

Can the Braden scale predict the development of pressure injuries in intensive care?

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ABSTRACT

This study aims to establish the effective predictivity of the Braden Scale in intensive care units (ICUs). A retrospective observational study was conducted by analyzing computerized medical records of patients admitted to an ICU in 2019. Patients admitted to the ICU in 2019 without pressure ulcers at the time of admission and with a hospital stay of at least 72 hours were considered for the study. Patients who developed pressure ulcers within the first 72 hours were excluded. Of the 239 patients considered suitable for the study, 230 (96.2%) had a Braden scale value lower than 16 and were considered at 'severe risk of developing lesions', and only 9 (3.7%) patients who had a value equal to or higher than 16 were considered at moderate risk. The Braden scale demonstrated very high sensitivity (100%) at the expense of low specificity (4.7%). The Braden scale calculated when patients enter intensive care is not capable of estimating the risk of developing lesions on its own due to its low specificity, which, therefore, makes it unsuitable for use in this context.

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Ethical approval and consent to participate: the study was submitted to the Ethics Committee of Emilia Romagna (Italy) and was approved on 14 June 2021 (Opinion no. 3037). All data was collected anonymously, and the most rigorous privacy standards were followed pursuant to the European regulation on the protection of personal data (Regulation 2016/679, part of the GDPR), and the provisions were issued by the guarantor for the protection of personal data in this regard.

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Introduction

Patients hospitalized in intensive care units (ICUs) are subjected to numerous risk factors resulting in the development of pressure ulcers, which is proven by the extensive literature. It has been demonstrated that length of stay in ICUs, use of mechanical ventilators, renal replacement therapy, and the use of vasopressors are some of the risk factors that influence the development of lesions in this environment.¹⁻¹⁰

The Braden scale validated by literature is routinely used to establish the risk of developing lesions, both upon entry into our ICU and daily, to monitor the risk parallelly with the clinical progress.

The Braden scale was developed in 1987 to try to identify patients at risk of bed sores by analyzing sensory perception, skin moisture, activity, mobility, friction, shear and nutritional status.¹¹ ICUs frequently comprise a high number of bedridden patients. However, there is a high rate of bladder catheterization, which prevents all occasions of skin moisture due to incontinence. A high operator-to-patient ratio guarantees frequent changes in patient position and the prompt replacement of linen

whenever necessary, limiting skin humidity events to the patient's sweating, drain leaks, or a few other events. Additionally, it is essential to consider the peculiar characteristics of patients in an intensive environment who, due to their medical condition, do not carry out the activities illustrated in the scale and immediately begin artificial, enteral, or parenteral feeding, effectively rendering the values of the scale's three items almost invariable during hospitalization. This is because they always provide the same result, and at the same time, the scale does not account for the aforementioned risk factors present in intensive environments.

In daily practice, we have observed that the Braden scale reported the majority of patients as being at risk of developing lesions without having seen any practical confirmation of the data. This could have been because of using anti-decubitus mattresses for all patients, but we view this data as a further bias in the scale that does not change the result depending on the mattress on which the patients are stationed and considers all dangerous surfaces in the same way.

The doubt about the reliability of the scale first arose when, following specific in-depth investigations, the presence of lesions in the department stood at 20%, in line with the relevant literature, while on a rough analysis, the scale estimated a very high percentage of patients with risk, which was later confirmed by the present study.

This study aims to demonstrate the poor predictive accuracy of the Braden scale in our ICU through the estimation of its predictivity and specificity. The study further aims to establish that the scale's result should not be the sole basis on which to calculate the risk estimate but as a part of a broader and more global evaluation in which more specific tools for the intensive context are present.

Materials and Methods

Study design and population

The study, called PRESBITI, was a retrospective observational study conducted over one year from 1 January 2019 to 31 December 2019. All patients between the ages of 18 and 90 admitted to the ICU of Rimini Hospital (Italy) without pressure ulcers at the time of admission and with a minimum stay of 72 hours in the unit were considered for the study. Patients who had developed pressure ulcers within 72 hours of admission were excluded, as they were considered the potential result of factors present in their previous care environments.

Upon entry into our unit, the patients are not given any protection by healthcare personnel in the areas most at risk, such as the sacrum, heels, or elbows, because all hospitalized patients have access to dynamic anti-decubitus mattresses (Quattro plus® Zuccato HC) with sequential

alternating cycle, and the nurse-to-patient ratio is 1:2, which guarantees frequent mobilization and evaluation.

Critically ill patients (average Simplified Acute Physiology Score II: 40), both medical and surgical, including adults and pediatric patients (5-7%), are admitted to our ICU, but pediatric patients were excluded from the study.

Data collection

The ICU houses a computer software owned by Drägerwerk AG & Co. (KGaA, Lübeck, Germany), which allows compilation of the computerized medical record. The medical record contains the medical and nursing diary, the therapy administered, the evaluation of Simplified Acute Physiology Score II, Sequential Organ Failure Assessment score, Braden and Richmond agitation-sedation scale, vital parameters and values relating to mechanical ventilation. Data relating to Braden's values and pressure sores, such as the date of appearance, stage and location of all patients, were extracted from this computer archive for patients hospitalized from 1 January 2019 to 31 December 2019.

The review began in July 2021 after approval by the ethics committee. The file was checked until the end of hospitalization to look for data on the possible appearance of lesions. No Braden data were collected after the appearance of the lesions, as they were considered insignificant to our study.

Each operator responsible for data acquisition opened the patient's archive with their access credentials and transcribed the requested data that had been entered by the operators during hospitalization onto an Excel sheet, signing them with their name.

Six anatomical areas in which to report lesions had been previously defined for statistical simplification. This comprised: i) lower limbs, which included thighs, knees and ankles; ii) upper limbs, which included elbows and shoulders; iii) back, which included the scapulae and dorsal spine; iv) sacrum area; v) heels; vi) nape.

Data management

The quality and integrity of the data reported in the database were checked by the primary researcher. If the data were ambiguous, he expressed a final judgment on inclusion in the study after a mutual agreement with the research team, while irrelevant data such as lesions not clearly caused by pressure were omitted from the analysis.

The stage of the lesion in our department is analyzed following the definitions of the second edition of the National Pressure Ulcer Advisory Panel of 2014.

Missing data

Since this is a retrospective study and we were unable to verify the accuracy of the data, three patients with lesions

were excluded from the study due to the inconsistency of the data. In the first patient, a first-stage lesion was reported, but no measures were recorded in the following days. In the second patient, the lesion was reported on the big toe and was not considered to be of pressure origin. The third patient was excluded because the lesion was reported as a suspected deep tissue lesion, and no further reports had been written.

Statistical analysis

A total of 239 patients were considered eligible for enrolment in the study period. All recorded variables were analyzed using the appropriate descriptive statistics, which included frequency, mean (M) and standard deviation (SD), median (Mdn), and interquartile range (IIQ).

The predictive capabilities of the Braden scale regarding the onset of lesions were studied through the calculation of sensitivity, specificity, and the area under the receiver operating characteristic (ROC) curve (area under the curve), with a 95% confidence interval. The analysis was performed using STATA 14.2 statistical software.

Ethics committee approval

The study was submitted to the Ethics Committee of Emilia Romagna (Italy) and was approved on 14 June 2021 (Opinion no. 3037). All data was collected anonymously, and the most rigorous privacy standards were followed pursuant to the European regulation on the protection of personal data (Regulation 2016/679, part of the GDPR), and the provisions were issued by the guarantor for the protection of personal data in this regard.

Results

Of all the patients hospitalized in 2019, 239 patients (101 females and 138 males) were considered eligible and enrolled. The patients were hospitalized for an average of 12 days (Median: 8; IIQ: 6-14; SD: 10.8), and 49 bedsores (20.5%) were found in the population under examination. The lesions appeared on average on the eighth day of hospitalization (Median: 7; IIQ: 5-11; SD: 5.4) (Figure 1).

The total wounds observed were 49, of which 16 (32%) were on the heels, 12 (24%) on the lower limbs, 10 (22%) on the back, 8 (16%) on the sacrum and 3 (6%) on the upper limbs.

The most represented stage was the second, with 33 (75%) lesions. Eight (18%) were first-stage lesions, and three (6%) were deep tissue or eschar lesions. In five patients, the stage of the lesion was not reported by the operators, and only the treatment was reported. Since the purpose of data collection was to establish whether the lesion was predicted by the Braden Scale and not its stage, we decided to enroll them in the study anyway.

The median Braden value detected at the time of admission was 11 (M: 11.2; IIQ: 9-13; SD: 2.7)

Values greater than or equal to 16 have been considered as the cut-off. As per existing literature, the values below 16, as one approaches six (minimum value), have been considered as progressively more and more at risk. The results of our sample show that 230 (96.2%) patients had a Braden scale value lower than 16, all considered to be at 'severe risk of developing lesions', and only nine (3.7%) patients had a value greater than or equal to 16 considered as moderate risk.

From the statistical analysis of our data, the Braden scale obtained a very high sensitivity equal to 100%. However, this was at the expense of very low specificity, amounting to only 4.7%, and an area under the ROC curve of 0.52 (IIQ: 0.45-0.58), which is very similar to pure randomness (Figure 2).

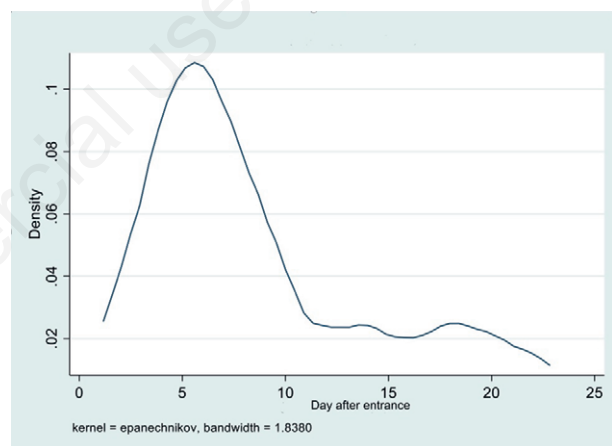


Figure 1. Frequency of appearance of lesions.

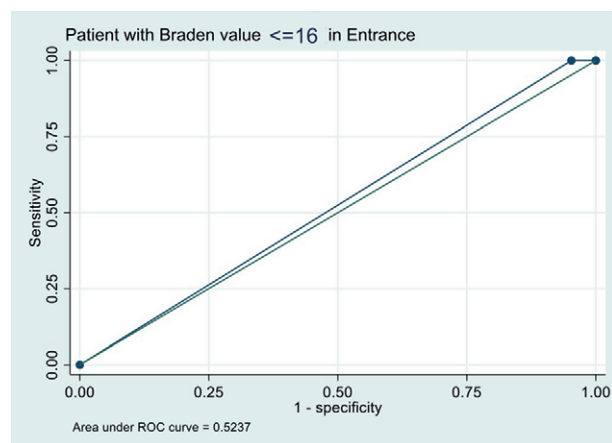


Figure 2. Area under the ROC curve of the relationship between sensitivity and specificity.

Discussion

The data from our study strongly indicate that in the healthcare context, the Braden scale alone is not sufficient to predict the development of pressure sores. Its predictive capacity is dependent on pure chance (ROC 0.52). This means that using only this scale to estimate the risk of developing pressure wounds can be erroneous and could lead operators to raise their attention to this aspect for all patients. The cause can probably be attributed to the various factors present in intensive environments such as vasopressor drugs, orotracheal intubation, dialysis, *etc.*, that are now widely demonstrated in the literature as risk factors. Contrarily, the three subscales of humidity, activity, and nutrition, despite being present in the intensive environment, do not undergo significant variability and are not predictive for the development of lesions, as already reported by Cox Jill in 2012.¹²

According to our study, the Braden scale must, therefore, be part of a broader evaluation system in which there are more specific tools and the surfaces where the patients are stationed are evaluated. In our case, patients are mainly bedridden on anti-decubitus mattresses and are not restricted in wheelchairs. They also do not walk as required by the Braden scale. Not even the nutritional status with the evaluation of meal consumption finds reasonable applicability in our context. This is because all patients who are not independent in their diet are supplemented with nutritional intake through artificial nutrition via a nasogastric tube or total parenteral nutrition just a few hours after entry or as soon as the patient's status allows. Moreover, there is the nurse-to-patient ratio which, in an intensive environment, is 1:2 and allows for closer monitoring of skin moisture than in an internal medicine department. The use of urinary catheters on almost all patients prevents them from remaining in an environment with moist skin for a long time. Thus, we can understand the invariability of three out of six items of the scale, and only sensorial perception, mobility, and sliding are able to grasp the variability of the risk factors with consequent preclusion of the adaptability of the scale to the patients' characteristics and the inevitable decline in its predictive capacity.

As proof of the above facts, specific scales have appeared in relevant literature in recent years to estimate the development of pressure ulcers in an intensive environment, including EVARCIU, COMHON, CALCULATE, EFGU, and RAPS-ICU.¹³⁻¹⁷ These take into consideration risk factors that are much more present and significant in an intensive environment, such as hemodynamic status, cognitive status, tissue oxygenation, mechanical ventilation, dialysis or length of hospitalization.

Previously, several studies have tried to determine the predictivity of the scale in intensive care: Cho and Noh in 2010,¹⁸ Cox in 2012,¹² Iranmanesh in 2012,¹⁹ Hyun in

2013,²⁰ Lima-Serrano in 2018,²¹ and Wei in 2020.²² All these studies describe the poor reliability of the Braden scale in an intensive environment. Our hypothesis, therefore, is that due to the subscales related to activity, humidity and nutrition, the Braden scale is generally unable to predict the development of lesions in intensive care patients. But the scale has demonstrated sufficient predictability for different types of patients and treatments, and medical staff still find it useful.¹⁹

The implication of our study is not to automatically and systematically apply the scale in intensive care but carefully consider the setting in which they operate and subsequently evaluate whether there are risk factors excluded from the scale that can put patients at risk. At the same time, they must evaluate whether the items included in the scale are applicable in the healthcare environment in which one operates.

The limitations of the study

The retrospective study collected data from a computerized archive of medical records from 1 January 2019 to 31 December 2019, compiled by all the nurses of the operating unit when the study was not yet planned. This may have led to slight discrepancies in the interpretation of the items, as they were not collected by dedicated observers. It was decided to validate the values anyway because the daily assessments always fluctuated within the same risk range indicated by the scale, thereby considering the variations irrelevant.

During the period analyzed, the scale was applied to all hospitalized patients where, for ethical and organizational reasons, anti-decubitus mattresses were adopted from the first day of hospitalization.

Conclusions

The Braden calculation at the time of entry into intensive care, is not independently capable of estimating the risk of developing pressure wounds. Its high sensitivity combined with low specificity causes patients at risk to be overestimated, making it unsuitable for use in the intensive care setting. It can instead be part of a more extensive assessment where it can be combined with more specific assessments already present and validated in relevant literature.

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