



The 2021 Update on Pressure Injuries: A Review of the Literature

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GENERAL PURPOSE: To provide a review of the recent literature on the epidemiology and treatment of pressure injuries (PIs).

TARGET AUDIENCE: This continuing education activity is intended for physicians, physician assistants, nurse practitioners, and nurses with an interest in skin and wound care.

LEARNING OBJECTIVES/OUTCOMES: After participating in this educational activity, the participant will:

1. Identify risk factors for developing PIs.
2. Differentiate factors that could affect the healing of PIs.
3. Select strategies that have an impact on the development of PIs.

ABSTRACT

Keeping up with the literature on pressure injuries is always a challenge for busy clinicians. In this article, the authors summarize six important articles published in 2021. Articles cover a range of topics including epidemiology, treatment, precision medicine, nurse staffing, and patient preferences for care. For each article, a description of the study results is provided along with a comment on why the results are important. This information is intended to help clinicians incorporate new data into their clinical practice.

KEYWORDS: dementia, epidemiology, genetics, patient preferences, pressure injury, staffing

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INTRODUCTION

The literature on pressure injuries (PIs) continues to grow, and many important publications have appeared in the past year. However, as we enter the third year of the COVID-19 pandemic, the authors have noticed interesting trends in the PI literature. Of course, many articles related to COVID infection, the impact of patient proning, and injuries related to masking have been published. Surprisingly, though, there was a relative paucity of clinical trials published this past year compared with the literature reviews in prior years. Although the performance of high-quality clinical trials is always challenging, particularly in the field of PIs, the authors suspect that the added challenge of COVID and related holds on clinical research is now impacting the types of studies that are being completed. Nevertheless, a PubMed search using the terms *pressure ulcer*, *pressure injury*, or *decubitus ulcer* and limited to 2021 yielded 462 unique citations.

In this article, the authors review six of the results. Articles were selected based on their perceived importance and innovation. In addition, the authors favored articles with good research designs that enhance the likely validity of the results. Articles were selected from the English literature to represent a broad range of topics including epidemiology, risk factors, treatment, and genetics. Articles were not limited to original research studies but also include useful syntheses of data. To avoid potential bias in the article selection process, the authors excluded articles that they had authored or that were published in *Advances*

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in *Skin and Wound Care*. The selected articles should not be considered the six “best” articles from the past year; rather, they represent important additions to the field. For each article, the authors summarize the key findings and then offer comments describing why they believe the article is important or innovative.

ARTICLE 1

VanGilder CA, Cox J, Edsberg LE, Koloms K. Pressure injury prevalence in acute care hospitals with unit-specific analysis. Results from the International Pressure Ulcer Prevalence (IPUP) Survey Database. *J Wound Ostomy Continence Nurs* 2021;48:492–503.

The purpose of this study was to provide current information on the prevalence of PIs and hospital-acquired PIs (HAPIs) in acute care hospitals in the US, describe trends in prevalence over time, and identify patient characteristics associated with HAPIs. The study used the International Pressure Ulcer Prevalence (IPUP) Survey Database. The IPUP Survey is performed at participating hospitals on a prespecified day during which a survey team conducts a skin assessment on 100% of all inpatients. Although data have been collected in this manner since 1989, the present report includes data starting in 2006 with an average of 134,405 adult participants annually. In 2019, data were reported from 887 hospitals: the overall PI prevalence was 9.1%, and HAPI prevalence was 2.6%. Although this represented a large decline from the 2006 rates of 13.3% and 6.4%, respectively, rates have been relatively unchanged since 2015. The researchers noted that HAPI prevalence was greatest in critical care units with a rate of 6.9%, and HAPIs were more likely to be severe. Patients with PIs were, on average, 6.2 years older than those without, and prevalence was highest (5.5% for HAPI) among patients with a body mass index (BMI) less than 18.5 kg/m². The sacrum/coccyx had the highest percentage of PIs and HAPIs for all stages with the exception of deep tissue PIs, which were most common on the heel. The study concludes that although there has been a decline in HAPI rates, this decrease has leveled off in the past 5 years. In addition, patients in critical care units are at the highest risk for HAPIs.

Comment

Epidemiologic studies can provide valuable insights into the extent of a problem. However, in the case of PIs, epidemiologic studies using widely different methodologies and often small sample sizes have resulted in inconclusive estimates that seem to obscure more than enlighten. In the vast PI literature, the works of VanGilder using the IPUP Survey Database have stood out for their standardized methodology that involves the direct examination of patients' skin, large sample sizes, and multiple years of data.^{1,2} Although the reported prevalence rates appear reasonable, the authors are struck by the large difference

from those reported in the DecuBICUs study.³ In that study, among 1,507 North American ICU patients in 2018, the HAPI rate was almost double that from IPUP at 13.3%. Given the apparently similar methodologies and large numbers of patients, it seems hard to reconcile these very different results, raising questions as to how certain conditions such as skin failure might be classified. But the larger question is: Where do we go from here in terms of further improving PI prevention? Publication of guidelines and toolkits,⁴ alignment of financial incentives with improved outcomes, and the performance of large-scale quality improvement interventions based on the Institute for Healthcare Improvement Breakthrough Series⁵ likely contributed to some of the initial successes. But based on VanGilder et al, these improvements have now stalled at a rate that is still unacceptably high. Clearly needed are a better understanding of what an unavoidable PI is and what fraction of new PIs meets these criteria. Improved criteria for identifying at-risk people in various settings will also be needed and may result from studies using machine learning and electronic health records. Finally, new technologies may lead to further reductions in pressure and shear while improving the microclimate. The authors hope that such findings will result in further declines in PI rates as reflected in future assessments from the IPUP Survey.

ARTICLE 2

Alipoor E, Mehrdadi P, Yaseri M, Hosseinzadeh-Attar MJ. Association of overweight and obesity with the prevalence and incidence of pressure ulcers: a systematic review and meta-analysis. *Clin Nutr* 2021;40:5089–98.

The aim of this systematic review and meta-analysis was to evaluate the effects of body weight on the incidence and prevalence of PIs. This objective was accomplished through a search of PubMed and Scopus for observational studies published between January 1990 and December 2019 that investigated the effects of overweight and obesity on PIs in adult patients. To be included, studies were required to report on the prevalence or incidence of PIs in patients categorized by BMI subgroups of underweight, normal, overweight, obese, and morbidly obese. The search yielded 457 original articles, of which 17 were selected for the final meta-analysis; 11 articles examined PI prevalence, and 7 articles dealt with incidence. The quality of each selected article was graded using criteria from the Agency for Healthcare Research and Quality.

There were a total of 2,228,724 participants in the prevalence studies and 218,178 in the incidence studies. Pooled data analysis was performed to show the relationship of each BMI subgroup with prevalence and incidence of PIs. Forest plots were also used for visualization of this relationship. In comparing individuals with obesity (BMI >30 kg/m²) with those without, no associations were found with PI prevalence

(odds ratio [OR], 0.91; 95% confidence interval [CI], 0.65–1.27) or incidence (OR, 0.97; 95% CI, 0.56–1.66). In examining all overweight groups (BMI >25 kg/m²) in comparison with individuals who were not overweight, being overweight was associated with a lower PI prevalence (OR, 0.54; 95% CI, 0.33–0.88), but no difference was noted in incidence (OR, 0.72; 95% CI, 0.48–1.1). Similarly, for only the overweight group (BMI 25–30 kg/m²) versus the normal weight group (BMI 18.5–25 kg/m²), both PI prevalence (OR, 0.6; 95% CI, 0.37–0.96) and incidence (OR, 0.72; 95% CI, 0.53–0.98) were lower in the overweight group. Having obesity or morbid obesity was not associated with PI prevalence or incidence compared with having normal weight. Being underweight (BMI <18.5 kg/m²) was associated with a significantly higher PI prevalence (OR, 2.38; 95% CI, 1.72–3.29) and incidence (OR, 2.28; 95% CI, 1.77–2.94) compared with individuals with normal weight. The review authors describe several limitations, including that BMI classification is not indicative of lean and fat mass content or distribution, and patients with obesity may still be malnourished. Overall, the results indicate that obesity and morbid obesity do not have significant effects on the prevalence and incidence of PIs. Conversely, being underweight increases PI risk.

Comment

The association between BMI and PI has long been debated. Internal stresses and strain on tissues may be impacted by being underweight or overweight. One could hypothesize that patients with obesity are both more immobile and more difficult to reposition, perhaps increasing the likelihood of PIs. However, an alternate hypothesis is that increased adipose tissue provides added “padding” that lowers PI risk. People who are underweight are at greater risk for malnutrition, although individuals who are overweight can experience malnutrition. Animal studies have demonstrated that the healing response to pressure is suppressed in malnourished animals, resulting in extensive skin damage.⁶ Studies investigating this association have often come to differing conclusions, so the meta-analysis by Alipoor and colleagues can provide further clarity.

It is noteworthy for the large sample size, with more than two million individuals contributing data on prevalence. The results clearly highlight that low BMI is associated with heightened PI risk, whereas having obesity seems to add little to the risk when compared with people with normal BMI. This conclusion mirrors the present authors’ previous findings (which were not included in the meta-analysis, perhaps because weight subgroups were not well identified). In the authors’ study of nearly 40,000 nursing home residents, they found that as BMI increased, PI incidence decreased up to a threshold of 25 kg/m² at which point it appeared to level off.⁷ It is im-

portant to note, however, that even with such large sample sizes, the number of individuals with exceptionally high BMI is still relatively small, so an increase in PI risk cannot be ruled out. Also, having obesity does not mitigate the need for good care and repositioning. One study demonstrated that in nursing homes with lower staffing levels, having obesity had a larger impact on PI development than it did in nursing homes with higher staffing levels, suggesting that repositioning might not be occurring as frequently with lower staffing levels.⁸ Regardless of BMI, high-quality preventive care is a must.

ARTICLE 3

Pussin AM, Lichtenthaler LC, Aach M, Schildhauer TA, Brechmann T. Fecal diversion does not support healing of anus-near pressure ulcers—results of a retrospective cohort study. *Spinal Cord* 2021. doi: 10.1038/s41393-021-00717-2

This study aimed to evaluate the association between diversion of stool with a stoma and the healing of anus-near stages 3 and 4 PIs. This retrospective cohort study was conducted with 463 consecutive adult patients with chronic spinal cord injury (SCI) who were hospitalized for surgical treatment of a stage 3 or 4 PI close to the anus at a German university hospital between 2007 and 2017. Surgical procedures included debridement under anesthesia or fasciocutaneous flaps. Data collected included SCI characteristics (etiology, localization, and severity), basic demographic characteristics, stoma characteristics, PI characteristics (size and stage), and surgical outcome characteristics (healing time, number of revisions, and complications). Two groups of patients were studied: those who had had a stoma and those without. The primary outcome was number of days to complete wound healing. Secondary outcomes included PI recurrence, other complications, and need for intensive care treatment. Healing of PIs in patients with and without a stoma were compared using multivariate regression models.

The final sample consisted of 445 patients because healing could not be described for 18 patients. Seventy-one patients (15.3%) had a stoma. The median duration of SCI was 222 months, and there was an average of 40 months between stoma creation and admission for ulcer treatment. The average PI size was 16.0 cm²; 62.9% were stage 3 and 37.1% were stage 4. The median duration of PI treatment until wound healing was 61 days; patients with a stoma required 77 days to heal versus 59 days in those without a stoma ($P = .02$). Results remained significant in multivariate models adjusting for factors including PI stage, American Society of Anesthesiologists score, smoking status, and BMI. Pressure injury recurrence occurred in 8.4% of participants; the presence of a stoma had no significant effect on recurrence. Intensive care treatment was also similar between the two groups. The researchers note several limitations, including uncertainty as to reasons



for stoma construction, differences in baseline characteristics between the two groups, and potential loss of information associated with the retrospective design. The researchers concluded that fecal diversion is not associated with improved healing of anus-near PIs. The authors recommend against fecal diversion as a standard therapy for PI treatment.

Comment

Few decisions in PI management are more difficult for clinicians than deciding whether to place a stoma in a patient with a large PI located near the anus. Certainly, it would seem to make sense. In a wound that is constantly exposed to feces, elimination of the resulting bacterial contamination and fecal toxins should promote healing. However, the evidence base for this practice is extremely limited. In one study of 67 people referred to surgery for PIs, those with a colostomy had a significantly lower PI recurrence rate (43% vs 69%, $P < .05$) and a shorter healing time than those without a colostomy.⁹ Other studies have cautioned, though, that the surgery has high mortality and limited success.¹⁰ More recent literature continues to emphasize how even minor, low-risk surgical procedures in frail patients are associated with substantial morbidity and mortality.¹¹

This new article by Pussin and colleagues is noteworthy for the number of patients included in the analysis and the cautionary message that it provides regarding the use of fecal diversion. Patients with a stoma took longer to heal. It is important to emphasize that this was not a randomized trial and people with a stoma were different, including being more likely to have larger, stage 4 PIs than those in the natural defecation group. It is also notable that the stoma was usually placed many years before the target ulcer. It could have been beneficial for an earlier PI. The extent of fecal soiling of the wounds if there had been no stoma is unknown. Incontinence care could also have potential benefits in providing opportunities for close examination of the skin and repositioning. Although the benefits of fecal diversion remain uncertain, the risks are very real. This suggests that fecal diversion should be performed only after an initial trial to heal the wound that includes controlling diarrhea and immediate dressing changes in response to soiling. The researchers conclude that "A randomized controlled study is mandatory to clarify the impact of the fecal diverting concept in the context of the treatment of anus-near pressure ulcers." Although the authors strongly support this statement, they are somewhat doubtful whether an adequate study can ever be performed but hopeful someone may prove them wrong.

ARTICLE 4

Yap TL, Alderden J, Kennerly SM, et al. To turn or not to turn: exploring nurses' decision-making processes

concerning regular turning of nursing home residents. *Gerontol Geriatr Med* 2021;7:1–12.

Repositioning is essential for PI prevention but may be especially challenging in nursing home residents with behavioral disturbances and Alzheimer disease or related dementia (ADRD). This study aimed to better understand nursing staff decision-making processes around repositioning in patients with ADRD. The study was a mixed-methods analysis at three US nursing homes and leveraged an existing clinical trial. Data were obtained by direct observation of residents during routine repositioning events and through focus groups with nursing home staff. Topics included in the focus groups were how behavioral disturbance affects repositioning, strategies used to care for challenging resident behaviors, and tailored approaches to repositioning. Residents selected for observation had to have a high, moderate, mild, or low risk of PI based on the Braden Scale. People with ADRD were identified based on *International Classification of Diseases* code or a Brief Interview for Mental Status score less than 12.

Of the 88 residents observed, 62 (70%) had ADRD. Agitation during repositioning was the most frequently observed behavior, present in 23% of residents with ADRD and 15% of those without ADRD. Aggressive behavior was seen in only one resident. Informing residents of the event and offering encouragement were the most frequently observed staff approaches. Six focus groups were held in which 36 nurses participated. Four major themes guiding repositioning were identified: cognizance (being mindful of one's approach to repositioning and planning for challenging behaviors), resources (importance of and potential discomfort arising from equipment), protocol-driven (need to follow institution-specific policies), and integrated method (balancing need for regular repositioning with resident preferences). Staff emphasized "the importance of balancing the tension between institutional safety protocols guiding efficient, task-driven care within the context of resident preferences and behaviors." The authors conclude by acknowledging the real-life challenges arising from resident preferences and behaviors and the need to balance patient preference for repositioning with regulatory requirements for PI care through an integrated approach.

Comment

Pressure injury prevention is often thought of as highly routinized: Check off each box in the guideline, and just make sure to reposition every 2 hours. Such routinized care would be especially important in patients with dementia who likely are at higher risk for PIs because they may be unaware of pain or pressure, unable to move independently, and unable to effectively verbalize needs. Yap and colleagues now highlight how behavioral disturbances

commonly seen in dementia may complicate repositioning plans and make good care anything but routine.

Repositioning, like much of clinical care, requires a customizable approach that includes keeping the patient informed and included in the decision-making process. This should yield cooperation and patient satisfaction. Assessing patient preferences is the first step in devising this nursing approach. What matters most to you? Considerations of lighting, noise, repositioning equipment, temperature of hygiene wipes, and so on are all aspects of patient preference for care. Music also has been identified as an effective approach to increase adherence to nursing protocols.¹² Repositioning throughout the hours of sleep may result in significant impact to sleep hygiene. This may also need to be considered with patient preferences and offers an opportunity for future research.

Of note, pharmacologic interventions were not used in the nursing approaches to the participants of this study, and aggressive events were minimal, perhaps reflecting nurses' detailed understanding of their patients. The toolkit of nonpharmacologic interventions for challenging behaviors in people with ADRD is large and should be customizable to meet the individualized needs of the patient.¹³ All too often, because of the time constraints for regulatory compliance and limited staffing, patient preferences are ignored. Personalized PI care can be a reality at the bedside. We must understand the importance of balancing patient preferences and regulatory requirements while achieving optimal patient care outcomes. Including caregivers who are familiar with the wants and needs of the patients is critical to good care.

ARTICLE 5

Padula WV, Nagarajan M, Davidson PM, Pronovost PJ. Investing in skilled specialists to grow hospital infrastructure for quality improvement. *J Patient Saf* 2021;17:51–5.

The goal of this study was to evaluate if having specialists skilled in wound care to support hospital quality infrastructure would be a worthwhile investment for improving hospital performance in PI care. This retrospective observational cohort study was conducted in 55 US academic medical centers reporting data to the Vizient Clinical Database/Resource Manager between 2007 and 2012. On a quarterly basis, these hospitals reported rates of stage 3, stage 4, and unstageable HAPIs as defined by the Agency for Healthcare Research and Quality Patient Safety Indicator 03. The data also included hospital characteristics, including the number of certified wound care nurses (CWCNs), number of beds, patient population characteristics (case-mix index), organizational quality (American Nurses Credentialing Center Magnet status), and external influences (CMS reimbursement conditions). A mixed-effects negative binomial regression model was applied to predict PI rates over time by the number of CWCNs

per 1,000 beds, controlling for Magnet status, case mix, and CMS reimbursement. The hospitals were grouped into quintiles based on average PI rates over time within hospitals.

The regression found that adding one board-certified wound care nurse per 1,000 hospital beds resulted in a 17.7% decrease in PI compared with the previous quarter. Moreover, higher-performing hospitals used their CWCNs more efficiently in preventing PIs, presumably by taking advantage of a stronger quality improvement infrastructure. The authors list several limitations including the underreporting of PI cases when using the Patient Safety Indicator 03, the inability to control for other factors that could modify the association between CWCNs and PI rates, and uncertainty in how the CWCNs were actually being used. The study concludes that skilled wound care specialists are a valuable investment for hospital infrastructure. In addition, hospitals need to configure their workforce to achieve better outcomes, and future government policies should provide better financial support to improve quality infrastructure, thereby reducing patient costs and improving quality of care.

Comment

Certified wound care nurses play an essential role in the prevention and treatment of PIs. Padula and colleagues remind us that many CWCNs are not only at the patient bedside but are an important component of hospitals' quality improvement infrastructure by developing policies and procedures, instructing staff in best practices, and monitoring performance. So, what is the impact to a hospital of investing in more CWCNs? Although CWCN staffing has not been studied in depth, the association between nurse staffing levels and PI rates has been extensively investigated.^{14–20} However, results from studies in hospitals versus nursing homes have often conflicted and been confounded by issues such as staffing mix and turnover. Overall, the literature seems to suggest that, on average, higher staffing levels are associated with reduced PI rates. We also know that there must be some minimal staffing level below which it is impossible to provide good-quality care. High-quality care likely can be provided across a range of staffing levels, depending on leadership and management; CWCNs are an important component of this wound care leadership and management. The findings of Padula et al confirm that hiring one additional CWCN per 1,000 beds will lower PI rates by almost 18%, a seemingly good investment. Moreover, CWCNs will be most efficient in those hospitals that already have a strong quality improvement infrastructure. It is always nice to know that our work is making a difference.

ARTICLE 6

Tsukatani T, Minematsu T, Dai M, et al. Polymorphism analysis of candidate risk genes for pressure injuries



in older Japanese patients: a cross-sectional study at a long-term care hospital. *Wound Repair Regen* 2021;29:741–51.

This study assessed the relationship between PIs and single-nucleotide polymorphisms (SNPs) of genes related to tissue tolerance. Participants were recruited from a Japanese long-term care hospital between July and October 2019. Participants had hospital stays of 6 months or longer at the time of recruitment; they were excluded if they had a history of a prior PI or if they had a current PI that lacked documentation of depth. Oral mucosal swabs were obtained, and DNA analyses performed by polymerase chain reaction to identify SNPs in the genes for five proteins involved in wound repair: hypoxia-inducible factor 1 subunit alpha (HIF1A), vascular endothelial growth factor C (VEGFC), heat shock protein 90 alpha family class A member 1 (HSP90AA1), myostatin (MSTN), and vitamin D receptor (VDR). Eight specific SNPs in these five genes were evaluated for their association with the presence of superficial or deep PIs.

Of the 178 participants, 130 had no history of a PI during the 6-month period, 20 had a history of superficial PI, and 28 had a history of deep PI. Two of the eight SNPs were found to be associated with PI. The frequency of the GG genotype of VEGFC rs1485766 was significantly higher in people with superficial PIs compared with those with no wound. The frequency of the CT + TT genotype of HIF1A rs11549465 was significantly lower in people with a deep PI compared with those with no wound. These associations remained significant after adjusting for factors including age, BMI, and Braden Scale score. Limitations include the cross-sectional design, which creates uncertainty as to causality between SNPs and PI development, and that a more comprehensive analysis using a genome-wide association study was not performed. The researchers suggest that information on SNPs might be useful to predict PI risk and could be used to tailor preventive interventions based on specific genetic susceptibilities.

Comment

The current conceptual framework for PI development considers both mechanical boundary conditions, such as the magnitude and duration of pressure, as well as the individual's susceptibility to and tolerance of injury.²¹ Many factors are known to influence tissue tolerance to pressure including diabetes, malnutrition, cigarette use, and poor perfusion. Based on the work of Tsukatani et al, we may now need to consider genetics as another factor that impacts tissue tolerance. The presence of superficial or deep PIs was associated with the presence of specific polymorphisms in two of the five genes that were examined. The mechanisms by which the changes in protein structures arising from genetic differences impact the development of PIs are not entirely clear. The researchers spec-

ulate that VEGFC-induced lymphangiogenesis might be protective in early PIs; delayed lymphangiogenesis from the GG genotype of VEGFC rs1485766 would then lead to lymphedema and delayed healing. Similarly, HIF1A helps regulate angiogenesis as well as cell apoptosis/proliferation in response to hypoxic conditions. Who knew that PIs might have a genetic predisposition? In this era of precision medicine, specific therapies directed to SNPs might be in our future.

CONCLUSION

Overall, 2021 was an interesting year for PI research. The current literature addresses some of the challenges that clinicians face, such as whether to consider fecal diversion and how to manage repositioning in people with behavioral disturbances. The possibility that PIs may have a genetic component could change how we think of them. The literature has also highlighted ongoing challenges: How can we further improve PI care and lower prevalence? More information on best practices will be needed. As the COVID pandemic ebbs, it is the authors' hope that there will be a resurgence in high-quality clinical trials to guide our future practices. We shall see what 2022 produces. ●

PRACTICE PEARLS

- Pressure injury rates have been stable since 2015, emphasizing the need for new efforts to improve preventive care.
- Being underweight, but not being overweight, increases PI risk.
- Evidence regarding the potential benefits of fecal diversion for promoting healing of anus-near PIs remains limited.
- A variety of strategies are employed by nurses in successfully repositioning people with behavioral disturbances from Alzheimer disease.
- Investing in skilled wound care specialists leads to improved PI outcomes.

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The registration fee for this CE activity is \$24.95 for nurses; \$22.00 for physicians.