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Validação de duas escalas de avaliação de risco de úlceras de pressão em utentes chineses da UCI

Validation of two pressure ulcer risk assessment scales among chinese ICU patients
Validación de dos escalas de valoración del riesgo de úlceras por presión en los usuarios chinos de la UCI

Ming Liu* ; Weiju Chen**; Qiuying Liao***; Qin Gu****; Meihua Hsu*****; Angela Poon*****

Resumo

Contexto: Uma escala de avaliação de risco válida e fidedigna é considerada uma ferramenta essencial na prevenção de úlceras de pressão. As escalas de risco de úlceras de pressão comumente utilizadas em utentes na Unidade de Cuidados Intensivos (UCI) são a Escala de Braden e a Escala de Cubbin & Jackson. Objectivo: Comparar e validar as escalas de risco de úlcera de pressão de Braden e Cubbin & Jackson em utentes chineses da UCI. Método: Foi proposto um projecto de pesquisa longitudinal onde a Escala de Braden e a Escala de Cubbin & Jackson eram simultaneamente utilizadas para colher dados de 139 utentes da UCI. A área sob a curva (ASC) do método característico operacional do receptor (COR) foi utilizada para avaliar a validade total das escalas. Resultados: Onze utentes (7,91%) desenvolveram úlceras de pressão. Baseado no valor limite de 16 pontos para a Escala de Braden e de 24 pontos para a Escala de Cubbin & Jackson, a sensibilidade, a especificidade, valor preditivo positivo e valor preditivo negativo para a Escala de Braden foi de 91,7%, 63,0%, 19,0%, 98,8%, respectivamente, e 33,3%, 95,3%, 40,0%, 93,8% para a Escala de Cubbin & Jackson. A ASC foi 0,155 para a Escala de Braden e 0,098 para a Escala de Cubbin & Jackson. Conclusão: A Escala de Braden tem alta sensibilidade e previsão negativa, enquanto Cubbin & Jackson escala tem alta especificidade. A Escala de Braden é melhor do que a Escala de Cubbin & Jackson em termos de validade geral.

Palavras-chave: úlcera por pressão; medição de risco; validade; cuidados intensivos.

Abstract

Context: A valid and reliable risk assessment scale is considered to be an essential tool in pressure ulcer prevention. The commonly used pressure ulcer risk scales in Intensive Care Unit (ICU) patients are the Braden Scale and the Cubbin & Jackson Scale.

Aim: To compare and validate the Braden and Cubbin & Jackson pressure ulcer risk scales among Chinese ICU patients.

Method: A longitudinal research design was proposed in which the Braden Scale and the Cubbin & Jackson Scale were simultaneously used to collect 139 ICU patients' data. The area under the curve (AUC) of the receiver operating characteristic (ROC) method was employed to evaluate the overall validity of the scales.

Results: Eleven patients (7.91%) developed pressure ulcers. Based on the cut-off point of 16 for the Braden Scale and 24 for the Cubbin & Jackson Scale, the sensitivity, specificity, positive predictive value and negative predictive value for the Braden Scale were 91.7%, 63.0%, 19.0%, 98.8%, respectively, and 33.3%, 95.3%, 40.0%, 93.8% for the Cubbin & Jackson Scale. The AUC was 0.155 for Braden scale and 0.098 for the Cubbin & Jackson Scale.

Conclusion: The Braden Scale has high sensitivity and negative predictability, whereas the Cubbin & Jackson Scale has high specificity. The Braden Scale is better than the Cubbin & Jackson Scale in terms of overall validity.

Keywords: pressure ulcer; risk assessment; validity; intensive care.

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Resumen

Contexto: una escala de valoración del riesgo válida y fiable se considera una herramienta esencial en la prevención de úlceras por presión. Las escalas de valoración del riesgo de úlceras por presión que comúnmente se utilizan con los usuarios de la Unidad de Cuidados Intensivos (UCI) son la Escala de Braden y Escala Cubbin-Jackson. Objetivo: comparar y validar las escalas de riesgo de úlceras por presión de Braden y Cubbin-Jackson con los usuarios chinos en la UCI. Método: se propuso un proyecto de investigación longitudinal en el que la Escala de Braden y la Escala Cubbin-Jackson se utilizaron simultáneamente para recolectar datos de 139 usuarios de la UCI. El área bajo la curva (ABC o AUC en inglés) del método característico de funcionamiento del receptor (COR, o ROC en inglés) se utilizó para evaluar la validez total de las escalas. Resultados: once usuarios (7,91%) desarrollaron úlceras por presión. Basado en el valor límite de 16 puntos para la escala de Braden y 24 puntos para la escala Cubbin-Jackson, la sensibilidad, la especificidad, el valor predictivo positivo y valor predictivo negativo de la escala de Braden fue 91,7%, 63, 0%, 19,0%, 98,8%, respectivamente, y 33,3%, 95,3%, 40,0%, 93,8% para la escala Cubbin-Jackson. La ABC fue 0,155 para la Escala de Braden y 0,098 para la Escala de Cubbin-Jackson. Conclusión: la escala de Braden tiene una alta sensibilidad y previsión negativa, mientras que la Escala de Cubbin-Jackson tiene una alta especificidad. La escala de Braden es mejor que la Escala Cubbin-Jackson en términos de validez general.

Palabras clave: úlcera por presión; medición de riesgo; validez; cuidados intensivos.

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Introduction

Development of pressure ulcers, also called pressure sore, is one of the major problems in acute and chronic care units, and has been regarded as an essential indicator of patient care quality (Kim *et al.*, 2009). Augustin and Maier (2003) indicated that pressure ulcers cause severe emotional and physical stress among patients as well as creating a significant financial burden on themselves and on the whole healthcare system. Patients in an intensive care unit (ICU) are particularly prone to developing pressure sores because of severe illness, being immobile as well as other inducing factors such as hemodynamic instability, incontinence and multiple comorbidities (Songbook, Ihnsook & Younghee, 2004). Groeneveld *et al.* (2004) reported that the prevalence of pressure ulcer in the ICU was 26.3%, with 29.2% in adult patients and 13.1% in pediatric patients; while Kates and Callahan (2009) reported up to 40% of critical care patients have pressure ulcers. However, it is well recognized that pressure ulcers can be effectively prevented by various measures including mechanisms for predicting vulnerable patients and appropriate interventions. Pressure ulcer risk scales have been advocated as a means of reduction strategies of pressure ulcer risk. There are quite a lot of pressure ulcer risk assessment scales existing in the literature; among them the Braden Scale, Norton Scale, Gouglas Scale, Waterlow Scale, and Cubbin & Jackson Scale are the most widely used. Nevertheless, a recent systematic review by Liu *et al.* (2012) indicates that although the Braden scale is the most commonly used scale globally, the Cubbin & Jackson scale has a better prediction ability in ICU patients. Brown (2004) stated that the effectiveness of a tool can be examined with several indicators: (1) sensitivity, also referred as the true-positive (TP) rate of a tool, the percentage of patients who develop a pressure ulcer; (2) specificity, also referred as the true-negative (TN) rate of a tool, the percentage of patients who do not develop a pressure ulcer and were classified as not at risk; (3) positive predictive value (PPV), the percentage of patients classified as at risk who develop a pressure ulcer; and (4) negative predictive value (NPV), the percentage of patients classified as not at risk who do not develop a pressure ulcer.

A study was conducted by Seongsook, Ihnsook & Younghee (2004) to compare the validity of Cubbin & Jackson, Braden, and Douglas scales in ICU patients. The results showed that based on the cut-off point presented by the developer, sensitivity, specificity, positive predictive value, and negative predictive value were as Cubbin & Jackson scale: 89%, 61%, 51%, 92%, respectively, and Braden scale: 97%, 26%, 37%, 95%, accordingly, as well as Douglas scale: 100%, 18%, 34%, 100%, respectively. The researchers concluded that the Cubbin & Jackson scale showed the best validity among the three tested scales.

Shahin, Dassen and Halfens (2007) pointed out that a perfect risk assessment scale for pressure ulcers with sound psychometric properties should be designed and tested with different health conditions in different health care settings. The literature review has not identified any study conducted for testing and comparison of Braden scale and Cubbin & Jackson scale among Chinese population. Therefore, this study aims at comparison and validation of Braden and Cubbin & Jackson pressure ulcer risk scales among Chinese ICU patients.

Methods

Participants

Participants of this study included 139 ICU patients who were admitted to two ICUs of two teaching hospitals in Mainland China from January 20 to July 20, 2012. The inclusion criteria were: a. 18 years old or above, b. no presence of any grade of pressure ulcer on admission, and c. hospitalized in the ICU for more than 48 hours. All participants received the same standard nursing interventions in terms of pressure ulcer prevention such as using gel cushion, being offered massages and having position changed every two hours.

Tools

Braden Scale

The Braden Scale was first presented by Bergstrom and Braden (Bergstrom *et al.*, 1987). The scale is composed of six subscales: activity, mobility, nutritional status, moisture, sensory perception, friction and shear. The minimum score for each

item is 1 and the maximum score is 3 or 4 with the potential scores ranging from 6 to 23. Low score indicates high risk of pressure ulcer development and the cutoff scores between ≤ 14 and ≤ 18 have been used in different studies. In this study, the cut-off point was set at 16 as presented by the scale developers.

Cubbin & Jackson Scale

The Cubbin & Jackson Scale was developed by Cubbin and Jackson (1991) as a modification of the Norton Scale used for intensive care patients. It includes ten variables (age, weight, general skin, mental condition, mobility, hemodynamic status, respiration, nutrition, incontinence and hygiene), and uses a 4-point scale. The total score ranges from 10 to 40, the lower the score, the higher the risk of pressure ulcers development, and the cutoff score is ≤ 26 . In this study, the cut-off point was set at 24 as presented by the scale developers.

Data collection

Before data collection, an approval from each relevant agency was obtained. Research team members received about 2-hour training on how to use the pressure ulcer risk assessment scales and the relevant ethical considerations. The principle of informed consent form was not applied because pressure ulcer risk assessment and observation for ICU patients are routine nursing measures, and the study did not change any procedure or nursing interventions for these patients except using two scales to assess patient simultaneously on admission. It is required that the risk of pressure ulcers should be assessed and recorded on every shift (a three-shift staffing system in both hospitals). In this study, the American National Pressure Ulcer Advisory Panel (NPUAP) classification was used to define the pressure ulcer, i.e. grade I is defined as non-blanchable erythema: redness which does not subside after pressure is relieved; grade II is damage to the epidermis extending into, but no deeper than the dermis; grade III involves the full thickness of the skin and may extend into the subcutaneous tissue layer; and grade IV is the deepest, extending into the muscle, tendon or even bone (Black *et al.*, 2007).

Data analysis

Descriptive statistics were used to describe the demographic characteristics of participants and the pressure ulcers. A t-test was conducted to verify the homogeneity of the group with pressure ulcer development and the group without pressure ulcer development. Sensitivity, specificity, positive predictive value and negative predictive value were obtained to confirm the validity of the scale. The area under the curve (AUC) of the receiver operating characteristic (ROC) method was employed to evaluate the overall validity of the scales.

Results

General characteristics of the participants

Among the 139 participants, 74 males and 65 females; aged from 18 to 100 years old with a mean age of 56.82 (SD=20.83). Pressure ulcers developed in 11 patients (7.91%), 5 males and 6 females, and there was no statistically significant gender difference between the group with pressure ulcers and the group without pressure ulcers. The sites of occurrence of pressure ulcers and stage classification are as follow: six at the sacrum (54.5%) with 2 in stage I and 4 in stage II, three at the scapula (27.3%) in stage I, and two at the heel (18.2%) in stage I. The pressure ulcer group aged 82.92 ± 9.48 and the no pressure ulcer group aged 54.35 ± 19.91 . There was a significant difference between two groups in terms of age ($p=.000$). The length of stay in pressure ulcer group was 7.08 ± 2.87 days and in the no pressure ulcer group was 4.76 ± 2.82 days, respectively. There was a statistically significant difference between these two groups in term of length of stay ($p=.007$).

Validity of Braden and Cubbin & Jackson scales

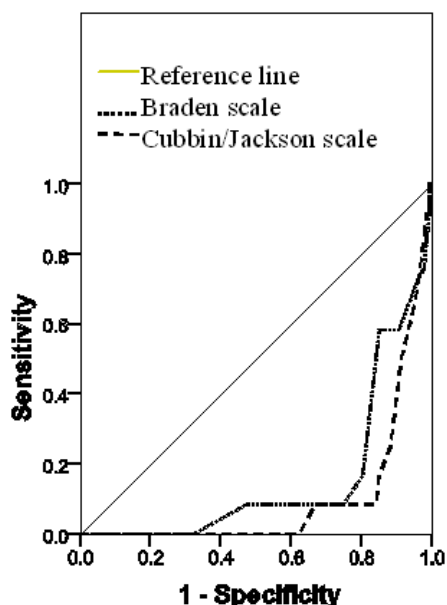
In the case of the Braden scale, the sensitivity was 91.7%, the specificity 63.0%, the positive predictive value 19.0% and the negative predictive value 98.8%, at the cut-off point of 16. In the case of Cubbin & Jackson scale, the sensitivity was 33.3%, the specificity 95.3%, the positive predictive value 40% and the negative predictive value 93.8%, at the cut-off point of 26 (Table 1).

TABLE 1 - Sensitivity, specificity, positive predictive value and negative predictive value by scales at each cut-off point

Scales	Cut-off point	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Braden	16	91.7	63.0	19.0	98.8
Cubbin & Jackson	26	33.3	95.3	40.0	93.8

The area under the curve (AUC) of the receiver operating characteristic (ROC) was exhibited in Fig.1.

The value for Braden scale is 0.155; the value for Cubbin & Jackson scale is 0.098.



Discussion

Incidence

Incidence is defined as measuring the number of persons developing new pressure ulcers during a period of time (Ayello, Berlowitz & Cuddigan, 2001). The incidence rate of pressure ulcers developed in this study was 7.91%, which is much higher than a rate of 1.1% among 1,165 ICU patients reported by Zeng, Yang and Li (2012) in Mainland China. However this incidence rate is quite similar to that of the 7.78% found by Yang (2012), in which both studies were also conducted among ICU patients in Mainland China. There are always wide variations in the range of incidence rates of pressure ulcer development in different studies (Ayello, Berlowitz & Cuddigan, 2001). Boyle and Green (2001) described a rate of 5.2% in Wales, and in India, Wolverton *et al.* (2005) found a rate of 13.7% in general ICU. Seongsook, Ihnsook

& Younghee (2004) found a 31.3% incidence rate of pressure ulcers in South Korea, while in Germany, Shahin, Dassen and Halfens (2009) reported a total incidence rate of 3.3% in ICU patients. In this respect, the incidence rate in the different regions or countries cannot be compared because each study had different patient characteristics, sample size and research methodology (Shahin, Dassen & Halfens, 2008).

Homogeneity factors

Data analysis revealed that there was a statistically significant difference between the group with pressure ulcers and the group without pressure ulcers in terms of age (82.92 vs. 54.35, $p=.000$) and length of stay (7.08 vs. 4.76, $p=.007$). These results were consistent with other study findings such as those in Bergstrom and colleagues' study, which demonstrated that the difference in mean age between those who developed pressure ulcers and

those who did not was nearly 10 years ($p < .0001$). Bours *et al.* (2001) stated the majority of factors that were significantly associated with the presence of pressure ulcers included age, length of stay, infections, moisture and mobility. Aging is an importantly prone factor of pressure ulcers because aging skin becomes thinner and weaker, with less fat and muscle which helps absorb pressure, results in the increase in skin fragility. Moreover, most elderly people some kind of chronic conditions such as diabetes, vascular diseases and so on, as well as poor mobility, reduced blood circulation, malnourishment or urinary or bowel incontinence. Length of stay is another risk factor for pressure ulcers; particularly those admitted to the ICU always are in critical conditions, which may result in immobility, poor nutrition or incontinence (Liu *et al.*, 2012). Eachempati, Hydo & Barie. (2001) concluded that length of stay more than 7 days in elderly patients confer significant risk for the formation of pressure ulcers. Therefore, we strongly recommend that the particularly intensive prevention care should be provided to the elderly patients in ICUs.

Validity of scales

Predictive validity is a measurement of how well a test predicts future performance. It is a form of criterion validity, describing the association between the findings of observation and the measured indicators. In this study, the criterion validity is expressed as sensitivity, specificity, positive predictive value and negative predictive value. Ideally, all the indicators have high values, however in reality, when the sensitivity increases, the specificity decreases (Larson, 1986). Comparison of the four criterion validity indicators of the two tested scales revealed that the Braden scale has high sensitivity (91.7%) and high negative predict value (98.8%); while the Cubbin & Jackson scale has high specificity (95.3%) and moderate negative predict value (93.8%). If taking Braden scale as a benchmark, additional care is provided to patients having a relatively low risk of pressure ulcer incidence can maximally prevent patient's development of pressure ulcers even if the nursing care workload is increased. Nevertheless, the study tried to identify an optimal tool, which has high specificity and a positive predictive value when the same conditions were given. In this respect, Cubbin & Jackson scale demonstrated a better specificity and positive prediction because this scale was specifically

modified from the Norton Scale for use in intensive care patients (Cubbin & Jackson, 1991).

The overall validity of the scales was evaluated by AUC. The AUC was 0.155 for Braden scale and 0.098 for Cubbin & Jackson scale. Comparatively, Braden scale showed the better overall validity than Cubbin & Jackson scale. This result was inconsistent with other studies, for instance, Seongsok, Ihnsook & Younghee (2004) reported the Cubbin & Jackson scale showed the best overall validity compared to the Braden scale and the Douglas scale. Kim *et al.* (2009) also illustrated that the Cubbin & Jackson Scale had the highest positive predictive validity and specificity when compared to the other two scales (Waterlow scale and Braden scale). A possible explanation could be the demographic characteristics' differences between the studies. Another possible reason was that the Braden scale was much more commonly used than Cubbin & Jackson scale in Mainland China (Liu *et al.*, 2012). Several participants in this study even commented that they were unfamiliar with the Cubbin & Jackson scale, therefore found it "difficult to apply in their practice; particularly in the domain of PMH-affecting condition, hemodynamics and oxygen requirements". Xue, Liu & Jing (2004) also indicated that nurses in Mainland China were more familiar with the Braden scale and understand it more easily when compared to other pressure ulcer scales.

Conclusions

This study concluded that pressure ulcer incidence rate was comparable with other studies in Mainland China. Age and length of stay demonstrated statistically significant differences between the group with pressure ulcers and the group without pressure ulcers. The Cubbin & Jackson scale had a better specificity and positive prediction while the Braden scale showed better overall validity than the Cubbin & Jackson scale. The sample size of this study was small and as mentioned earlier, the predictive validity of assessment tools were affected by the characteristics of the population, hence results generalization should be cautioned.

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