Pressure Ulcer Development in the Operating Room

Nursing Implications
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Susan Michelle Scott, RN; Patricia A. Mayhew, RN; Elizabeth Ann Harris, RN

The patient had surgery for repair of an abdominal aneurysm. The procedure lasted six hours. The patient’s skin was reported to be intact on admission to the surgical intensive care unit following surgery. On the second postoperative day, a 6 x 8 cm bruise-like area over the sacrum was reported. Despite treatment and preventive measures, by the sixth postoperative day, an 8 x 10 cm sacral lesion covered with eschar developed.

A scenario such as the one described here may indicate that a pressure sore developed during the surgical period. The incidence of pressure sores in surgical patients varies from 12% to 66%; however, the operating room as an etiologic factor is undefined. A study of surgical patients who developed unexplained burn-like injuries after lengthy surgical procedures concluded that these lesions were pressure sores. Three common factors in these

Susan Michelle Scott, RN, BSN, CETN, is an enterostomal therapy nurse, Veterans Affairs Medical Centers, Little Rock/North Little Rock, Ark. She earned her bachelor of science degree in nursing from the University of Central Arkansas, Conway.

Patricia A. Mayhew, RN, PhD, is an associate professor, University of Arkansas for Medical Sciences, College of Nursing, Little Rock, and a nursing research facilitator, John L. McClellan Memorial Veterans Affairs Hospital, Little Rock. She earned her bachelor of science degree in nursing from Florida International University, Miami, and her master of science degree and doctorate in nursing from the University of Texas at Austin.

Elizabeth Ann Harris, RN, MNSc, is the former nursing director of the surgical cluster,
burnlike lesions of unknown etiology were lengthy procedures, vascular surgery in which the patient's blood perfusion was low or interrupted, and sustained pressure because of immobility.

The time of immobility is even longer than actual time on the operating room bed given that prolonged pressure may begin with sedation and last during the time the patient is in the preoperative area, through the surgical procedure, and continue into the recovery period. Therefore, a long surgical procedure actually may mean many more hours of sustained pressure. Surgery is one of the few times when an individual who is not normally at high risk for pressure sore development is placed at high risk. When the patient has other risk factors, the risk of skin breakdown is exacerbated during surgery.

The relationship between sustained pressure during a surgical procedure and the development of a pressure sore is not always evident. The pressure exerted deep in the tissue is greater than the pressure at the skin surface; therefore, tissue damage is not always visible until long after the pressure was exerted. Pressure sores acquired during the surgical procedure may appear hours or days after surgery but typically develop 1 to 3 days after surgery, making linkage to the etiologic event difficult. Often, staff nurses are blamed for poor care when the patient may have incurred irreversible tissue damage before leaving the operating room. These pressure ulcers originate in the muscle overlying a bony prominence and progress outward. They usually progress rapidly and enlarge further before healing begins. The pressure ulcer first appears as a reddened area resembling a burn within 24 to 48 hours postoperatively (Fig 1). The area rapidly progresses to an ecchymotic area that resembles a bruise (Fig 2) or a dark discoloration in people with dark skin (Fig 3). In the next stage, the skin may form blisters or begin to peel, exposing the partial-thickness skin layers. Two to six days after the initial insult, necrosis is noted. The wound may progress to full-thickness tissue loss, which requires debridement and further treatment before healing will occur (Fig 4).

Pressure, Time

Many intrinsic and extrinsic variables are associated with pressure ulcer development; however, the ultimate cause is pressure. In skin breakdown, there is an inverse relationship between pressure and time period. The patient can stand a great amount of pressure over a short period of time or a low pressure over a longer period of time without sustaining tissue damage. Pressures that exceed capillary interface pressure (i.e., 25 to 32 mm Hg) can result in altered tissue perfusion and ischemia. Capillary pressures often exceed this, especially over bony prominences during surgery; therefore, length of time on the OR bed can be a significant contributing factor in intraoperative pressure ulcer development. In some cases, OR bed pads are one of the few variables that can be adjusted in a surgical procedure. These pads, plus extra padding in vul-

Elizabeth Ann Harris

University Hospital, Little Rock, Ark. She earned her bachelor of science degree in nursing and her master of nursing science degree from the University of Arkansas for Medical Sciences, Little Rock.

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vulnerable areas, may be instrumental in reducing pressure during the procedure. Conventional OR bed pads are foam, usually 1 to 2 inches thick, and covered with black conductive laminated vinyl fabric. These pads may be hard and offer little pressure relief for patients.

Recent progress has been made in the development of pressure-reduction OR bed pads. Newer pads use
- fabric with a multidensity foam core or
- foam, gel, and flexible conductive laminated vinyl fabric to achieve lower pressures.

A study compared a conventional pad with each of these two newer types of pads. The pad using the fabric with a multidensity foam core had the lowest interface pressures for all bony prominences in all positions. All of the pads were unacceptable (ie, they did not reduce pressure below 32 mm Hg) in relieving pressure for the heels and back of the head in the supine position, the trochanter in the lateral position, and the knee cap in the prone position. This suggests that particular attention and extra foam or gel protection devices may be needed in these vulnerable areas.

Both advanced technology pads were able to reduce pressure to 32 mm Hg or less in the supine position for the sacrum and scapula, in lateral position for the ribs, and in the prone
position for the shoulder. This appears to indicate that advanced technology in operating room pressure reduction pads is helping decrease the risk of pressure ulcer development during surgery by decreasing pressure levels over bony prominences. This study reports on pressure readings alone, however, and we found no clinical trials that examined patient outcomes in terms of pressure ulcer development when advanced technology bed pads were used. Proper use of these advanced technology pads probably will reduce the incidence of pressure ulcer development in the operating room, but the risk still is present.

In addition to pressure and time, extrinsic and intrinsic factors also contribute to pressure ulcer development.

**Extrinsic factors**

Skin moisture, shear, negativity (ie, when layers of cloth decrease the pressure-reducing ability of the OR bed pad), and heat may impinge on the outer layers of the surface of skin, decreasing its tolerance to pressure.

**Moisture.** Exposure of the skin to moisture leads to maceration, which weakens the natural barrier of the epidermis. Pooled fluids used in skin preps can be a breeding ground for pres-
The patient's nutritional status may contribute to pressure ulcer development.

Perioperative nurses must be careful to keep all dependent skin surfaces dry during surgical procedures. **Shear.** Another principal factor in pressure sores acquired in the OR is shear. Shearing occurs when outer layers of the skin slide, resulting in tearing of the underlying tissues. Tissue damage at sites other than bony prominences, especially the buttocks, probably results from shear. Perioperative nurses should note that placing patients in an unusual position may contribute to this type of skin breakdown. Conscious patients may be able to transfer and position themselves on the bed. This will reduce friction and shear in moving. Patients also are more likely to position themselves so that as much pressure as possible will be alleviated. If patients are unable to move, nurses may use turn sheets to assist in lifting and reduce shear. Patient transfer systems such as rollers or air transfer devices also may be used to reduce frictional forces during transfers. In addition, transparent dressings placed over high risk areas, such as elbows, the sacrum, and heels, may assist in reducing these forces.

**Negativity.** Negativity can be seen as a significant risk factor for skin breakdown during the intraoperative period. Negativity is created when layers of cloth or material decrease the pressure-reducing ability of the OR bed pad. The draping procedure, therefore, becomes very important in preventing pressure ulcers. In one study, eliminating as many layers of cloth or material between the patient and the OR bed pad decreased sacral pressure readings. Perioperative nurses must keep in mind that each layer (eg, sheets, hyperthermia blankets) added to the bed will decrease the pressure-reducing capabilities of the pad.

**Heat.** Heating blankets used to prevent hypothermia also may aggravate the development of pressure ulcers. Tissues respond to heat with increased metabolic rates that require a greater cellular need for oxygen and nutrition. In a patient whose perfusion is already compromised by the immobility of surgery or vascular procedures, this may result in tissue damage. The time required for pressure damage may be shortened compared to that of tissue that is not being warmed. A possible solution is to reduce the use of these blankets during surgery. If this is not a viable solution, other means, such as the use of pressure-relieving pads, may need to be explored. Operating room pressure reduction pads with both heating and cooling capabilities are being developed. This technology could be instrumental in addressing this problem.

**Intrinsic factors**

Intrinsic factors, especially nutritional status, influence the integrity of the skin and support structures, particularly collagen and elastin, and diminish the ability of soft tissues to absorb and tolerate pressure. Other intrinsic factors that affect pressure ulcer development include age and blood perfusion.

**Nutrition.** Nutritional status may contribute to pressure ulcer development. Low albumin levels are associated with pressure sore development in the elderly. Nutritional intake before and after surgery often is compromised and may contribute to this problem during the perioperative period. A thorough nutritional assessment should be done on all high-risk patients. Patient history, ideal body weight, physical assessment, and laboratory values including albumin, pre-albumin, transferrin, total lymphocyte counts, and total protein can be used to assess nutritional status and degree of nutritional risk.

Generally, patients are nutritionally at risk if they are less than 90% or more than 120% of their ideal body weight.
The nurse’s knowledge of risk factors, causes, and prevention of skin breakdown is crucial in predicting potential problems.

Ideal body weight. Recent weight loss or being NPO for more than five days also puts the patient at risk. Other nutritional risk factors include chronic disease, history of alcohol intake, and protracted nutrient losses as with malabsorption, renal dialysis, or draining wounds. Drugs such as chemotherapy, steroids, and immunosuppressants also affect nutritional status. These patients may benefit greatly from preoperative nutritional therapy. Patients must have positive nitrogen balance to promote wound healing and prevent skin breakdown. Although the perioperative nurse may be unable to correct nutritional deficiencies, once aware that the patient has them, he or she can anticipate that the patient may be at increased risk for pressure sore development and plan to protect and position the patient appropriately.

Other Risk Factors

Because patients are under anesthesia, they are immobilized and subject to sustained pressure. This also creates alterations in vascular status and therefore places the patient at greater risk for tissue damage. Anesthesia also may cause suppression of the immune system for a period after surgery. Hypovolemia and anemia associated with withholding fluids before surgery as well as blood loss during surgery may contribute to pressure sore development as well.

Conclusion

Pressure ulcer occurrence brings pain and suffering to the patient and can be financially devastating to a health care facility. More than $10 billion was spent on pressure ulcer treatment in the United States alone in one year. New and improved prevention techniques are needed in all hospital settings where patients are prone to excessive pressure and immobility. The operating room is one such setting.

The perioperative nurse’s knowledge of risk factors, causes, and prevention of skin breakdown both within and outside the operating room suite is crucial in predicting potential problems. Accurate preoperative and postoperative skin assessments are essential for documenting incidence. Early detection of skin changes by the OR staff may enhance early treatment and preventive measures to reduce further complications from the surgical procedure.

Research is needed to document the incidence of pressure ulcers acquired in the OR. Investigation also is needed to identify risk factors that are significant in predicting pressure ulcer development in the OR and to develop risk assessment tools sensitive to the surgical experience.

Clinical research trials are needed to test the effectiveness of pressure-reducing OR bed pads as well as the effectiveness of other interventions designed to decrease the incidence of skin breakdown during the perioperative period. Multicenter studies will probably be necessary to generate truly representative data on this subject. We still have much to learn about pressure ulcer occurrence and prevention in the surgical patient during the perioperative period. One thing we do know is that the perioperative nurse is a key person in recognizing and preventing the problem. The perioperative nurse can make a difference.

Notes

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