Validity of pressure ulcer risk assessment scales: Cubbin and Jackson, Braden, and Douglas scale

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Abstract

This study was to compare the validity of three pressure ulcer risk tools: Cubbin and Jackson, Braden, and Douglas scales. Data were collected three times per week from 48 to 72 h after admission based on the three pressure ulcer risk assessment scales and skin assessment tool developed by the Panel for the Prediction and Prevention of Pressure Ulcers (1994) from 112 intensive care unit (ICU) patients in a educational hospital Ulsan, Korea during December 11, 2000 to February 10, 2001. When a patient developed a pressure ulcer at the time of assessment, the patient was classified into ‘pressure ulcer group’, and when patients did not have a pressure ulcer until they died, moved to other wards or were discharged from the hospital, they were classified into ‘not pressure ulcer group’. Four indices of validity and area under the curves (AUC) of receiver operating characteristic (ROC) were calculated. Based on the cut-off point presented by the developer, sensitivity, specificity, positive predictive value, negative predictive value were as follows: Cubbin and Jackson scale: 89%, 61%, 51%, 92%, respectively, Braden scale: 97%, 26%, 37%, 95%, respectively, and Douglas scale: 100%, 18%, 34%, 100%, respectively. AUCs of ROC curve were 0.826 for Cubbin and Jackson, 0.707 for Braden, and 0.791 for Douglas. Overall, the Cubbin and Jackson scale showed the best validity among scales tested and we recommended it for this ICU.

Keywords: Validity; Pressure ulcers; Risk assessment

1. Introduction

The development of a pressure ulcer necessitates additional time and costs needed for nursing care (Kim, 1996). It also carries the underlying connotations of neglect, mismanagement, feelings of failure and guilt on the part of care providers, which can contribute to the lowered efficiency of nursing care (Beckmann, 1995). Moreover, the patients in the intensive care units (ICUs) are usually patients with severely limited mobility and elderly patients and so they report higher rates of pressure ulcer formation compared with patients in general wards (Bergstrom et al., 1987; Kim, 1998). Therefore, it is very important to identify the groups at high risk of pressure ulcers using a valid pressure ulcer risk assessment tool and provide them with intensive and appropriate nursing intervention to prevent ulcer formation from high risk patients (Bergman-Evans et al., 1994).

When applied to patients, a pressure ulcer risk tool should be capable of identifying patients who are likely to develop a pressure ulcer and therefore sufficient research on the validity of tools should be conducted (Goodridge et al., 1998). A few studies have been made to assess the validity of pressure ulcer risk tools (Bridel, 1993; Samantha and Thomas, 1998; Towey and Erland, 1998). But the results varied depending upon the variables including the number of subjects, the pressure ulcer preventive care, the skill of care providers, and the
race of the patients. Thus, they could not be regarded as generalized findings. In particular, these studies primarily reported on sensitivity and specificity, hardly mentioning the positive predictive value and the negative predictive value among the four indicators that constitute the validity. As well, studies on the validity between specific instruments or among various tools are rare. Above all, there has been little study on which instrument has the highest validity for the patients in the ICUs who are at high risk of developing pressure ulcers.

The ICUs of the hospital under study recently decided to use the existing pressure ulcer risk assessment tools to prevent pressure ulcers in the patients and tried to identify and select the best tool with the highest validity among the various instruments under experimentation. To this end, this study examined the sensitivity, specificity, positive predictive value and negative predictive value of the following three risk assessment scales; Cubbin and Jackson (1991) scale, Braden (1987) scale, Douglas (1986) scale, and to identify the most suitable calculator for the ICUs of the hospital under study.

2. Method

2.1. Participants

The subjects of this study included 125 patients of 21 years of age or above who were admitted to three ICUs (the internal, the surgical and the neurology departments) of ‘D’ hospital (483 beds) in Ulsan city, South Korea from December 11, 2000 to February 10, 2001. Of the 125 patients, 13 patients died, were discharged or were moved to other wards during the period and were thus excluded, leaving the 112 patients for the final analysis. Though the participants were in three different ICU, all patients received the same nursing interventions, especially those related to ulcer prevention. They were all using water mattress, being taken massages, and being changed position per 2 h for preventing pressure ulcers.

2.2. Tools

2.2.1. Cubbin and Jackson scale

The Cubbin and Jackson scale is an instrument developed to assess the pressure ulcer risks of the patients in the ICUs. It comprises the ten items: age, weight, the skin condition of the whole body, mental state, mobility, nutrition, respiration, incontinence, hygiene, and hemodynamic state. It is a four-point scale and the total score can range from 10 to 40. The lower the score, the higher the risk of pressure ulcer development. When the cut-off point is 26, the risk of the pressure ulcer development is at its highest (Cubbin and Jackson, 1991).

2.2.2. Braden scale

Developed in the United States, the Braden scale is most widely used and its validity has been verified. It is known as a user-friendly instrument with detailed explanations of the factors comprising the scale (Bergstrom et al., 1987). The scale consists of six factors: sensory function, moisture, activity, mobility, nutrition, shearing force and friction. It is a three- or four-point scale and the total score can range from 6 to 23. The cut-off point is 16 but it is reported that it is desirable to raise the cut-off point to 18 when assessing elderly patients (Braden and Bergstrom, 1994; Samantha and Thomas, 1998; Lyder et al., 1999).

2.2.3. Douglas scale

The Douglas scale is based on the Norton scale but it includes symptoms that could not be represented by the Norton scale. It comprises a total of seven items (four four-point items and three five-point items) that include nutrition/blood pigment values, activity, incontinence, pain, skin conditions, mental state and special risk factors. The total score can range from 8 to 24. The lower the score, the higher the risk of pressure ulcer development. The cut-off point is set at 18. When the total score is below 18, a patient is at risk of pressure ulcer development (Prichard, 1986).

2.2.4. Skin assessment tool for pressure ulcer development

The skin assessment tool for pressure ulcer formation developed by the Panel for the Prediction and Prevention of Pressure Ulcers (1994) is classified into four stages. The first stage refers to a state wherein the skin color does not change to its original white when the skin is pressed: this is a premonitory symptom for skin ulcer. The second stage refers to a partially thickened damage that invades the epidermis and part of the dermis. The ulcer is shallow and clinically it forms abrasion, a blister or a hole-like a shallow crater. The third stage refers to a completely thickened damage that invades the dermis but not the fascia. The fourth stage refers to the tissue mortification and the damage to the muscle, bone, cord or joint capsule.

2.3. Data collection

The researchers visited the ICUs and observed the presence or absence of the pressure ulcers in the subjects. The first assessment of the subjects was conducted within 24–72 h of admission. The following assessments were conducted three times a week (Monday, Wednesday and Friday) from 2 to 5 in the afternoon. When a patient developed a pressure ulcer at the time of assessment, the
patient was classified into ‘pressure ulcer group’, and when patients did not have a pressure ulcer until they died, moved to other wards or were discharged from the hospital, they were classified into ‘not pressure ulcer group’. Regardless of the type of group, pressure ulcer risk scores were calculated using three tools. If the subjects were ‘pressure ulcer group’, the scores were calculated on the date of ulcer formation, and if the subjects were ‘not pressure ulcer group’, the scores were on the date of death, moving to another place, or discharge. While, the data of the items presented in the pressure ulcer risk tools were collected by using the nursing records or by direct observation.

2.4. Data analysis

The collected data were encoded and entered into the SPSS program. Prior to an official analysis, a preliminary analysis was conducted to summarize the data statistically and examine the trends, in addition to checking the input data errors.

For a pressure ulcer development rate, the general characteristics of the subjects and the characteristics of pressure ulcers, their frequency and percentage were obtained using descriptive statistics. An $X^2$ test was conducted to verify the homogeneity of the group with pressure ulcer development and the group without pressure ulcer development. It is here a two-tailed test was used with the significant level ($z$) set at 0.05.

Sensitivity, specificity, positive predictive value and negative predictive value were obtained to confirm the validity of the scales. Sensitivity represents the rate of the patients predicted to develop pressure ulcers by the scale scores of the patients who developed pressure ulcers; specificity refers to the rate of the patients predicted not to develop ulcers by the scale scores of the patients who did not develop pressure ulcers. The positive predictive value indicates the rate of the patients who actually developed pressure ulcers of the patients who were predicted to develop pressure ulcers by the scale scores; and the negative predictive value refers to the rate of the patients who did not actually develop pressure ulcers of the patients who were predicted not to develop pressure ulcers by the scale scores.

The area under the curve (AUC) of the receiver-operating characteristic (ROC) was calculated to assess the overall validity of the scales. The ROC method is one of the methods that are used to confirm the validity and that are widely used for the standardization of the medical diagnosis or decision-making criteria or the development and standardization of the questionnaires or tools (Zweig and Campbell, 1993; Morasso et al., 1996). The ROC graph can be drawn by linking the points on the coordinates consisting of the sensitivity on the Y-axis and the 1-specificity on the X-axis using all the values in the range observed. The sensitivity and the 1-specificity have nothing to do with the morbidity rate. As the whole range of the risk assessment results is expressed in a curve, the sensitivity and the 1-specificity can present the identifying ability of a risk calculator without receiving any influence from the morbidity rate of the group of subjects. The AUC is most widely used as the validity indicator that can be obtained through the ROC analysis and can distinguish the distinctive power of the risk calculators. A higher AUC value means a higher validity or a higher distinctive power (Kim, 1999). If an instrument shows a higher score in the group with pressure ulcer, and when the AUC is 0.8, it means that when a patient from each of the group with pressure ulcers and the group without pressure ulcers is sampled at random and the scale values are compared, the probability that the group with ulcer development will have a higher value than the group without ulcer development will be 80% (Metz, 1978; Moses and Shapiro, 1993).

3. Results

3.1. General characteristics of the subjects

The mean age was 62 and 64 patients (57.1%) were men. Forty-two percent (47 patients) were admitted to the ICU of internal medicine, and 41% (46 patients) were from neurology. Eighty-seven patients (77.7%) who did not receive operation was, and 64.0% among patients who had had an operation which took at least two and a half hours (16 patients). Pressure ulcers developed in 35 patients among the 112 patients (31.3%), and there was no statistically significant difference between the group with pressure ulcers and the group without pressure ulcers.

3.2. Validity of the pressure ulcer risk assessment tools

In the case of the Cubbin and Jackson scale, the sensitivity was 89%, the specificity 61%, the positive predictive value 51%, and the negative predictive value 92%, at the cut-off point of 24, as presented by the scale developers. In the case of the Braden scale, the sensitivity was 97%, the specificity 26%, the positive predictive value 37%, and the negative predictive value 95%, at the cut-off point of 16 suggested by the scale developer. In the case of the Douglas scale, the sensitivity was 100%, the specificity 18%, the positive predictive value 34%, the negative predictive value 100% at the cut-off point of 18 (Table 1).

Fig. 1 shows the receiver operating characteristics (ROCs) curve to assess the overall validity of the scales and the AUC of each scale. The value for the Cubbin and Jackson scale is 0.826; the value for the Braden scale 0.707; and the value for the Douglas
Overall, the Cubbin and Jackson scale showed the highest validity.

4. Discussion

Nursing care to prevent pressure ulcers may be provided to all the patients who are admitted to the ICUs. But it may be more efficient to first identify the patients with a high risk of developing pressure ulcers and then provide them with proper intensive care to prevent them from developing. In this context, various pressure ulcer risk assessment tools have been developed to identify patients who are at risk of developing pressure ulcers and each calculator features unique and varied methods. What is important, however, is that the assessment of the patients using these tools should be capable of identifying the risk of pressure ulcer development accurately. Accordingly, studies on the validity of the predictive power of the calculators need to be made fully (Goodridge et al., 1998). Especially since, as Zimmerman et al. (1998) pointed out, the predictive tools inevitably reflect the population characteristics and the medical culture of the country in which they were developed and have demonstrated potential limitations arising from the application of predictive tools to a population for which they have not been validated, it is essential to test the validity of the predictive assessment tools before applying to the certain patients.

In accordance with the conceptual classification made by Schulte and Perera (1993), the validity in this study refers to the criterion validity, describing the relevance between the findings of research and observation and the measured indicators. In general, the criterion validity is expressed as sensitivity, specificity, a positive predictive value and a negative predictive value. It is ideal that all the indicators have high values but in reality, when the sensitivity goes up, the specificity down (Larson, 1986).

To overcome this problem, first, emphasis should be given to specific indicators among the four validity indicators. Pressure ulcers give physical pain to the patients and necessitate longer hospitalization and additional medical costs (Kim, 1996). As well, they carry the underlying connotations of neglect, mismanagement, feelings of failure, and guilt on the part of caregivers, possibly lowering the efficiency of nursing care (Beckmann, 1995). Therefore, it is important to identify the patients who are expected to develop pressure ulcers and prevent the development of pressure ulcers in those patients by providing them with intensive preventive caring, emphasis should be given to sensitivity and a negative predictive value. But the nursing care time increases when additional care is given to the patients having a relatively low risk of pressure ulcer incidence. When a hospital considers this seriously, an emphasis should be given to specificity and a positive predictive value. In the ICUs of the hospital under studying, nursing care to prevent pressure ulcers was provided to all the patients who were expected to develop ulcers with a view to reducing pressure ulcer development in the first place, and therefore a pressure ulcer risk tool with high sensitivity, and a high negative predictive value was selected. But the study tried to select an optimal tool having high specificity and a positive predictive value when the same conditions were given. Second, the overall validity can be calculated quantitatively using the ROC method.

Based on the cut-off points suggested by the scale developers, this study obtained the sensitivity and negative predictive value for each of the three scales under study. As a result, the sensitivity and the negative predictive value were 89% and 92%, respectively, in the case of the Cubbin and Jackson scale; 97% and 95% in

<table>
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<th>Scales</th>
<th>Cut-off point</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Positive predictive value (%)</th>
<th>Negative predictive value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cubbin and Jackson</td>
<td>24</td>
<td>89</td>
<td>61</td>
<td>51</td>
<td>92</td>
</tr>
<tr>
<td>Braden</td>
<td>16</td>
<td>97</td>
<td>26</td>
<td>37</td>
<td>95</td>
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<tr>
<td>Douglas</td>
<td>18</td>
<td>100</td>
<td>18</td>
<td>34</td>
<td>100</td>
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![ROC curve by scales](image-url)
the Braden scale; and 89% and 92% in the Douglas scale. That is, the sensitivity and predictive value reached a satisfactory level in all the scales, but in particular, the Braden scale demonstrated higher values. In terms of the specificity and positive predictive value, the Cubbin and Jackson scale recorded 61% in specificity and 51% in the positive predictive value; the Braden scale 26% and 37%, respectively; and the Douglas scale 18% and 34%, respectively, showing low values in all the scales. The Cubbin and Jackson scale showed relatively satisfactory values for all the four indicators to assess the validity but other scales did not demonstrate consistent results. The AUC was 0.826 for Cubbin and Jackson, 0.707 for Braden, and 0.791 for Douglas. Overall, the Cubbin and Jackson scale showed the best validity. Considering the findings, it is believed that the Cubbin and Jackson scale demonstrates relatively consistent results despite the changes in the clinical settings and subjects, and therefore it can be concluded that the most valid pressure ulcer assessment tool for the ICUs among three tools.

However, we would like to make five recommendations for further researches. First, just three commonly used pressure ulcer assessment tools were considered in this study, so it is recommended to compare the predictive validity among other various pressure ulcer assessment tools in the same or other ICUs. Perhaps then other assessment tools which were not considered in this study might show the best predictive validity. Secondly, because the patients in the ICUs are usually patients with severely limited mobility and elderly patients, they report higher rates of pressure ulcer compared to those of patients in general wards, we just took into account the study subjects and occurrence of the pressure ulcers in ICUs. It is necessary to consider what the most valid assessment tools in the various wards are. Thirdly, as mentioned earlier, the predictive validity of assessment tools are affected by the characteristics of the population, it is necessary to test the predictive validity of them before using, and the results can be generalized by these repeat researches. Fourthly, we did not follow development for patients transferred to other wards or going home. Some patients may have developed pressure sores after being transferred to a ward which were entirely attributable to their management in the ICU, and they could be considered ICU acquired pressure ulcers. Lastly, the sample size was too small to test the validity, and further research is needed with a larger sample to get the generalised findings.

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References


