or physically restrained.

The desire to change position is another category of factors that can influence mobility. Depression can decrease mobility. Pain and discomfort may influence a patient's willingness to change position. If the process of turning is associated with pain, patients may be unwilling to turn. If a certain position is associated with pain, patients may be unwilling to maintain that position. Furthermore, it is not uncommon for people to prefer one position and to persist in exercising that preference.

The third category of factors that can decrease mobility includes diseases and interventions that decrease a patient's ability to perceive pain. Physical conditions that damage the central or peripheral nervous system fall into this category, as do analgesics. In addition to diminishing pain associated with disease and injury, analgesics also may dampen pain associated with soft tissue ischemia, making this natural defense against prolonged pressure inaccessible to patients. Sedatives also may decrease mobility. Although this list of factors that can decrease mobility is not exhaustive, it does provide nurses with a frame of reference for assessing patient mobility.

The parameters of intensity and duration can be used for more than identifying patients and anatomical sites that are at risk for developing pressure ulcers; nurses also can use these parameters to intervene and minimize the risk of soft tissue injury secondary to pressure. Three categories of interventions that focus on altering either duration or intensity of pressure are positioning, repositioning, and support surfaces.

POSITIONING

High interface pressures are routinely recorded over the trochanters and heels (Berjian, 1983; Garber, 1982; Maklebust, 1986). When rounded areas like the hips and heels are carrying the weight of the body, the area that is available to carry this weight is small and pressure over these areas is high. Even when resting on a pressure-reducing support surface, pressures remain relatively high because these small areas do
not sink far into the surface. For this reason, when caring for patients with decreased mobility, it is important that nurses augment the pressure reduction that support surfaces provide with positioning strategies.

Several investigators compared using a side-lying position that places subjects directly on their trochanter with positions that shift weight onto the buttocks (Garber, 1982; Seiler, 1986). Significantly higher transcutaneous oxygen tension readings were obtained over the trochanter when individuals were positioned on their side at a 30° angle compared with positioning at a 90° angle, which placed them directly on their trochanter (Seiler, 1986).

Significantly lower interface pressures were recorded over the trochanter when subjects were positioned with the upper leg flexed at a 40° angle at the hip and 35° at the knee, and supported on a pillow behind the lower leg than when subjects were positioned directly on their trochanter (Garber, 1982) (Figure 1). Although the outcomes in these studies were changes in transcutaneous oxygen tension and interface pressure, and not the incidence of pressure sores, these studies provided preliminary evidence to support the value of using positioning to decrease the incidence of pressure ulcers over the trochanters. The Panel for the Prediction and Prevention of Pressure Ulcers in Adults (1992) recommended that caregivers avoid positioning patients directly on their trochanter.

The heels and prominent bones of the feet and ankles also merit special attention. Increased vigilance is indicated whether patients are supine or lying on their side. In a patient who is unable to reposition his or her lower extremities, the potential for soft tissue injury associated with the high interface pressures in these areas is compounded by the patient's inability to decrease the duration of time that these pressures are applied.

The Panel for the Prediction and Prevention of Pressure Ulcers in Adults (1992) recommended that caregivers use devices that totally relieve pressure on the heels when caring for patients who are completely immobile—the most common devices being those that raise the heels off the support surface. When placing these devices, it is important to ascertain that they also relieve pressure on the bony prominences of the ankles and feet. Donut-type devices are not recommended.

REPOSITIONING

Like positioning strategies, repositioning is designed to decrease the duration of pressure. Although there is little research to support how often patients who are at risk for developing pressure ulcers should be repositioned, the data that are available suggest that turning patients every 2 to 3 hours decreases the incidence of pressure ulcers (Norton, 1975).

When attempting to identify a turning schedule that will meet the needs of individual patients, nurses must weigh a variety of factors. These factors include the degree of immobility, presence of such factors as poor nutritional status that might affect the ability of soft tissue to withstand the injurious effects of pressure, and amount of pressure that is likely to be applied over a bony prominence.

The need to tailor the repositioning schedule to the demands of the situation is evident in what the Panel for the Prediction and Prevention of Pressure Ulcers in Adults (1992) recommended. When patients at risk for pressure ulcers are in bed, caregivers are advised to reposition them at least every 2 hours. This interval drops to every hour when patients are sitting in a chair and is shortened to every 15 minutes for patients who can shift their own weight. If care-
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givers cannot reposition seated patients every hour, then these patients should be returned to bed. Because repositioning patients can be accompanied by increased pain and discomfort, repositioning schedules should be consistent with goals related to pain control and comfort.

The shorter intervals for seated patients reflect the high levels of interface pressure that have been recorded over the ischial tuberosities (Garber, 1984; Houle, 1969). Depending on the surface, mean interface pressure over the ischial tuberosities ranged from 38 mm Hg for subjects seated on an alternating pressure contoured chair when the individual slats were exerting minimal pressure, to over 300 mm Hg for subjects seated on a hard flat surface (Kosiak, 1958).

SUPPORT SURFACES
Whereas positioning strategies and repositioning schedules focus on reducing the duration of pressure, use of support surfaces focuses on reducing the intensity of pressure. This usually is achieved by redistributing the pressure over a greater surface or alternating the points to which pressure is applied. A pressure-reducing support surface may be an overlay that is placed on top of a standard hospital mattress, a mattress that replaces the standard hospital mattress, or a bed. Although the number of products that nurses have to choose from is large, the evidence that is available to support the efficacy of these products has limited relevance to clinical practice.

Of the randomized, controlled trials that have been reported, only one included a group of patients nursed on standard hospital mattresses (Andersen, 1982; Daechsel, 1985; Whitney, 1984). These investigators found a significantly higher incidence of pressure ulcers in patients nursed on the standard mattress when compared with patients nursed either on an air or water mattresses.

All other comparisons in these three studies were between different types of pressure-reducing support surfaces. Andersen and associates (1982) compared an air mattress with a water mattress, Daechsel and Conine (1985) compared an alternating pressure pad with a silicone mattress overlay, and Whitney and coworkers (1984) compared a 4-inch convoluted foam overlay with an alternating pressure mattress. In all three studies, there was no significant difference in the incidence or severity of pressure ulcers. Although there is evidence that pressure-reducing support surfaces can decrease the incidence of pressure ulcers, there is no evidence that any one type of pressure-reducing support surface is more effective.

Nurses must address the paucity of scientifically sound data on the clinical effectiveness of pressure-reducing support surfaces. In most clinical settings, nurses are involved in selecting the products that they will use to prevent pressure ulcers. When reviewing product literature, they must look carefully at the outcomes the investigators measured. Values for interface pressure, oxygen tension, and blood flow are measures of intermediate outcomes and allow the user only to speculate on how effective a product might be in preventing pressure ulcers.

The outcomes that nurses must see to assess clinical efficacy are the number and severity of pressure ulcers that developed. Because nurses may select products, they must ask for studies that compare products and use statistical tests to determine whether there is a significant difference between support surfaces in the incidence of pressure ulcers. Merely examining the number or percentage of patients who developed pressure ulcers will not allow the nurse to infer efficacy. Finally, nurses must examine the design of the studies that they are given to determine whether a risk assessment scale with known reliability and validity was used to select patients for the evaluation and that patients were randomly assigned to products.

It will take time for nurses to influence the quality of the data that are available to them to make decisions about products. In the meantime, they are still faced with the task of selecting support surfaces that have the greatest probability of protecting at-risk patients from developing pressure ulcers.

Of all the information that is available to help nurses achieve this goal, values for interface pressure are the most abundant. A word of caution when using interface pressure to com-
pare products: the procedures and instruments that investigators use can affect the readings that are obtained. Because the size, shape, and positioning of the pressure sensor affects the absolute values of the pressure being monitored, interface pressures are not always comparable. If researchers presented interface pressures as percentages of pressures measured on a standard hospital mattress, nurses could more readily compare data across techniques.

Although absolute values for interface pressure provide little information that nurses can use to evaluate clinical efficacy, nurses can use them to rank the relative effectiveness of various products. Once again, the patient's general condition and the intervals that can be anticipated between repositioning will influence the extent to which interface pressure must be lowered to significantly decrease that patient's risk for developing pressure ulcers.

In addition to looking at the values for mean interface pressures, nurses must request information about the standard deviations. The standard deviation is a statistic that gives information about how widely the values vary around the mean. By examining the size of the standard deviations, nurses can get a picture of how consistently a product performs. The larger the standard deviation, the less consistent in preventing pressure ulcers the support surface will be.

When attempting to judge the clinical effectiveness of a support surface, nurses also should consider the composition of the sample that was used to record the interface pressures. Investigators who compared interface pressure readings obtained on healthy volunteers with those obtained on elderly patients reported that the pressures on the elderly patients were significantly higher (Clark, 1989). This suggests that the support surface might not be as effective in protecting elderly patients as it would be in protecting patients who were similar to the healthy volunteers.

When selecting foam products, nurses must be concerned with the thickness, stiffness, and density of the foam. Indentation Load Deflection (ILD) is a measure of stiffness and is the force (in pounds) required to press an 8-inch diameter circular object called a platen a certain percentage into a 16 × 16 inch slab of foam. When evaluating foam for a support surface, the value at 25% is commonly used. (Density is a measure of how much material is in the foam and generally is measured in pounds per cubic foot.)

The recommended range for these parameters for foam wheelchair cushions for patients who weigh between 50 and 300 pounds is a thickness of 3 to 4 inches, a 25% ILD between 40 and 70 pounds, and a density between 1.8 and 2.8 pounds per cubic foot. The recommended values for foam mattress overlays are a thickness of 3 to 4 inches, a 25% ILD of 30 pounds, and a density between 1.3 and 2.5 pounds per cubic foot. Nurses should request the values for these three parameters from those who produce and market foam support surfaces and use the values to help them be sure that the foam is the appropriate material for the user.

Support surfaces differ in the amount of time required to monitor and maintain them. Caregivers must check overlays that are filled with water or air to make sure that they are adequately inflated. How often a product must be checked will vary with the use environment; however, as a safety factor, air products should be visually checked daily to ensure that the support surface is not deflated.

Air products also should be checked weekly with a quantitative inflation gauge to ensure that the proper inflation level is maintained (Figure 2). Although these gauges may not currently be available in many practice settings, they are a more precise measure than a hand check. Therefore, in those settings where air cushions and mattress overlays are used, nurses should discuss the possibility of procuring several quantitative inflation gauges with the purchasing or biomedical engineering departments.

Water systems must be checked anytime that a leak is detected by the presence of a wet area or when a new user is placed on the support surface. A word of caution when
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using water mattresses with a heater: When the head of the bed is raised, ensure that the patient is not bottoming out and lying on the heating unit—thereby running the risk of being burned (R. Frantz, personal communication, October 8, 1992).

Caregivers should check overlays or cushions filled with water or air on a daily basis by slipping an open hand with the palm facing up between the overlay or cushion and the bed mattress or chair. They should be able to feel a 3/4- to 1-inch layer of air or water between their hand and the lowest part of the patient’s anatomy (e.g., trochanter, sacrum, heels, or ischial tuberosities). If there is doubt regarding whether the patient is bottoming out, an interface pressure evaluator can be used to ensure that the body is fully suspended. (Inexpensive interface pressure evaluators are commercially available.)

When air products are being used at home, it is useful to provide caregivers with a quantitative inflation gauge. By attaching the gauge to a properly inflated device and then marking the face of the gauge with a marker to indicate the position of the needle, it becomes easy for caregivers to check a product and ensure that optimal performance is maintained. (The term caregiver was chosen because nurses caring for home-bound patients must consider the level of compliance that they can expect from the individual responsible for either providing or overseeing the daily care.)

If the support surface being considered is powered by a motor, nurses must include information in their decision-making process about the reliability of the motor, warranties for parts and repairs, and who is responsible for maintaining and repairing the motor—as well as how quickly repairs can be completed. Support surfaces that are lying around in a basement or maintenance shop frustrate nurses’ efforts to protect patients at risk for developing pressure ulcers.

When considering surfaces that are powered by a motor for patients in their homes, nurses must request information about the cost of running these products and what happens to the product when there is a power outage. People who live on a fixed income may not be able to afford an increase in their electric bill and may attempt to control this additional expense by running the motor only a few hours a day. Additionally, a motor-operated support surface that deflates completely during a power failure does not protect the user.

Some of the other features nurses should consider when selecting a pressure-reducing surface are weight, durability, space required for storage, ease of cleaning, and cost. Air-filled products are lightweight and easy to clean, but can be punctured and may not be easy to repair. Liquid-filled products usually are easy to clean, but they are heavy, can be punctured, and may not be easy to repair. Gel-filled products can be cleaned easily and adjust to body movement, but are heavy, take up much storage space, and are expensive. Foam products are lightweight, inexpensive, and easy to modify, but they cannot be cleaned, wear out readily, have properties that change with time, and may support combustion.

EVALUATION

Whenever possible, the nursing staff should include patients in the process of developing a plan for decreasing pressure. If patients have family members or friends who want or need to be involved, the nursing staff should accommodate these individuals also. After the plan has been agreed on, the nursing staff should write it down and be sure that all those who will have a role in carrying out or overseeing the plan have the knowledge and skills they need to perform their roles. After implementation, the nursing staff should assess how well the plan is working.

Routine and systematic skin assessments are an essential component of any plan to decrease pressure and thereby decrease the risk for developing pressure ulcers. The Panel for the Prediction and Prevention of Pressure Ulcers in Adults (1992) recommended that the skin be assessed from head to toe daily, with particular attention to bony prominences. Because caregivers are repositioning patients who are at risk for developing pressure ulcers
throughout the day, the plan for assessing the skin can be worked into the repositioning schedule and not create a hardship on caregivers or patients.

Good lighting will help caregivers inspect the skin and is especially important when assessing patients with dark skin. Erythema is difficult to see in patients with dark skin; caregivers may need to use their hands to detect areas of induration or changes in skin temperature. The back of the head also may require additional attention; caregivers must separate the hair so that the scalp can be seen clearly.

Nurses must teach those who will be responsible for assessing the skin how to differentiate between reactive hyperemia and a stage 1 pressure ulcer. A stage 1 pressure ulcer is a nonblanchable erythema of intact skin that does not fade when pressure is removed (National Pressure, 1989). Reactive hyperemia is a blanchable reddening of the skin that occurs when pressure is removed. The reddened area usually will fade within one half to three fourths of the time that the pressure was applied (Lewis, 1925). Thus, an area of reactive hyperemia that is noted when repositioning patients who have been lying on their side for 2 hours should be gone within 1 to 1 1/2 hours.

Should a caregiver observe a stage 1 pressure ulcer, the nursing staff must reevaluate the plan for reducing pressure. It is important to ascertain whether caregivers have been able to adhere to the plan. If they have been able to comply with the plan, it is possible that the intervals between repositioning must be decreased or another type of pressure-reducing support surface must be selected. If caregivers are not able to comply with the plan, then the nursing staff must work with the caregivers to adapt the plan to what they can provide. Regardless of how the plan is adjusted, every effort should be made to keep patients from lying on a pressure ulcer.

Interventions will not prevent all pressure ulcers, but they will help decrease the risk of development and help minimize the severity of pressure ulcers that do develop.

SUMMARY

By estimating both the magnitude of pressure that is likely to be applied to an area and the time frame over which pressure is likely to be maintained, nurses can select interventions to decrease both parameters of pressure. Although these interventions will not prevent all pressure ulcers, they will help to decrease a patient's risk for developing pressure ulcers and help minimize the severity of any pressure ulcers that do develop. Without routine and systematic plans to monitor interventions, however, these potential benefits are far less likely to be realized.

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KEYPOINTS

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2. Although these interventions will not prevent all pressure ulcers, they will help to decrease a patient’s risk for developing pressure ulcers and help minimize the severity of any pressure ulcers that do develop.

3. Without routine and systematic plans to monitor interventions, however, these potential benefits are far less likely to be realized.


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