

CLINICAL PERSPECTIVE

Pressure Ulcer Research Issues in Surgical Patients

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A natural outgrowth of pressure ulcer research is the evaluation and refinement of the information available on specific patient populations. Literature on pressure ulcers in surgical patients has justifiably focused on identifying risk factors for pressure ulcer development in this particular population. A limited number of studies also have compared the effects of various support surfaces on pressure ulcer occurrence. Researchers have drawn heavily on the available information to design their studies and have creatively tailored their investigations to reflect the distinctive characteristics of the surgical experience, particularly with respect to intraoperative events.

Scrutiny of the surgery-related pressure ulcer literature shows a unique set of conceptual, research, and practice issues that can be used to interpret research to date and to create a research agenda for pressure ulcers in surgical patients. The purpose of this paper is to briefly describe some of these issues in order to initiate dialogue that may improve the study of pressure ulcers relative to the operating room (OR) and to encourage judicious examination of recommendations for changes in practice.

Incidence

Reporting pressure ulcer incidence rates from previously conducted studies is a strategy commonly used by researchers to convey the significance of the problem and

ABSTRACT

This paper focuses on key pressure ulcer research issues in surgical patients pertaining to incidence, risk assessment, temporality, methodology, and interpretation and utilization of findings. The recent emphasis on the effect of intraoperative events on pressure ulcer occurrence is discussed in terms of the underlying conceptualization, theoretical and empirical evidence, and consequences for research. The ongoing quest for predictors of pressure ulcers in surgical patients and the results of clinical studies in this population illustrate the limitations of current pressure ulcer risk assessment instruments; therefore, an example of an alternative risk assessment strategy for surgical patients is presented. Addressing these issues in a timely fashion is important given their potential impact on future research and the growing interest in studying pressure ulcers in surgical patients.

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to compare study results. Incidence is the correct calculation for the overwhelming majority of OR-acquired pressure ulcer studies, if it is presumed that having surgery places subjects at risk and that the subjects are followed up over time to determine pressure ulcer occurrence.¹ Methodically dissecting reported incidence rates may clarify some apparent discrepancies, raise critical questions, and facilitate synthesis of findings among studies.

Anatomic site

In studies of surgical patients, the assumption should be discarded that incidence rates are always derived from pressure ulcers occurring anywhere on the body. Some studies restrict observations of occurrence to specific anatomic locations^{2,3}; merely reading the titles and abstracts of published papers is not

always sufficient to detect this. If the focus on selected anatomic areas is not clear, the incidence of pressure ulcers may appear to be deceptively low.

Intervention effects

An analogous consequence may occur if only the total incidence rate derived from an intervention study is referenced. This can be especially misleading if the intervention effectively reduces pressure ulcer occurrence. Two recently conducted studies comparing their hospitals' standard support surface with a newer support surface provided data from which total

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incidence rates of 4.11% and 4.10% could be calculated.^{4,5} The incidence rates of 8.75% and 7.14% in the "standard" support surface groups more likely reflect the actual preintervention incidence in these samples. The lower total incidence rates are likely attributable to the effectiveness of the newer support surface, with incidence rates of 0% and 1% in patients who were placed on these surfaces. These rates are derivable from the original study reports. Investigators who choose to reference rates from the 2 studies should carefully consider how to present these data.

Inconspicuous disparities

Noting distinctions between total and subset incidence rates may reveal pronounced disparities. Even if the disparities do not represent the primary purpose of the study, they merit careful inspection and appraisal for their potential impact on future investigations. One example is a study of skin blood flow in 2 types of surgical patients who were either in the prone (spinal disk herniation repair) or supine (abdominal surgery) position.⁶ The total pressure ulcer incidence was 37.5% (9/24, erroneously published as 36%); however, 100% of the subset of prone patients developed iliac ulcers compared with 16.6% in the subset of patients who were supine. Because the emphasis of the study and discussion of findings centered on skin blood flow in patients who did and did not develop pressure ulcers, this ancillary finding on iliac ulcers could easily be overlooked or disregarded.

Staging

Incidence rates of pressure ulcers in surgical patients tend to be lower in some recently conducted studies. Among the speculations on why this may occur are general improvements in skin care practices, Hawthorne-type effects, and implementation of a staging system recommended by the National Pressure Ulcer

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Advisory Panel (NPUAP) and adopted by the Agency for Health Care Policy and Research (AHCPR) pressure ulcer clinical guideline panels.⁷⁻¹¹ The importance of the NPUAP staging system is evidenced by the fact that Stage I pressure ulcers represent the most prevalent type of pressure ulcer in many samples of surgical patients,^{2,6,7,12-16} yet they are the most difficult to identify and assess.^{10,17} Earlier definitions may have resulted in inflated Stage I incidence rates due to inclusion of the off-loading hyperemic response,^{3,11,15} which may still be problematic in some settings. Another issue is literature that describes particular types of surgery-related pressure ulcers that do not meet the currently accepted staging criteria.^{18,19} Studies that account for these types of pressure ulcers usually classify them as Stage I or unstageable.^{3,7,20} Studies that do not address these pressure ulcers leave the reader wondering whether they did not occur, they were not included, or they were classified as something else.

Accuracy

Although investigators typically are accurate in reporting incidence rates from

their own data, numerous research reports begin by misinterpreting the 1986 Versluysen study of elderly hospitalized femoral fracture patients.²¹ They incorrectly report a 66% incidence as the high end of the incidence rate range among studies of pressure ulcers in surgical patients.^{3,4,7,15,22,23} Although 66 of 100 patients in this study developed pressure ulcers, only 89 were surgical patients, 27% of whom had pressure ulcers prior to surgery.²¹ The total number of surgical patients who developed pressure ulcers is not discernable, but even if all 66 occurrences were in the surgical group, the maximum incidence rate would be 47% when the preoperative occurrences are excluded. Continuing to use the 66% incidence rate has recently been questioned, not because of its inaccuracy, but because hip fracture patients in current practice are operated on sooner after hospital admission than patients in the Versluysen study.²⁴ The discussion focused on the contemporary relevance of the 66% incidence rate but did not question its accuracy within the study. The interpretive inaccuracy arising from the Versluysen study has been perpetuated for 14 years and is particularly problematic when researchers contrast their own study findings with the 66% figure.

Authors bear the responsibility of accurately reporting and interpreting incidence rates. Primary literature should be examined not only to ensure accuracy, but also to discover and report any notable serendipitous findings of the study. In this manner, both the author's reporting and the interpretation of data will fully and accurately represent the study's significance. As the number and diversity of pressure ulcer studies in surgical patients expand, subsets of patients that parallel a particular subpopulation of interest may become more plentiful, which will enable comparisons of incidence rates among more similar subsets. Likewise, subset incidence rates may be

calculable from data reported in a study, which is a worthwhile task if referencing the subset incidence would be more meaningful than the study's total incidence rate.

Terminology and Temporality Emphasizing intraoperative events

Labels used in titles of published articles to signify the phenomenon of pressure ulcers that occur in surgical patients typically fall into 2 categories. The broader category solely implies the occurrence of pressure ulcers in surgical patients: "in surgical patients,"¹⁵ "elderly surgical patients,"²³ and "patients undergoing prolonged operations."¹⁴ The more narrow category implies that the intraoperative period encompasses the etiologic factors relevant to pressure ulcer development. Labels reflective of this category include "intraoperatively acquired,"¹² "OR-induced,"¹¹ and "during cardiac surgery."⁷ The most obvious distinction between the 2 categories is the narrower label's implication that pressure ulcers are caused or formed during the intraoperative period. This may represent an attempt to direct attention toward the more understudied intraoperative period, an effort to highlight an event period suggestive of a distinction between surgical patients and other vulnerable populations, or a conviction that pressure ulcers in surgical patients are entirely attributable to the intraoperative period. Irrespective of the intent, the label disparity underscores the existence of temporal issues facing researchers in this area. Further complicating this issue is the conceptual dissonance of attributing pressure ulcer occurrence to intraoperative events while examining postoperative variables as pressure ulcer predictors. Continuing to use the more narrow labels will be troublesome if it restricts our understanding of pressure ulcer formation or narrows the scope of inquiry during this early stage of research on

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pressure ulcers in surgical patients.

There is little doubt that intraoperative events pose a pressure ulcer risk. Researchers cite literature about pressure intensity and duration, factors that affect tissue tolerance for pressure, and OR-specific variables that pertain to both of these topics. The portrait that emerges is one of a patient with diminished sensory perception during prolonged immobility with unrelieved pressure who is exposed to myriad factors that compromise tissue tolerance. Although this is an accurate depiction, the contention that causation or formation of pressure ulcers in surgical patients occurs exclusively during the intraoperative period is arguable.

Temporal manifestation

Linking the postoperative manifestation of pressure ulcers to intraoperative events has historically been problematic. The 41-year-old study by Kosiak²⁵ that indicated a time lag between pressure application and ulceration in animals is frequently cited in contemporary literature. Similarly cited are the time frames for pressure

ulcer presentation set forth by Gendron¹⁸ and Vermillion¹⁹ in their studies of certain pressure ulcers in surgical patients. Although data from clinical studies generally follow the time frames cited in these publications, most studies do not focus on detailing time of pressure ulcer presentation or cross-classifying time of presentation with location and stage. Even if these data were available, generalizations may not be particularly useful because of variations in Stage I definitions, duration of follow-up, time of first assessment, and frequency of assessments. Given these limitations, postoperative days 1 to 4 represent the commonly reported ranges of the highest concentration of pressure ulcer manifestation times.^{3,4,7,14,15,26}

Competing hypotheses

Considering the delay and wide temporal variation in the visual manifestation of pressure ulcers, speculations about pressure ulcer development at some point other than in the intraoperative period may be plausible. Patients are usually included in studies only in the absence of visible pressure ulcers; however, some patients may be vulnerable preoperatively when pressure ulcer formation is initiated but does not present until the postoperative period. Versluisen²¹ found pressure ulcer occurrences in elderly surgical patients hospitalized for femoral fracture in the preoperative and postoperative periods. Papantonio and colleagues³ found that transfer from another facility was a significant factor in sacral pressure ulcer occurrence in cardiac surgical patients. The pressure ulcers could have begun developing preoperatively, although tissue exposure to preoperative pressure was not ascertained.

Of greater concern is the postoperative period, with inherent risks that may include restricted mobility or activity, equipment that may affect ability to be repositioned, medications and sleep

alterations that could diminish sensory perception and tissue tolerance, and sub-optimal nutrition. However, pressure ulcers formed during the early postoperative phase are likely to be attributed to the intraoperative experience, a hazard that is compounded by inadequate descriptions of postoperative care and potentially relevant events during this phase.

In the present paper, narrower labels such as "OR-acquired" and references to "cause" and "formation" of pressure ulcers have been intentionally used to reflect the current terminology and underlying conceptualization of pressure ulcer occurrence as conveyed by some of the literature. However, data are currently insufficient to justify asserting that any single phase is the period during which a pressure ulcer is caused or formed. Furthermore, this understanding of cause forces the assumption that a pressure ulcer is either formed or not formed during an isolated period, leaving little room for the possibility of subsequent cumulative effects, particularly with respect to extent of tissue damage.

Risk Assessment

Classic approach limitations

When exploring pressure ulcer risk assessment for surgical patients, temporal themes continue to be central. From a predictive standpoint, the preoperative score would be the only score of interest if one considers ulcer formation to be exclusively an intraoperative occurrence. However, risk assessment scales have yielded conflicting findings regarding their use as predictors of pressure ulcers in surgical patients, and they may not be indicative of risk in a substantial number of patients, particularly in patients who are ambulatory before surgery. This holds true even for the psychometrically sound Braden Scale, which has performed well when used in other populations.²⁷⁻²⁹ In a mixed group of surgical patients with a

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45% incidence of pressure ulcers, preoperative Braden Scale scores indicated low risk ($M = 21.9$) and were not predictive of pressure ulcer occurrence.¹⁴ One study did find preoperative Braden Scale scores to be significantly lower in cardiac patients who developed pressure ulcers postoperatively; however, the mean scores in patients with pressure ulcers (21.6) and without pressure ulcers (22.5) were both low-risk scores.¹³ Patients such as these probably would not be identified as at-risk preoperatively, and it is unlikely that extraordinary preventive interventions would be initiated.

Administering the Braden Scale after induction of general anesthesia is futile because patients would receive the lowest possible scores on all but the nutrition and moisture subscales. All patients would be identified as being at risk, with minimal variability from which to predict pressure ulcer occurrence. Thus, no extraordinary interventions would be initiated during the intraoperative period. Postoperative assessments should certainly be performed for clinical purposes, even

if not for research. In cardiac surgical patients, postoperative Braden Scale scores have been indicative of risk and have been significantly lower in patients who developed pressure ulcers.^{26,30} Depending on when during the postoperative period the risk assessment scores were obtained, they would likely be lower than they were preoperatively and should guide prevention strategies. If postoperative assessment scores are predictive of pressure ulcer occurrence in the postoperative period, pressure ulcers cannot be attributed irrefutably to the intraoperative period, and preventive interventions based on the assessment would be implemented only after the assessment had been performed. Studies of pressure ulcers in surgical patients have examined preoperatively and intraoperatively the multiple variables that are potentially predictive of pressure ulcer occurrence. Therefore, it can be safely assumed that the goal is to initiate prevention strategies intraoperatively or immediately thereafter.

The search for predictors of pressure ulcers in surgical patients is reflective of the belief that prediction could be improved if risk were based on information other than, or in addition to, information derivable from currently available tools. Using the Braden Scale and AHCPR guidelines, it can be said that: (1) mobility and activity impairments indicate the need for further assessment; (2) risk assessment parameters are the same (same tool) irrespective of time of assessment; (3) interventions can be targeted to specific risk factors; (4) risk status is not static; (5) prevention strategies should be evaluated and altered based on the most recent assessment; and (6) pressure-related interventions escalate as the magnitude of risk increases.^{9,31} Although research is insufficient to develop a pressure ulcer risk assessment tool for surgical patients at the present time, the type and measurement time of variables

examined in studies to date provide an opportunity to envision the general characteristics for such an instrument, which varies from these features of contemporary risk assessment.

Temporal-factor optimization

The widely used Braden Scale is necessarily brief, easily used, and frequently administered to large numbers of patients in a short period of time by multiple practitioners. In contrast, preoperative and intraoperative risk assessments in hospitals would be performed only once on a smaller number of patients and would likely be performed by a small group of specialists. Thus, developers of a surgical patient pressure ulcer risk assessment tool may have the luxury of striving for the best set of predictors with fewer constraints on length and complexity.

Risk assessment in surgical patients could be a multistage process with 3 predetermined assessment times: preoperative, intraoperative, and postoperative. Each assessment would evaluate differing parameters, and each risk "score" could be rapidly revised to alter prevention strategies. Variables measured intraoperatively in studies of surgical patients, such as an estimate of OR time, could be included in the preoperative assessment if they emerge as useful predictors. Many prevention strategies explicitly directed toward minimizing intraoperative and early postoperative risk associated with the Braden Scale's assessment parameters are addressed in the Association of Operating Room Nurses' (AORN) clinical practice guidelines and recommended practices.³² These strategies could be evaluated and standardized within a facility. Preoperative risk could be used to determine whether standard interventions should be supplemented, such as the use of special OR table support surfaces or patient transfer devices.

In patients for whom the preoperative

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risk score did not indicate a need for special intervention, intraoperative risk assessment at the conclusion of a surgical procedure could be used to evaluate any additional risk. This intraoperative risk score would be used to implement appropriate interventions for the postoperative period. The Braden Scale might be used postoperatively and would be readministered as necessary. If used postoperatively, it also should be administered preoperatively to serve as a baseline for comparison, even if the score is not used in the preoperative calculation of risk.

Clinical Research Designs and Interventions **Descriptive pursuits**

Retrospective and prospective descriptive designs with varying data sources predominate studies of pressure ulcers in surgical patients. With pressure ulcer prevention as the goal, the role of prospective descriptions in identifying pressure ulcer predictors, developing a risk assessment instrument, and providing clues to potential preventive interventions is crucial. Addressing staging and temporal issues in order to generate a comprehen-

sive, uniform characterization of pressure ulcers will facilitate accrual and synthesis of meaningful data and development of a risk tool; it also may provide clinical data pertaining to the pathogenesis of pressure ulcers in surgical patients. In addition to expanding the types of surgical patients studied, sample sizes large enough to permit multivariate analyses are preferable. Continuing to search for pressure ulcer risk factors in surgical patients is prudent, but many variables that have already been examined merit reappraisal. Most of these variables represent clinical indicators derived from relevant theoretical knowledge and empirical data. Considering the meager number and questionable comparability of studies, rejecting any of these variables at this point is premature.

Accounting for care

Missing from most studies of pressure ulcers in surgical patients are adequate descriptions of care and prevention-oriented practices during hospitalization, which hinder generalizability of findings and neglect variables that may bear directly on pressure ulcer occurrence or may diminish treatment effects.^{24,33,34} A descriptive study conducted in a facility with 2 yearly incidence rates of 12.5% and 25% reported a 4.7% incidence during the study period, with no increase in the use of special preventive equipment.⁷ The authors postulate that this may have been attributable to the nursing division's initiatives to decrease pressure ulcer incidence. Frequency of repositioning or turning has been found to be significantly lower in surgical patients with pressure ulcers in both intervention and descriptive studies,^{3,7,26} and patients on specialty beds in the postoperative period have been turned less frequently than patients without this preventive intervention.²⁶

Findings such as these suggest that it would be expedient to consider controlling or documenting care. Because these

findings also intimate the potential of prevention programs to decrease pressure ulcer incidence, investigating prevention program effects in surgical patients may reveal benefits similar to those in other groups that have been studied.³⁵ Irrespective of conjectures regarding time of pressure ulcer formation, the possible influence of early postoperative events, such as turning, strongly favors extending investigations through the postoperative period to examine more than just pressure ulcer occurrence.

Intervention studies

In designing a study, weighing the limitations and conflicting findings of studies to date against overlooking a potentially important variable may pose a dilemma, particularly in an intervention study. Several variables have yielded fairly consistent findings that might be useful in minimizing the likelihood of confounding treatment effects via sampling or stratified random assignment. For example, diabetic and vascular surgical patients tend to have a higher incidence of pressure ulcers^{3,12,13,22}; therefore, stratifying and prospectively randomizing based on type of surgery and presence of diabetes would ensure that these patients were equally represented in the treatment groups. Or the sample could be limited to 1 type of surgery.

In intervention studies that examine treatment effects on pressure ulcer occurrence, the intraoperative period is sorely understudied. The OR may be perceived as a period with limited opportunities for prevention-oriented interventions, but AORN lists several intraoperative practices relative to pressure ulcer prevention—such as positioning and stasis prevention devices, minor positional changes, and prevention of solution or body fluid pooling—that have not yet been fully studied.³² OR table support surfaces have been the predominant focus of intraoperative intervention

investigations.^{2,4,13,22} Because duration of pressure is usually not controllable during this period of vulnerability, minimizing the pressure intensity via the OR support surface may be of paramount importance in pressure ulcer prevention. Studies that manipulate OR table support surface characteristics but do not examine pressure ulcer outcomes will continue to be valuable; however, studies with pressure ulcer occurrence as an outcome should be a priority.

Interpretive overstatement

Researchers tend to describe their own studies adequately. However, subsequent citations in the literature may distort or misrepresent the studies. A common example of this is referencing studies of OR table support surfaces that examine interface pressure but not pressure ulcer occurrence^{36,37} as having found an association between interface pressure and pressure ulcer occurrence.^{2,14} A more serious problem is recommending an intraoperative intervention based on flimsy clinical evidence without considering potential harm. One study of 33 patients who underwent prolonged surgical procedures (17 hours) found a higher incidence of pressure ulcers in patients who were on warming blankets.¹⁴ It was unequivocally recommended that warming blankets be removed from underneath surgical patients. The study, however, failed to address the evidence attesting to the detrimental effects of hypothermia.³⁸⁻⁴⁰ Although a strong, literature-based case against directly warming pressure-exposed tissue can be made, other studies in surgical patients have not found warming blankets to significantly affect pressure ulcer occurrence.^{2,3} This is an important area of concern that warrants rigorous study.

Conclusions

This overview of selected pressure ulcer issues has framed, in the context of surgi-

cal patients, problems that are universally characteristic of pressure ulcer research and has offered for deliberation the distinctive challenges and opportunities that come with studying this population. Of particular note in many surgical patients is the unusual circumstance of being able to precisely identify a circumscribed time frame of "first" risk (ie, the intraoperative period). The similarity of prestudy/poststudy design affects the way pressure ulcers are studied in this population; surgery is the intervention and pressure ulcer is the dependent variable. This feature is a burden when it serves to prematurely define the intraoperative period as the period of risk and thereby affects the way research is designed and the way it is interpreted. Conversely, it presents an opportunity to illuminate the pathogenesis of pressure ulcers in surgical patients by more comprehensively describing pressure ulcer occurrences and linking them to other variables. In addition, innovative approaches to risk assessment tool development could culminate in a more useful instrument by deviating from the classic characteristics of contemporary pressure ulcer risk assessment.

The extant body of knowledge pertaining to pressure ulcers has been instrumental in selecting study variables and accelerating research in the surgical population. It is also a sufficiently substantive foundation to support the simultaneous conduct of multiple lines of inquiry. However, the challenge to discern what knowledge is lacking for surgical patients is of equal import. Literature is a tangible reflection of what we know about pressure ulcers and is a significant mode of transmitting this knowledge. Conscientious review of primary literature sources will influence the accuracy and precision of research reports and present findings in a meaningful context for the reader. Considering the relatively recent emergence of surgical pressure ulcer literature, particularly the handful of reports on

prospective studies based on observational data, grasping this early opportunity to ponder and debate issues addressed in this paper will propel the development of a cohesive body of knowledge from which to better describe, explain, predict, and prevent the serious problem of pressure ulcers in surgical patients. ♦

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