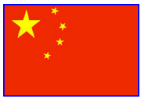
Risk assessment tools for pressure injury in intensive care patients: a review



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SUMMARY

- Accurate assessment of the risk for pressure injury is the premise of implementing effective prevention and timely treatment.
- An appropriate pressure injury risk assessment tool could help nurses in intensive care unit better understand patients' health condition and implement proper nursing care to prevent pressure ulcer.

INTRODUCTION

Pressure injury risk assessment, an important component of pressure injury prevention, aims to identify patients at high risk for pressure injury as well as the associated risk factors to inform the delivery of effective nursing care to prevent the occurrence of pressure injury (Chou et al., 2013). Intensive care unit (ICU), a special department for critically ill patients, has the highest incidence rate of pressure injury than that in other units. A global multi-center survey showed that the prevalence of pressure injury in ICU was about 10.3%, while it was 3.9%-4.3% in general medical-surgical units (VanGilder, 2009). The progression of pressure injury is more severe in ICU patients and 3.3% of ICU patients developed stage III, stage IV, and unstable pressure injury, or deep issue injury (Chou et al., 2013). Study demonstrated that delayed healing of pressure injury would increase the risk of mortality by six times (Dong & Lv, 2010). By contrast, routinely assessing the risk for pressure injury and implementing preventive strategies accordingly could reduce the incidence rate and alleviate the severity of pressure injury, as well as decrease the treatment costs (Chou, 2013). In ICU, a large proportion of patients have unstable vital signs with priority given to life saving rather than skin protection despite the prolonged bedrest and fragile skin of the patients, resulting in increased risk for developing pressure injury. Additionally, identifying the risk factors for pressure injury is a crucial step of developing and implementing effective prevention and treatment strategies (Wound Ostomy and Continence Nurses Society, 2017). All these could be achieved by using a pressure injury risk assessment tool.

Currently, the Braden scale, Norton scale, and Waterlow scale are the three commonly used pressure injury risk assessment tools in ICU. Each of these tools assess the risk for pressure injury and the related risk factors from a specific perspective. Additionally, different populations (such as Chinese ICU patients) may require a tool that could fit the context culture and could provide reliable assessment results, which is also a common concern of nurses. This study compared these three risk assessment tools for the risk of pressure injury development with aim to provide insights for choosing and applying an appropriate tool in ICU practice.

COMPARISON OF PRESSURE INJURY RISK ASSESSMENT SCALES

Features of an ideal pressure injury risk assessment scale

An ideal pressure injury risk assessment scale should be able to distinguish patients with and without pressure injury risk. Therefore, pressure injury risk assessment scale should have sound reliabilities as indicated by high sensitivity, specificity, positive predictive value, and negative predictive value (Jiang, 2015). Sensitivity refers to the probability that patients who develop pressure injury are also at risk of pressure injury as indicated by the score of pressure injury risk assessment (Jiang, 2015). Specificity indicates the probability that patients who do not develop pressure injury are also not at risk of pressure injury as indicated by the pressure injury risk assessment score. Both sensitivity and specificity range from 0 to 1, with a higher value indicating a higher sensitivity or specificity (Jiang, 2015). Particularly, a sensitivity value of 75% or above is considered as with good predictive value to predict a positive case (Jiang, 2015). Positive predictive value reveals the probability of patients screened to be at risk of pressure injury (screened positive) actually developing pressure injury, whereas negative predictive value reflects the probability that patients who are screened not at risk of pressure injury (screened negative) truly do not develop pressure injury. Sensitivity is correlated to positive predictive value, while specificity is related to negative predictive value. All these four are the indicators when evaluating the performance of a scale and thus compared among the three scales in this study.

Characteristics of the three commonly used pressure injury risk assessment scales

Table 1 summaries the characteristics of the Braden scale, Norton scale, and Waterlow scale.

The Braden scale

The Braden scale was developed in 1987 and consists of six items the risk of pressure injury according to six aspects in terms of sensory perception, moisture, activity, mobility, nutrition, as well as friction and shear to predict the risk of pressure injury development (Bergstrom et al., 1987). Each item is rated from 1 (least favorable) to 3 or 4 (most favorable), and the score of each item is summed to yield a total score of 6-23 with low score indicating high level of risk for pressure injuries development. A score of ≤16 of the total score is suggested to identify patients at risk (Braden & Bergstrom, 1994).

The Braden scale is considered as the most extensively validated pressure injury risk assessment scale and demonstrates a high predictive capacity. According to a systematic review, the sensitivity,

Assessment indicators	Risk assessment tools		
	Braden Scale	Norton Scale	Waterlow Scale
Sensitivity (%)	38.9-100	82.83	75.8-100
Specificity (%)	26-100	78.20	10.3-38
Positive predictive value (%)	4.5-100	17.9	5.3-33.3
Negative predictive value (%)	50-100	98.8	65.7-100
Characteristics of the scale	Developed by Braden and Bergstrom (USA) in 1987. The most widely used pressure injury risk assessment worldwide. Balanced sensitivity and specificity, with relatively ideal predictive effects. Assesses six domains of risk factors, including sensory perception, moisture, activity, mobility, nutrition, as well as friction and shear.	Published by Norton in 1979, it is suitable for pressure injury risk assessment of elderly patients. Recommended for pressure injury prediction by the US Department of Health Care Policy Research. Assesses five domains of risk factors, including physical condition, mental condition, activity, mobility, and incontinence.	Designed by Waterlow in 1985. It is the most widely used pressure injury risk assessment tool in the UK. Suitable for pressure injury risk prediction of ICU critical patients and surgical patients. Assesses the following risk factors, including build/weight, height, visual assessment of the skin, continence, mobility, sex/age, appetite, and special risks in terms of tissue malnutrition, neurological deficit, medication, and major surgery/ trauma.
Limitations	The degree of risk can only predict the risk of presence of pressure injury, but not the severity of pressure injury. The indicator of nutrition only includes the intake process, without the consideration of nutritional metabolic disorder and malabsorption, which are important risk factors of pressure injury for ICU patients.	Lacking the nutritional assessment and body sensory perception assessment, both of which are important for evaluating the risk of pressure injury for ICU patients. Inadequacy of comprehensive predictive ability.	Unbalanced sensitivity and specificity, which may result in false positive results, unnecessary of prevention strategies, and a waste of nursing resources.

Table 1. Characteristics of the commonly used pressure injury risk assessment tools

specificity, positive predictive value and negative predictive value of Braden scale ranged from 38.9% to 100%, 26% to 100%, 4.5% to 100%, and 50% to 100%, respectively (Pancorbo-Hidalgo et al., 2006). Particularly in a population in mainland China, these four values were reported as 89%, 72%, 5%, and 100% for sensitivity, specificity, positive predictive value and negative predictive value respectively (Kwong et al., 2005). It has been reported that patients with a Braden scale score below the cutoff point have more than 4-fold of risk developing pressure injury (García-Fernández et al., 2014; Pancorbo-Hidalgo et al., 2006). Despite the widely used and balanced sensitivity and specificity of the Braden scale, it is criticized as only evaluating the presence of pressure injury but without the assessment of the severity of pressure injury (Hu, 2010) and the evaluation of nutritional metabolic disorder and malabsorption which are important factors to predict pressure injury in ICU patients (Jiang & Liu, 2009) .

The Norton scale

The Norton scale was initially developed for a geriatric population (Norton et al., 1975). It contains five items to assesses five areas including physical condition, mental condition, activity, mobility, and incontinence assess to predict risk of pressure injury development, with each item being rated from 1 (very bad) to 4 (very good). The total score is calculated by summing the score of each item, thereby resulting in a range of 5 to 20 with lower score indicating higher risk. A score of 16 is used as the cut-off point to differentiate risk patients from non-risk patients (Norton, 1989).

The Norton scale is considered as a suitable tool for elderly patients to assess their risk of pressure injury and has been recommended by the US Department of Health Care Policy Research to predict the risk for pressure injury in elder population (Liang & Wang, 2010). The sensitivity, specificity, positive predictive value, and negative predictive value of the Norton scale was reported as 82.83%, 78.20%, 17.9%, and 98.8%, respectively (Jiang, 2015). A recent meta-analysis reported a good predictive ability of the Norton scale (RR = 3.69, 95%CI: 2.64-5.16) (García-Fernández et al., 2014). However, this risk assessment scale is criticized as unable to comprehensively evaluate the risk of pressure injury in ICU patients as it fails to take other ICU specific risk factors such as decreased sensory function and the use of shear that may increase the risk of pressure injury into consideration (Xue et al, 2004). Moreover, limited validation studies regarding the Norton scale have been conducted, resulting in less data to support the reliability and validity of this scale (Pancorbo-Hidalgo et al., 2006).

The Waterlow scale

The Waterlow scale was developed based on the Norton scale and considered as more comprehensive (Waterlow, 1985). The Waterlow scale predicts the risk of pressure injury through evaluating the aspects of body mass index, visual assessment of the skin, sex, age, continence, mobility, nutrition, and special risks in terms of tissue malnutrition, neurological deficit, medication, and major surgery/ trauma. Each item assesses pressure injury risk from one aspect and scored differently. Patients scoring 10-14 are considered as at risk, 15-19 as high risk, and 20 or above as very high risk. A score of 16 or above usually is used as the cutoff point for at-risk patients in clinical studies (Wardman, 1991).

The Waterlow scale reported a range from 75.8% to 100% for sensitivity, 10.3% to 38% for specificity, 5.3% to 33.3% for positive predictive value, and 65.7% to 100% for negative predictive value (Pancorbo-Hidalgo et al., 2006). The Waterlow scale score exhibited an adequate predictive capacity (OR = 2.05, 95% CI: 1.11-3.76) (Pancorbo-Hidalgo et al., 2006). However, the major limitation of the Waterlow scale is the unbalanced sensitivity and specificity. The high sensitivity but how specificity may increase the risk of false positive results, which is that patients may be classified as at-risk for pressure injury according to the results of Waterlow scale but in reality they are not at such risk. Consequently, prevention measures may be applied to these patients who actually are not in need of them, resulting in a waste of medical and nursing resources.

DISCUSSION

Developing valid pressure injury risk assessment scale for ICU patients has become a concern globally, however, there is no consensus on the standard risk assessment scale for ICU patients. All the three commonly used risk assessment scales, namely, the Braden scale, the Norton scale, and the Waterlow scale, are developed based on different risk factors of pressure injury, resulting in different criteria to determine the risk of pressure injury. In a literature review, De Laat and colleagues (2006) identified more than 50 risk factors of pressure injury from a series of epidemiological studies; the prevention and treatment of pressure injury guideline also reported multiple risk factors of pressure injury (National Pressure Injury Advisory Panel and European Pressure Injury Advisory Panel, 2014). Considering the complex risk factors for pressure injury in ICU patients, comprehensive assessment for the risk is recommended.

Choosing an appropriate risk assessment tool

As there is no consensus on the standard pressure injury risk assessment tool, the reliability and validity of the scales, the contents of the assessment, the medical condition of the patients, and the comprehension level of the users should be considered when choosing a pressure injury risk assessment scale (Jiang, 2015). For example, a pressure injury assessment scale with a comprehensive head to toe skin examination is recommended by the Pan-Pacific pressure injury prevention and management guideline, as such comprehensive assessment is more predictive for pressure injury (Australian Wound Management Association, 2012). Additionally, selecting a risk assessment scale according to the condition of patients is recommended in clinical practice, such as Waterlow scale for ICU patients while Branden scale for patients in general ward, as patients with difference health condition may have different risk factors for pressure injury (Hu et al., 2010).

Another concern regarding the choosing of an appropriate risk assessment tool is context-specific, such as ICU-specific risk assessment tool. The Jackson-Cubbin scale for adults (Jackson, 1999) was specifically designed for ICU patients, however this tool has not yet been validated rigorously (Jiang, 2017) and is criticized as having a high false-positive rate but low accuracy rate (Boyle & Green, 2001). Recently, a new tool- the COMHON index which assess five aspects of risk including conscious level, mobility, hemodynamics, oxygenation, and nutrition, has been developed specifically for critically ill patients and demonstrated good reliability and validity (Cobos Vargas et al., 2011). Additionally, a study comparing the inter-rate reliability of COMHON index with the Braden scale, the Norton scale and the Waterlow scale revealed the best inter-rate reliability of the COMHON index in ICU setting compared with other three scales (Fulbrook & Anderson, 2015), indicating the promising use of COMHON index in ICU settings.

Dynamically assessing the pressure injury risk for ICU patients

Dynamically evaluating patients' risk for pressure injury could allow early identity the high-risk population and implementing timely prevention strategies accordingly. If a local irreversible skin damage has occurred before ICU admission, pressure injury may happen within 24-48 hours (Zhao, 2010). Therefore, it is recommended that high-risk patients should receive initial pressure injury risk assessment within 2 hours after ICU admission. Additionally, the frequency of assessment should be determined by level of risk, medical condition of patients, and the progression of injury (Australia Commission on safety and Quality in Health Care, 2011). ICU patients tend to be critically ill and complicate with various health problems, thus requiring multiple medical devices for life support. Therefore, ICU patients need to be assessed on a daily or even per shift basis until the risk score is within the normal range. However, the assessment tools are limited in assessing the risk of pressure injury caused by the use of medical devices (such as external fixation, ventilator masks, and drainage tubes), thus, nurses are recommended to evaluate the pressure on the local skin of the bony sites of patients who are in the use of the medical devices at every shift. It is worth to notice that the scores obtained from pressure injury risk assessment scales indicate the extent of pressure injury risk such as moderate-to-high risk, while this does not imply that low-risk patients are free from developing pressure injury. Conversely, patients with a lower risk score may also develop pressure injury (Maklebust et al., 2005). Thus, nurses should also pay attention to this subpopulation of patients instead of simply overlooking them.

CONCLUSION

Pressure injury cause physiological pain, psychological problems, and economic burden for ICU patients and increase the workload of nurses. The use of pressure injury risk assessment scales could allow nurses timely assess and identify risk factors for pressure injury and initiate early nursing intervention accordingly. However, developing a scale with comprehensive assessment of the risk factors for pressure injury is recommended, despite the widely use of the current pressure injury risk assessment scales.

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