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Using technology to enhance prevention of pressure injuries in the spina bifida population

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Abstract

Patients with spina bifida (SB) are highly susceptible to pressure injuries (PIs) due to limited mobility and sensory deficits, and they may occur during multiple surgical procedures. The article highlights that PIs, which significantly increase hospital costs and extend patient stays, can be prevented mainly through evidence-based interventions. One of the critical technologies used at this stage is pressure mapping to monitor and optimize pressure distribution on surfaces, whether lying or seated, particularly during prolonged medical procedures. Additionally, the article emphasizes the importance of educating families and caregivers about early signs of PIs, photography, using electronic health records for tracking, and effective home care strategies to prevent these injuries post-discharge. Future research should investigate how to enhance prevention methods in hospital settings, especially for patients undergoing surgeries or other lengthy procedures. Overall, the article underscores the critical role of early identification of risk, intervention, and technological support in reducing the incidence and impact of PIs in patients with SB.

Keywords

spina bifida, pressure injuries prevention, pediatric care, pressure mapping technology, surface selection

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Introduction

Pressure ulcers, now termed pressure injuries (PIs), have contributed to morbidity and mortality in people with limited mobility.[1] The previous terminology was descriptive, using terms such as bedsores and decubitus ulcers.[1] Current research is looking into advancing the science of the development of PIs by providing surface pressure measurements for different surfaces (mattress, seat cushions) and other patient positions to choose the most effective product and position for pressure redistribution to lower the incidence of PI.[1–3]

PIs are a significant issue in all care settings and healthcare systems. Although their prevalence varies across care settings, PIs are most commonly encountered in intensive care units (ICUs).[2,4,5] While the literature has primarily focused on elderly patients in ICUs, unfortunately, PIs also exist in the pediatric population. Studies have reported that the prevalence and incidence of PIs in the pediatric population range from 0.47% to 31.2%.[6–9] Spina bifida (SB) is the most frequently occurring neural tube defect, with myelomeningocele being its most severe and disabling form.[10,11] This condition is often linked to long-term challenges, including mobility impairments, incontinence, cognitive difficulties, and an increased risk of PIs.[12] Due to sensory deficits and immobility below the spinal defect, individuals with SB are particularly vulnerable to developing PIs, which significantly impact their quality of life and increase healthcare costs.[13]

Risk factors with a focus on pressure

The primary risk factors contributing to the development of PIs are pressure force and shearing[14–16]; however, scant literature focuses on patients who may undergo multiple

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surgical and interventional radiology procedures that may contribute to the development of PI.[14–16] Children with SB face unique challenges that heighten their risk for secondary complications, including obesity. Poor nutritional habits and reduced mobility contribute to a higher prevalence of obesity in this population.[17] Obesity, in turn, exacerbates risks for metabolic syndrome-related conditions such as diabetes mellitus, dyslipidemia, hypertension, cardiovascular diseases, sleep apnea, osteoporosis, and impaired skin integrity.[18,19] Additionally, sensory deficits below the level of the spinal defect in open SB often prevent patients from noticing minor wounds on the lower extremities, sacral area, and back.[20] For wheelchair users, regular assessment for proper sizing and equipment fitting is crucial to prevent complications such as PIs.[20] Furthermore, friction from medical devices like ostomies, tracheostomies, and urinary catheters can cause skin damage in areas with reduced sensation. Immobility and increased body weight can disrupt sitting balance due to paralysis of the abdominal, thoracic, and lumbar muscles in patients with open spinal defects, further contributing to the development of PIs.[21]

Over six years of collecting data on hospital-acquired pressure injuries (HAPIs), a previous study found that many of the HAPIs originated in the operating room during prolonged procedures and where patients had lower perfusion as measured by mean arterial pressure or blood pressure (BP).[2] Prolonged surgical procedures and compromised perfusion present significant risk factors for PIs.

Pressure mapping can identify high-risk areas during these scenarios, highlighting areas of highest pressure on the sacrum, occiput, and scapula, as well as increased shear forces in the hip region with changes in bed elevation.[3]

Prevention of PIs using technology

Previous research by Kim et al. identified key factors associated with PIs in individuals with SB, including reduced mobility, urinary incontinence, and lack of appropriate seating support. These findings underline the importance of tailored preventive strategies to address specific risk factors in this population.[22] Schechter et al. emphasized the role of sociodemographic attributes, such as family income and access to care, in influencing outcomes for individuals with SB. Addressing these disparities is crucial for improving PI prevention strategies.[23]

Many factors can contribute to skin breakdown; this section primarily focuses on the role of surfaces and pressure redistribution. These factors can be measured using a pressure mapping machine with accompanying software.[2] This technology has been used since 2011 in the authors' facility, initially funded by a Children's Miracle Network grant. It has been applied to map pressure surfaces for infants, children, and adults.[2] Over six years of collecting data on HAPIs, particularly in the operating room during prolonged procedures and in patients with low perfusion (as measured by BP and mean arterial pressure), it was identified that full-thickness PIs started as deep tissue injuries.[2] Full-thickness PIs, particularly those originating as deep tissue injuries, underscore the necessity of rigorous prevention strategies. PIs are primarily preventable through interventions aligned with evidence-based guidelines.[24,25] Moreover, pressure mapping technology could be adapted to assess and improve surfaces specifically for patients with SB, particularly those reliant on wheelchairs. Ensuring optimal surface support can be critical in reducing the risk of PIs in this vulnerable population.[3]

The presence of PIs in hospitalized patients with SB has been shown to increase hospital costs by approximately 10% and extend the average length of stay by 24% compared to their peers without these injuries.[13] These findings underscore the significance of early identification and intervention, particularly for parents and caregivers, in mitigating severe complications associated with PIs.[26,27] Educational initiatives like the 'Did You Look?' campaign have effectively raised awareness about early detection of PIs. This campaign encourages caregivers and healthcare professionals to conduct regular skin assessments, emphasizing the importance of identifying early signs of tissue damage to prevent severe complications.[28]

Prevention of PIs using pressure mapping system technology

Comprehensive care for patients with SB requires collaboration among various healthcare professionals. Surgeons, anesthesiologists, and nurses must work together to implement effective strategies and reduce the risk of PIs. Implementing such strategies not only helps reduce the incidence of PIs but also improves overall patient outcomes, particularly in high-risk populations such as those with SB.[2] Moreover, educational initiatives targeting caregivers are critical. Developing and providing access to educational resources, such as instructional videos on wound care, can significantly empower caregivers. These resources help them recognize the early signs of PIs and equip them with the necessary skills to manage these conditions effectively at home. This approach is vital for families of patients with SB, who often require ongoing and vigilant care to prevent the development of PIs.[2]

Photography and the use of electronic medical records (EMRs)

Consistent photography and the use of EMRs can provide tracking and documentation of skin over time. Many EMR systems now allow for the insertion of photos with

date and time stamps into wound notes. It is suggested to take one photo from far away to show bony prominences for the position of the wound and one from closer with a measuring device (a simple paper ruler or a cotton swab with measurements). Seeking permission to take photos with the patient's phone can allow them to be shared with outside providers.

Holistic care and transition planning for patients with SB

Wound care and dressing techniques play a critical role in managing PIs. As a general rule, the principle "if the wound is wet, dry it; if it's dry, moisten it" should be applied. Recent studies indicate that using collagen dressings immediately after cleaning the wound, at an earlier stage than previous approaches, may accelerate the healing process.[29] When discharging patients, particularly those at risk for PIs, it is crucial to ensure they are provided with the necessary education and materials for home care. The Centers for Medicare and Medicaid Services only cover the cost of specialty surfaces for patients after they have developed a stage three PI.[30]

During discharge, it is important to raise awareness by providing patients and their families with photographs showing early skin changes.[30] Having these photos on their phones makes it easier to share with external providers and benefits even those without access to health records. This approach encourages excellent patient and family engagement in skin and wound assessment.[31] A multidisciplinary approach is crucial for optimizing outcomes in patients with SB.[32] The "specialty medical home" model, in which a specialist with expertise in SB coordinates care, is highly recommended for managing the complexities of this condition.[32] This model ensures that care is tailored to the patient's needs and provides a consistent approach throughout life. Transitioning from pediatric to adult care is another critical element that requires early planning, particularly considering the patient's cognitive development. This process involves close collaboration among all care teams to ensure a seamless transition and continued support (Level V evidence). In addition, high-intensity multidisciplinary rehabilitation programs, including cognitive behavioral therapy, have enhanced cognitive function, mood, independence, and bowel/bladder management (Level II evidence).[33] Such interventions highlight the importance of comprehensive and continuous care strategies throughout the patient's lifespan.[32] Education for families and caregivers aims to raise awareness and knowledge about PIs.[3] These educational sessions also cover home care strategies and the role of support groups. Technologies like pressure mapping machines can effectively monitor the surface's pressure distribution during seated activities used in home care.[3]

Conclusion

In conclusion, the prevention and management of PIs in children with SB require a multidisciplinary approach, the integration of advanced technologies, and comprehensive education programs. Technologies such as pressure mapping systems play a crucial role in the early detection and prevention of these injuries by providing real-time data that helps caregivers and healthcare providers make informed decisions regarding positioning and pressure redistribution during hospitalizations and home activities. Collaboration among surgeons, anesthesiologists, nurses, and other healthcare professionals ensures a holistic approach to care, which can significantly reduce the risk of complications and improve patient outcomes while in the hospital.

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