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Research Progress on Assessment Tools for Risk Factors of Pressure Injury in Elderly Inpatients

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Abstract: Elderly hospitalized patients frequently experience nursing complications such as pressure injuries. It is crucial for nursing staff to accurately identify risk factors and appropriately utilize assessment tools, which constitutes a key focus of clinical prevention efforts. This article categorizes the risk factors for pressure injuries in elderly patients into three types: non-modifiable factors, modifiable factors, and environmental/nursing-related factors. It provides a comprehensive analysis of the application and limitations of traditional assessment tools such as the Braden, Waterlow, and Norton scales, while summarizing research advancements in modified localized scales, risk prediction models, intelligent assessment tools, and specialized evaluation instruments to assist clinical nursing professionals in selecting and employing appropriate assessment tools as references.

Keywords: Elderly hospitalization; Risk factors for pressure injuries; Assessment tools; Research progress

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1. Introduction

Pressure injury refers to localized damage to the skin and deep soft tissues caused by pressure or a combination of pressure and shear forces, manifesting as skin breakdown or open ulcers at bony prominences. It is one of the most common nursing complications among elderly hospitalized patients [1]. The aging population in China is accelerating at a rapid pace, and the number of elderly hospitalized patients continues to increase annually. Elderly individuals often suffer from chronic underlying diseases and functional decline, resulting in persistently high rates of pressure injuries. Identifying the risk factors for pressure injuries in elderly hospitalized patients and appropriately selecting and utilizing assessment tools constitute critical components of clinical pressure injury prevention [2]. This article primarily reviews the classification of risk factors for pressure injuries in elderly hospitalized patients, traditional assessment tools and their clinical applications, as well as research advancements in novel assessment tools, aiming to provide references for clinical nursing practice.

2. Classification of risk factors for pressure injury in elderly hospitalized patients

2.1. Unalterable risk factors

Unalterable risk factors refer to characteristics inherent in patients that cannot be directly modified through nursing interventions, yet they remain of significant value for risk assessment and graded prevention.

2.1.1. Age

With advancing age, the elasticity of the skin declines, the subcutaneous fat layer thins, and collagen in the dermis decreases, resulting in reduced skin resilience against pressure and shear forces. The microcirculatory function of the skin deteriorates, and capillary regeneration capacity diminishes, leading to a slower repair process under compression. Numerous studies have demonstrated that hospitalized patients aged 70 years or older exhibit a higher probability of developing pressure injuries compared to younger patients, with the risk increasing significantly for every additional decade of age [3].

2.1.2. Gender factor

The incidence of stress injuries in elderly female patients is generally higher than that in males, which may be attributed to the sudden decline in estrogen levels post-menopause, leading to reduced collagen content in the skin and diminished skin barrier function. Additionally, the anatomical characteristics of the hip and pelvis in elderly women subject the sacrococcygeal region and bony prominences such as the ischial tuberosities to greater local pressure, thereby increasing the likelihood of injury [4].

2.1.3. Presence of multiple underlying diseases

Diabetes mellitus is one of the most prominent conditions, where chronic hyperglycemia leads to peripheral neuropathy, reducing patients' sensitivity to compressive discomfort, while microvascular complications result in inadequate local tissue perfusion and impair tissue ischemia tolerance and repair capacity. Patients with sequelae of cerebrovascular diseases, such as hemiplegia or paraplegia, face an extremely high risk due to prolonged bed rest accompanied by sensory and motor dysfunction, resulting in sustained local tissue compression [5]. Patients with chronic cardiopulmonary insufficiency face elevated risks due to prolonged tissue hypoxia and inadequate nutritional supply to the skin and subcutaneous tissues. Patients with advanced-stage malignant tumors are often at high risk owing to cachexia and systemic organ failure. A prior history of pressure injuries should also not be overlooked, as patients with such a history exhibit significantly increased recurrence risk.

2.2. Modifiable risk factors

Modifiable risk factors refer to those that can be improved through active interventions; addressing these factors constitutes the primary strategy for preventing stress injuries.

2.2.1. Nutritional status

Elderly hospitalized patients often experience insufficient protein and caloric intake due to decreased appetite, masticatory dysfunction, and impaired digestive and absorptive capacity, leading to hypoproteinemia. Reduced serum albumin levels constitute an independent risk factor for stress injury in elderly patients. Adequate protein intake is essential for maintaining the normal structure of skin and subcutaneous tissues and promoting wound healing. Trace elements such as vitamin C and zinc play critical roles in collagen synthesis

and wound healing; their deficiency increases the likelihood of injury occurrence [6].

2.2.2. Limited mobility and movement capacity

Elderly hospitalized patients experience prolonged bed rest due to illness, postoperative immobilization, or pain, resulting in sustained vertical pressure on bony prominences. When tissue pressure exceeds the capillary occlusion pressure and persists for an extended duration, local blood flow is interrupted, leading to tissue ischemia and hypoxia, ultimately causing cell necrosis. Assisting patients with active movement or passive position changes constitutes a fundamental approach to preventing pressure injuries. A moist environment compromises skin integrity, representing another modifiable factor. Elderly patients often experience prolonged skin moisture due to urinary/fecal incontinence, excessive sweating, or wound exudate. Moisture softens the stratum corneum and weakens barrier function, increasing susceptibility to friction and shear forces while creating a favorable environment for bacterial and fungal growth. Impaired sensory perception is closely associated with pressure injuries. Due to cognitive dysfunction, delirium, or neurological disorders, elderly patients exhibit diminished awareness of compressive discomfort and are unable to voluntarily adjust their posture to alleviate localized pressure [7].

2.3. Environmental and nursing factors

Devices such as dynamic alternating-pressure air mattresses and static pressure-relieving cushions can automatically adjust pressure distribution according to changes in patient positioning, significantly reducing peak pressure at bony prominences, and have been proven effective in reducing the incidence of pressure injuries [8]. Position management and repositioning frequency directly affect the duration of sustained pressure on local tissues; regular repositioning is the most fundamental and effective measure for preventing pressure injuries, with a general recommendation that bedridden patients be repositioned every two hours, with the specific frequency individually adjusted based on the patient's risk level. Insufficient nursing staffing is likewise an important factor affecting the quality of prevention; when nursing workloads are excessive, it becomes difficult to complete preventive measures such as repositioning and skin assessments as scheduled. Strengthening nursing staff training and optimizing workflows have positive significance for reducing the incidence of pressure injuries.

3. Traditional pressure injury risk assessment tools and their clinical applications

3.1. Commonly used classic assessment scales

3.1.1. Braden scale

The Braden Scale, developed by Braden and Bergstrom in 1987, is currently the most widely used tool for assessing pressure injury risk in clinical nursing practice both domestically and internationally. The scale provides a comprehensive evaluation across six dimensions: perception ability, moisture level, mobility, activity capacity, nutritional intake, and friction/shear forces, with a total score ranging from 6 to 23 points, where lower scores indicate higher risk. Clinically, a score of 18 is considered the critical threshold: 15–18 indicates mild risk, 13–14 indicates moderate risk, and 12 or below indicates high risk. The Braden Scale features a concise structure, allowing nursing staff to master it after brief training [9].

Validation studies conducted on elderly hospitalized patients demonstrated that the Braden Scale exhibits high sensitivity and moderate specificity. However, certain assessment dimensions, such as perceived

ability and subjective evaluation of nutritional intake, show significant inter-assessor variability in scoring consistency [10]. Additionally, the scale does not incorporate age and comorbidities, factors specific to elderly patients which somewhat limits its predictive accuracy.

3.1.2. Waterlow scale

The Waterlow Scale was developed by Waterlow in 1985 and covers multiple dimensions including body mass index (BMI), skin type, gender, age, nutritional status, incontinence status, mobility, neurological dysfunction, and medication use. It also includes items related to surgical risks. The total score is calculated by assigning different weights to each item, with higher total scores indicating greater risk [11].

This scale features a comprehensive range of assessment dimensions, with particular emphasis on nutritional status and skin condition, making it highly suitable for elderly patients with multiple chronic comorbidities. However, its extensive item list includes some entries with insufficiently clear definitions, resulting in prolonged assessment time. Additionally, studies suggest that its specificity is relatively low, increasing the risk of over-assessment and consequently unnecessary waste of nursing resources.

3.1.3. Norton scale

The Norton Scale, developed by Norton et al. in 1962, is one of the earliest tools for assessing the risk of pressure injuries. The scale comprises five dimensions: physical condition, mental status, activity capacity, mobility ability, and incontinence. Each dimension is scored on a four-point scale ranging from 1 to 4, with a total score ranging from 5 to 20 points. Clinically, a score of 14 is often used as the cutoff value; scores below 14 indicate an elevated risk [12,13]. The Norton Scale features a simple structure and is widely used in geriatric care. However, it has limited assessment dimensions and does not cover critical risk factors such as nutritional status and friction-shear forces, resulting in limited capacity to evaluate patient-specific risks in elderly individuals. Some studies indicate that its ability to identify high-risk patients is inferior to that of the Braden Scale, leading to a declining global usage rate.

3.2. Common issues with traditional scales

The aforementioned scales still exhibit certain common issues when applied to elderly hospitalized patients. First, these scales were developed based on Western populations, resulting in applicability biases in the China elderly patient population. Second, most are general-purpose assessment tools that fail to adequately account for age-specific factors such as geriatric syndromes, polypharmacy, and cognitive dysfunction. Third, the guidance regarding assessment timing and frequency is rather vague, lacking dynamic evaluation strategies tailored to elderly patients with varying risk levels. Fourth, assessment outcomes rely on the subjective judgment of caregivers, leading to significant scoring discrepancies among different assessors.

4. Research progress on novel risk assessment tools for pressure ulcers

4.1. Modified localized assessment scale

Due to the poor applicability of traditional assessment tools in the elderly patient population in China, domestic scholars have conducted extensive efforts in introducing and modifying these tools. The PURPOSE-T scale was developed by British researchers and comprises two primary assessment modules: skin condition and patient risk factors, covering aspects such as skin integrity, history of pressure injuries,

age, nutritional status, incontinence, mobility, and medication use [14]. Domestic researchers localized the imported data and conducted reliability and validity tests, with results demonstrating that the Chinese version of PURPOSE-T exhibits strong internal consistency and discriminant validity. Some researchers modified the scale based on the Braden Scale, adding items related to elderly patients such as cognitive function, diabetes history, and hemoglobin levels, and recalibrated the cutoff values using large-scale domestic sample data [15]. The improved scale demonstrates enhanced sensitivity and specificity compared to the original version; however, results from different studies still vary, necessitating larger-scale multicenter studies for validation.

4.2. Risk prediction model

Risk prediction models employ statistical methods or machine learning algorithms to construct mathematical models based on patients' demographic characteristics, disease information, and laboratory test indicators, enabling the quantification of an individual's probability of developing pressure injuries. Compared to traditional scales, risk prediction models can incorporate more objective variables and account for complex interactions among these variables [16]. The column chart has become a widely used visualization tool for prediction in recent years. Researchers collect large-scale clinical data and employ logistic regression to identify independent risk factors such as age, serum albumin levels, diabetes, consciousness status, and bed rest duration, presenting them in the form of column charts. Nursing staff can quickly estimate the probability of occurrence by summing the corresponding scores for each factor, offering an intuitive and user-friendly approach.

Machine learning-based prediction models have increasingly become a research hotspot. Algorithms such as random forests, support vector machines, and artificial neural networks can automatically identify nonlinear relationships and higher-order interaction effects in data, demonstrating advantages in processing high-dimensional clinical data. Multiple studies indicate that their predictive accuracy surpasses that of traditional Braden scale scores; however, model construction relies on large volumes of high-quality data with limited interpretability, resulting in relatively high barriers to clinical application.

4.3. Intelligent assessment tool

Intelligent assessment tools hold significant potential for development in the field of pressure ulcer risk evaluation. An intelligent posture monitoring system utilizing thin-film pressure sensors can obtain real-time pressure distribution data from the patient's body-to-mattress contact surface and transmit this data wirelessly to the nursing terminal. If the pressure duration on any area exceeds a preset threshold, the system automatically sends a repositioning reminder. Studies indicate that the implementation of this system has led to a notable improvement in patients actual repositioning compliance rates and a significant reduction in the incidence of pressure ulcers [17]. Evaluation applications for smartphones and tablets have been implemented in several hospitals, digitizing assessment scales and incorporating automated scoring and risk grading features. This reduces errors associated with manual calculations while automatically recording evaluation times and results, facilitating the tracking of dynamic changes in patient risks. Some applications integrate stress ulcer staging identification capabilities, utilizing image processing technology to assist in determining injury staging and severity, thereby enhancing the standardization of assessments.

4.4. Special assessment tool

Elderly inpatients exhibit significant variations in disease types and nursing needs, making it challenging

for general assessment tools to meet the precision requirements of different specialties. In the field of intensive care, specialized assessment tools for ICU patients incorporate specific items such as hemodynamic parameters, mechanical ventilation duration, and sedation-anesthesia scores into routine evaluations, thereby enhancing the accuracy of risk prediction for critically ill elderly patients [18]. In the field of operating rooms, tools for assessing intraoperative acquired pressure injuries incorporate surgical factors such as procedure type, estimated operative duration, intraoperative positioning, and anesthesia method, providing a targeted basis for intraoperative risk stratification. In the context of long-term care for elderly patients, simplified assessment tools retain key items while streamlining the scale structure for bedridden seniors, thereby reducing evaluation time and making them more suitable for use in institutions with limited nursing resources [19].

5. Conclusion

The development of pressure injury risk assessment tools has evolved from universal scales to locally adapted modified scales, and ultimately to intelligent predictive systems. For the specific population of elderly hospitalized patients, a single assessment tool is no longer sufficient to meet the demands of precise prevention. Future efforts should focus on establishing a comprehensive risk assessment system that integrates static evaluations with dynamic monitoring, tailored to the clinical characteristics of elderly patients. While advancing the development and validation of new tools, it is essential to enhance nursing staff training to improve their proficiency in correctly utilizing various assessment tools, thereby ensuring accurate alignment between assessment findings and preventive measures and effectively reducing the incidence of pressure injuries among elderly hospitalized patients.

Disclosure statement

The author declares no conflict of interest.

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