

SKIN CARE INTERVENTION FOR PATIENTS HAVING CARDIAC SURGERY

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- **BACKGROUND** Pressure ulcers are a major problem after cardiovascular surgery, occurring in 9.2% to 38% of patients.
- **OBJECTIVES** To determine the effectiveness of a skin care intervention program in preventing development of ulcers or progression from one stage to another and to determine the extent to which selected risk factors were associated with development and progression of pressure ulcers.
- **METHODS** A simple interrupted time series design was used. The protocol involved interrelated assessment, staging, and type of intervention provided. The Braden Scale was used to determine risk for skin breakdown.
- **RESULTS** Of the 351 patients in the study, 327 (93%) maintained skin integrity and 24 (7%) had skin breakdown. Breakdown by stages was as follows: stage 1, 62% ($n = 15$); stage 2, 29% ($n = 7$); stage 3, 4% ($n = 1$); and stage 4, 4% ($n = 1$). Age, sex (female), and heart failure were statistically significant risk factors for breakdown ($P = <.001$, .02, and .02, respectively). The mean scores on the Braden Scale of the breakdown group differed significantly from those of the skin integrity group from days 2 through 5 after surgery ($P = .01$). Seventeen (71%) of the breakdowns occurred during the first 4 days after surgery.
- **CONCLUSIONS** Skin assessments and nursing interventions should be increased on the day of surgery and the first to fifth postoperative days, including multiple assessments and skin care focused on maintaining skin integrity. (*American Journal of Critical Care*. 2003;12:535-544)

Pressure ulcers remain a significant healthcare problem, particularly among older persons, persons who are debilitated, and persons with immobility. Further, patients who need major surgery have multiple risk factors, many of which become exacerbated with surgery. Pressure ulcers are a serious problem after cardiovascular surgery, occurring in from 9.2% to 38% of patients.¹ A pressure ulcer is defined as any lesion caused by unrelieved pressure that results in damage to underlying tissue; pressure ulcers are considered both inevitable and preventable.²

Prolonged pressure and compression of tissue are major contributing factors to the development of pressure ulcers.^{3,4} These forces cause 2 primary processes to occur at the point of localized pressure: occlusion of blood vessels due to external pressure and endothelial damage in the microcirculation to such a point that the damaged tissue area cannot remove toxic cellular materials and excess fluids. Small relative changes in pressure distort the tissue and occlude microcirculation, and necrosis may ensue within a few hours.⁵

Two factors influence the development of pressure sores in surgical patients: intrinsic factors particular to each patient and extrinsic or environmental factors. Intrinsic risk factors of importance include age, comorbid conditions, nutritional status, body size, mobility status, activity level, and body temperature.^{6,9} Extrinsic

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factors that intensify the effects of other risk factors include heat, shearing, friction, and moisture.⁹ Pressure ulcers that originate during surgical procedures may appear within a few hours postoperatively, but most usually occur 1 to 3 days after surgery.¹⁰

Patients are highly vulnerable to pressure ulcers after cardiac surgery.^{1,10,11} Age, preoperative morbidities, diabetes, and hypertension are contributing factors in these patients.^{6,8,12-14} Factors such as length of time on the operating table, restricted movement, and assaults on skin integrity such as shear and friction also contribute to skin damage, and diagnostic procedures and cardiac assistive devices are associated with skin breakdown.^{11,15-18}

Cardiac surgery patients are at high risk for pressure ulcers because of restricted movement associated with surgery, diagnostic procedures, and cardiac assistive devices.

Determining the relative influence of various factors in the development of pressure ulcers is difficult. Pressure is a key factor, and interventions will not always prevent ulcer development. However, interventions can decrease risk and minimize severity.²

Many ulcers are prevented in immobile or mobility-impaired patients by use of simple interventions that involve shifts in body position, cushions for bony prominences, and frequent turning, all of which reduce compression and pressure on vulnerable parts. Turning patients every 2 hours is an effective preventive approach, but with reduced nursing staff in hospitals today, this intervention is too expensive to continue for long periods.¹⁹ Consequently, during the past 10 to 15 years, ulcer management has shifted to use of new technologies that require less personal care from health-care providers. Today, prevention of pressure ulcers and retardation of their progression include use of mechanical, pharmacological, surgical, and correct body-positioning techniques.

The cost of preventing pressure ulcers may be far less than the cost of high-technology treatments and continued hospitalization. Pressure ulcers are a significant, independent predictor of both hospital costs and length of stay.^{16,20-22} For patients who have iatrogenic pressure ulcers, the mean hospital cost is \$1877 greater and the length of stay is 4 to 7 days longer than for patients who do not have pressure ulcers.⁶

The results of several studies related to prevention of pressure ulcers have been reported since the 1992

publication of *Pressure Ulcers in Adults: Prediction and Prevention*,² the guidelines of the Agency for Health Care Policy and Research (now the Agency for Healthcare Research and Quality). Many researchers^{2,23-28} focused on a single intervention, such as massage, small shifts in body position, turning and positional changes during surgery, protective devices, topical lotions, specialty beds and support surfaces, and the use of external tissue expansion devices. Studies on the effectiveness of programs to prevent pressure ulcers in acute care patients generally addressed risk assessment, interventions to reduce pressure, staff education, and improved documentation of skin condition.²⁹⁻³² In most of the studies,^{1,33-36} the frequency of pressure ulcers decreased 3.5% to 24% after a prevention program was implemented. In several investigations,³⁷⁻³⁹ protocols combining staging and nursing actions were used. However, the application of preventive and/or management protocols has not been consistent in daily routines.^{1,40,41}

Numerous problems with the methods used in the studies to date make interpretation and comparison of the findings difficult. Investigators often relied on the use of a single setting with small samples. High-risk patients were often not identified, development of pressure ulcers was poorly defined, and the inclusion of stage 1 ulcers varied. Often only a single assessment was made after implementation of a prevention program, and some researchers provided a description of the program without any indication of how interventions were linked to risk factors. Thus, many questions about the effectiveness of programs to prevent pressure ulcers remain unanswered. Additional research is needed that links risk factors and process measures (intensity and consistency of interventions delivered) to clinical outcomes (occurrence or retardation of pressure ulcers).

Therefore, we investigated the pattern of development and progression of pressure ulcers in patients who had elective open chest cardiac surgery. Our specific aims were to determine the effectiveness of a skin care intervention program (SCIP) in preventing development of pressure ulcers or progression from one stage to another more severe stage and to determine the extent to which selected risk factors were predictors of the development and progression of pressure ulcers.

Methods

The study was conducted in 2 intensive coronary care units for patients who have open chest cardiac surgery in a medical center in the South. In a hospital-wide prevalence study in 1997-1998, part of the com-

Table 1 Simple interrupted time series plan

Time	Day of admission (1)	Time	Day of surgery (3)	Time	Days after surgery (3-6)
AM	T ₁ Assessment T ₁ Intervention	AM	T ₃ Assessment T ₃ Intervention	AM	T ₅ Assessment T ₅ Intervention
After surgery					
PM	T ₂ Assessment T ₂ Intervention	PM	T ₄ Assessment T ₄ Intervention	PM	T ₆ Assessment T ₆ Intervention

Total assessments: 12
Total interventions: 12 (additional ones as needed if staging progressed)

prehensive quality management program, the nosocomial rate of pressure ulcers by unit/division was examined a few months before our study. Reports generated by the quality management department indicated a 40% prevalence in the cardiac surgery intensive care unit (CSICU) and a 10% prevalence in the cardiac surgery intermediate unit (CSIU). The nursing leaders in these units were asked to address this situation.

The standard protocol for preventing and managing pressure ulcers in the units consisted of the following:

- a skin assessment in which the Braden Scale⁴² was used at the time of admission to the unit,
- a step-by-step plan of care with specific actions specified if breaches in integrity were noted,
- identification of risk factors,
- documentation on a flow sheet of the care provided, and
- a list of education and self-care activities patients were to engage in as they were able.

Several explanations were suggested by staff for the lack of effectiveness of this standard skin assessment: an increase in the number of open chest cardiac procedures, changes in criteria such that patients with high risk factors were now undergoing surgery, uncertain consistency and accuracy of assessments and risk ratings by personnel, and acceptance of patients for open chest cardiac surgery who had multiple comorbid conditions.¹¹

Intervention Protocol

The following changes were made in the standard skin care protocol, and the revised protocol was tested in this study:

- a skin assessment with staging and risk factor scores was done at the time of admission to the unit before surgery;
- a skin assessment that included staging and risk factor scores was done twice each day of hospitalization, irrespective of previous staging and scores;

- preventive actions were taken at the time of admission to educate patients, irrespective of risk factor scores and staging of skin integrity;

- a cluster of actions was established for each stage of skin assessment; and

- the enterostomal therapist was promptly notified if or when risk factor scores decreased to 16 and if patients had breaches of skin integrity greater than stage 2, since these measures indicated that risk levels were increasing.

Setting and Subjects

Patients were admitted to an 745-bed regional medical center where approximately 1000 to 1200 patients have cardiac surgery each year. All patients admitted for open chest cardiac surgery for a 6-month period were considered for the study. Patients were included if they were more than 18 years old, had coronary artery bypass graft and/or valve surgery, and were admitted to the CSIU or the CSICU. Patients were excluded if they received mini bypass grafts or had mitral valve surgery, because of the shortened length of stay.

Data were collected on all patients who met the study criteria and were admitted to the 8-bed CSICU, which provides intensive care for cardiac surgery patients, or to the 26-bed CSIU, an intermediate care unit that serves patients who require monitoring before and after surgery. In order to avoid the ethical dilemma of withholding a standard intervention, the SCIP was used for all patients in the study, and patients were categorized after discharge into 2 groups: those who had pressure ulcers during their hospitalization and those who did not.

The medical center's institutional review board approved the study protocol. The board waived the requirement to obtain informed consent because the nursing interventions to maintain skin integrity consisted of standard nursing and medically ordered actions already used at the medical center.

Table 2 SCIP Prevention and Management Activities for Nursing Interventions and Medical Orders*

<u>Stage assessment</u>	<u>Cluster</u>	<u>Recommended activities</u>
Stage 0 No redness or breakdown	A	Walking, sitting in chair <u>Patient education about:</u> need to - Dangle - Increase activity/mobility levels as appropriate on each post-op day - Maintain adequate nutrition <u>Self-help activities</u> - Butt lifts - Elbow elevations - Heel hoists - Weight shifts - Report promptly any area of skin discomfort - Emphasize need for patient participation in these self-care activities
Stage 1 Erythema only: redness does not disappear for 24 hours after pressure is relieved	B	Stage 0 activities as appropriate <u>plus:</u> <u>Nursing actions</u> - Skin cleansers (standard care products) - Heel protectors and elevations - Positioning (pillow, etc.) - Air cushions as appropriate - Elbow protectors <u>Medical actions</u> (per/order) - Transparent dressing - Hydrocolloid dressings
Stage 2 Break in skin such as blisters or abrasions	C	Staging 0 & 1 activities as appropriate <u>plus:</u> <u>Nursing actions</u> - Skin cleansed with normal saline - Static air cushion use - Fecal containment apparatus (prn) - Use other moisture barriers <u>Medical actions</u> (per/order) - Wound gels (prn) - Transparent dressings - Wound gels - Absorptive dressings
Stages 3, 4 & 9 (or E-Eschar) Stage 3 Break in skin exposing subcutaneous tissue Stage 4 Break in skin extending through tissue and subcutaneous layers Stage 9 Dark necrotic tissue. (Use this or E-Eschar until tissue sloughs, then continue staging)	D	Stage 0, 1, & 2 activities as appropriate <u>plus:</u> <u>Nursing actions</u> - Pack ulcer with sterile normal saline (prn) - Irrigate with saline - More frequent positioning <u>Medical actions</u> (per/order) - Culture wound - Apply topical antibiotics - Special absorptive dressings - Special packing gauze - Surgical/enzymatic debridement (prn) - Specialty beds as appropriate

*The term post-op indicates postoperative; prn, as needed; SCIP, skin care intervention program. The skin assessment tool of Bergstrom⁴⁴ was used for stage assessments.

Table 3 SCIP Protocol Documentation Checklist*

Patient's name: _____ Admission date: _____ Hospital #: _____

Skin care staging guide

Instructions:

- Stage 0 No redness or breakdown
- Stage 1 Erythema only: redness does not disappear for 24 hours after pressure is relieved
- Stage 2 Break in skin such as blisters or abrasions
- Stage 3 Break in skin exposing subcutaneous tissue
- Stage 4 Break in skin extending through tissue and subcutaneous layers, exposing muscle or bone
- Stage 9 Dark necrotic tissue. (Use this rating or E-Eschar until tissue sloughs, then continue staging)

1. Refer to guide for staging assessment and place stage number by (S).
2. Refer to Braden Risk Factor Scale to assess risks. Use numbers at top of scale to get a score. Enter total score beside (RF).
3. Refer to SCIP protocol activities for nursing interventions for each stage of ulcer development. Select a cluster by A, B, C or D appropriate for assessment of stage. Enter cluster designation under heading.

Day	Nursing assessments	Findings	Nursing action(s) selected by cluster by designation (A, B, C, D) or combinations of these	
Admission day	Skin assessments • Staging • Risk factor score	(AM)	(S)	_____
			(RF)	_____
		(PM)	(S)	_____
			(RF)	_____
Operative day	Skin assessments • Staging • Risk factor score	(AM)	(S)	_____
			(RF)	_____
		(PM)	(S)	_____
			(RF)	_____
Post-op day 1	Skin assessments • Staging • Risk factor score	(AM)	(S)	_____
			(RF)	_____
		(PM)	(S)	_____
			(RF)	_____

*Post-op indicates postoperative; SCIP, skin care intervention program.

Study Design

A descriptive interrupted time series plan⁴³ was used (Table 1). The SCIP was followed through the standard length of stay of 6 days for all patients admitted to the cardiac care units.

The study design accommodated repeated interventions, which had variations within the standard protocol. Threats to validity were controlled through standardization of activities and clustering of interventions, use of reliable/valid instruments, and enroll-

ment of all subjects with comparable types of surgery who met inclusion criteria.

Intervention

Each patient received independent therapeutic nursing interventions to maintain skin integrity twice daily from admission to discharge, and education was provided to patients about how to perform selected activities on a self-help basis. In later stages of ulcer development, therapeutic nursing interventions were

combined with designated medical treatments commonly used to manage pressure ulcers. Nursing actions were guided by the SCIP (Table 2), according to skin integrity and risk factor assessments.

For example, cluster A nursing actions were recommended activities for patients with no redness or signs of breakdown. These activities included having patients walk and sit in a chair and educating patients about the need to dangle their legs; increase activity as appropriate; maintain adequate nutrition; perform self-help activities, such as butt lifts, elbow elevations, heel hoists, and weight shifts; and promptly report any skin discomfort. Cluster B activities were nursing actions for patients who had stage 1 breakdown; cluster C, for patients with stage 2 breakdown; and cluster D, for patients with stage 3 and stage 4 breakdown (Table 2, Recommended Activities). Wound dressings were in clusters B, C, and D and were listed in a generic format such as transparent dressing, hydrocolloid dressing, wound gels, and absorptive dressing.

The 2 kinds of intervention activities, nursing and medical, were arranged in clusters and related to the stage of ulcer development. No effort was made to determine the relative influence of each of the therapeutic nursing interventions. Nurses indicated that they might use several of the therapeutic interventions at one time, depending on their clinical judgment of patients' needs. The focus was on whether clusters of nursing interventions would be effective for maintaining skin integrity.

The SCIP Protocol Documentation Checklist (Table 3) provided a systematic progression record that integrated assessments, risk factors, nursing interventions, and nursing and medical interventions. The assessment conducted at the time of admission provided data on both staging and risk factors. These data were recorded on the checklist. Documentation on the checklist was organized by day for the twice-daily assessments. After assessments and evaluation of risk factor scores were completed, staff selected the activity cluster that best fit the skin integrity staging assessment. The relevant information about the selection was entered in the appropriate area on the checklist for each assessment. Staff then implemented the interventions selected.

For each patient, at the end of the average hospital stay (6 days), the checklist provided a running account of assessments made every 12 hours, from the time of admission to discharge; the status of the patient's skin integrity; risk factors; and the interventions that were provided. Underlying the organization of the prevention and management activities was an assumption that well-known nursing actions would

Table 4 Characteristics of the sample

Variable	Patients with skin breakdown (n=24)	Patients without skin breakdown (n=327)	P
Female, %	58	35	.02
Age, mean (SD), years	72 (5.9)	63 (11.0)	.001
Time from admission to surgery, mean (SD), days	4 (4.3)	2 (2.1)	.001
Time from admission to hospital discharge, mean (SD), days	21 (29.1)	7 (3.9)	.001
Time from admission to hospital discharge, median, days	12	6	NA

NA indicates not applicable.

prevent pressure areas and retard progression to more serious involvement of tissues.

Training of Nursing Staff

Training of the nursing staff in the study units consisted of videotapes demonstrating use of the Braden Scale to measure risk factors and the staging procedure to update experienced staff and train new staff. Each staff member watched the tape as many times as needed until he or she understood the protocol and the way the assessments and risk factors were to be measured and recorded.

Data Collection Instruments

Demographic data collected included age, sex, length of stay, height, weight, body mass index (calculated as weight in kilograms divided by the square of height in meters), initial medical problems (comorbid conditions), and previous vascular surgery. The Braden Scale⁴² was used to measure risk factors for development of pressure ulcers.^{24,45-47}

The Braden Scale is composed of 6 subscales used to measure the variables of activity, mobility, sensory perception, nutrition, moisture, and friction and shear. The subscales are scored from 1 (least favorable) to 3 or 4 (most favorable). Scores are summed for a total score, which ranges from 6 to 23; lower scores indicate higher risk for pressure ulcers. Sensitivity of 100% and specificity of 90% and 64% have been reported for predictive validity.^{24,45,48} Test-retest reliability is reported as $r=0.95$.⁴⁸ In this study, patients with a Braden Scale score of 16 or lower were considered at risk for pressure ulcers because this score is an optimal one for prediction of outcomes of patients who have pressure ulcers.^{45,48} The Braden Scale was used to measure risk

Table 5 Clinical risk factors for patients who did and did not have skin breakdown*

Risk factor	No. of patients	
	Patients with skin breakdown (n=24)	Patients without skin breakdown (n=327)
Hypertension	75	62
Body mass index >25	57	74
Diabetes	50	32
Heart failure	42	20†
High cholesterol levels	29	35
Previous myocardial infarction	21	25
Chronic obstructive pulmonary disease	21	11
Previous vascular surgery	12	4

*All numbers are percentages. Body mass index was calculated as weight in kilograms divided by the square of height in meters.

† $P = .02$.

factors at the time of admission and then every 12 hours throughout the hospital length of stay.

Skin condition was assessed by using a skin assessment tool that shows bony prominences and requires the assessor to note the presence or absence of pressure ulcers at each site.⁴⁹ The form has construct validity and can be used to collect data on 99% of possible pressure ulcer sites.⁵⁰ Assessment of pressure ulcers provided information about the classification, stage, and location of ulcers. Ulcers were staged according to the plan proposed by the Agency for Health Care Policy and Research Panel³ for predicting and preventing pressure ulcers in adults.

Collection of Data

Each patient's record included a demographic sheet and the SCIP Protocol Documentation Checklist throughout the patient's length of stay on the CSIU or CSICU. Assessment and intervention data were collected at each observation and were recorded at the time of admission and then every 12 hours until the patient was discharged (Table 3).

Results

The prevalence of pressure ulcers decreased from 11.7% before implementation of the SCIP to 6.8% during the intervention period. Of the 351 patients in study group, 24 (7%) had pressure ulcers during their hospital stay. Table 4 summarizes the characteristics of the patients who did and did not have skin breakdown. The breakdown group included significantly more women, was significantly older, had a longer length of stay, and required a longer wait before surgery than did the nonbreakdown group.

Table 6 Day on which skin integrity was first breached among patients with skin breakdown (n=24)

Day	No. of patients		Total	% *
	Ulcer stage			
	1	2		
Of admission	0	0	0	0
Of surgery	5	1	6	25
After surgery				
1	2	0	2	8
2	2	0	2	8
3	3	0	3	12
4	3	1	4	17
5-12	4	2	6	25
47	0	1	1	4

*Percentages do not total 100 because of rounding off.

Table 5 gives the clinical risk factors in the 2 groups. The most common risk factors in the group without skin breakdown were hypertension, obesity, elevated cholesterol, and diabetes. In the group with breakdown, the most prevalent risk factors were hypertension, obesity, diabetes, and heart failure. The prevalence of heart failure was significantly higher in the breakdown group. The mean number of risk factors per patient was 3.2 for the breakdown group and 2.6 for the nonbreakdown group ($P < .05$).

Twenty-five percent of skin breakdowns (stage 1) were present at the end of the day of surgery; most occurred by postoperative day 4.

None of the patients had pressure sores at the time of admission. Among the 24 patients who had skin breakdown, 19 (79%) had stage 1 pressure ulcers and 5 (21%) had stage 2 ulcers at the initial breakdown. In 2 of the patients with stage 2 breakdown, the ulcers progressed to stage 3 in one and to stage 4 in the other. Table 6 indicates the day on which skin integrity was initially breached. A total of 17 (71%) of the 24 breakdowns occurred by the end of postoperative day 4. Surprisingly, 6 (25%) of the initial breakdowns occurred by the end of the day of surgery. For those 6 patients, the mean delay in getting surgery was only 2 days and their mean age was 74 years. They were thus similar to the patients in the breakdown group as a whole, which had a mean delay of 4 days before surgery and a mean age of 72 years. However, 67% (4) of these patients with early break-

Table 7 Score on Braden Scale through postoperative day 4 for patients with and without skin breakdown

Day	Score on Braden Scale, mean (SD)		P
	Patients with skin breakdown (n=24)	Patients without skin breakdown (n=327)	
Of admission	18 (3.4)	22 (1.7)	<.001
Of surgery	12 (2.5)	13 (2.8)	.43
After surgery			
1	15 (3.3)	17 (5.5)	.16
2	16 (3.6)	19 (2.4)	<.001
3	16 (3.3)	20 (2.4)	<.001
4	16 (2.8)	20 (2.2)	<.001

down had heart failure, compared with 42% in the breakdown group as a whole.

The mean scores on the Braden Scale through postoperative day 4 for the 2 groups are given in Table 7. At the time of admission, the mean score was significantly lower for the group who later had skin breakdown than for the group who did not. However, both groups had mean scores in the low-risk range. Only 4 patients in the group with skin breakdown had scores in the moderate- or high-risk range at the time of admission. For both groups, the mean scores decreased sharply by the end of the day of surgery and then began to increase by the end of the first postoperative day. In the group with skin breakdown, the recovery stalled, and by the end of the second postoperative day, the mean score was significantly lower than the mean score for the group without skin breakdown (indicating an increase in risk).

Discussion

The purposes of this study were to determine the effectiveness of the SCIP in preventing development of pressure ulcers or progression from one stage to a more severe stage and to determine the extent to which selected risk factors were predictors of the development and progression of pressure ulcers. The percentage of patients who had pressure ulcers after implementation of the SCIP was 6.8%, markedly lower than the percentage of 11.7% reported for the CSICU and CSIU in the 6 months preceding this study and lower than the 9% to 40% reported by the National Pressure Ulcer Advisory Panel.¹ Our observations of patients' skin may have heightened staff nurses' awareness of patients' risks for pressure ulcers, and this increased awareness may have resulted in increased vigilance and subsequently more nursing interventions, but we have no data on this factor.

Age, female sex, and heart failure were significant risk factors for the development of pressure ulcers

in our patients. Our data are consistent with the results of other retrospective and prospective studies that indicated a relationship between pressure ulcers and age.^{10,24,41} Age is probably a proxy variable for tissue resistance to pressure, shear, and friction, which are variables in the Braden Scale. The finding that female sex was a risk factor in our study is consistent with findings of Bergstrom et al.⁴⁷

It is not surprising that heart failure was a risk factor, because it contributes to hemodynamic instability and respiratory insufficiency, and these in turn increase the risk for pressure sores by lowering tissue perfusion. Lewicki et al¹¹ found that patients with pressure ulcers had a higher occurrence of comorbid conditions, including heart failure, than patients without pressure sores.

We found that subjects who had pressure ulcers had significantly lower mean scores on the Braden Scale during their length of stay than did those who remained free of pressure ulcers. Braden and Bergstrom⁴⁶ found that a score of 18 or lower at the time of admission was highly predictive of the development of pressure ulcers but not as predictive as a similar score when the assessment was done 48 to 72 hours after admission.

Our study supports the results of Lewicki et al,⁵¹ who found that the score on the Braden Scale at the time of admission was not highly predictive for skin breakdown. Among our patients, only 6 (25%) of those in the group that later had skin breakdown had a cutoff score of 16 or lower on the Braden Scale at the time of admission. If a score of 18 was used as the cutoff, 9 (34%) of the patients had a score predictive of skin breakdown. Compared with the results of assessment completed 12, 24, and 36 hours postoperatively, the results of risk assessment at the time of admission were not as predictive of the development of pressure ulcers. Patients who were at risk 12 hours postoperatively were those with diminished mobility, activity, and/or sensory perception. Patients with these characteristics require prompt and focused intervention to prevent development of pressure ulcers.

These results underscore the importance of making observations every 12 hours to refine prediction and focus interventions, particularly for patients who are not mobilized the first day after surgery and who have complications. Ongoing assessment also allows detection of the point at which a patient's condition improves sufficiently to discontinue unnecessary treatments.

On the basis of these data, we recommend initial assessment at the time of admission to detect risk factors and evaluate skin integrity and to assist clinicians in creating individualized plans of care. Additionally, we recommend reassessment within 24 hours and then at 48 hours postoperatively to enable refinement

of the assessment and plan of care. The predictive validity of the second assessment on postoperative day 2 was very high.

Using the Braden Scale and the Agency for Health Care Policy and Research guidelines, we note the following:

- impairments in mobility and activity indicate the need for further assessment,
- risk assessment parameters are the same (same tool) irrespective of time of assessment,
- interventions can be targeted to specific risk factors,
- risk status is not static,
- prevention strategies should be evaluated and altered on the basis of the most recent assessment, and
- pressure-related interventions escalate as the magnitude of risk increases.

With a program of formal risk assessment, patients who are at the highest levels of risk can receive preventive care. Accurate identification of those at risk makes it possible to implement preventive strategies and decrease inappropriate use of resources, reducing the overall cost of care. Providing structured skin assessment and wound care reduces the risk of acquiring pressure ulcers and prevents the progression of pressure ulcers detected at early stages.^{52,53}

Conclusion

Development and progression of pressure ulcers are events that can be altered by nursing care. The outcome of patients with pressure ulcers depends in large part on frequent clinical assessments and consistently applied nursing interventions. Debate is ongoing as to whether all pressure sores are preventable or whether some ulcers will develop in high-risk patients even when quality care is provided.¹ More research is required to address this question. In the mean time, our results indicate that the risk for pressure ulcers can only be predicted by repeated assessments of patients' conditions throughout hospitalization.

Risk factors for pressure ulcers and of skin integrity should be assessed immediately after surgery and 24 and 48 hours after surgery.

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