

The Application of Micromovement to Prevent Pressure Injury in Patients on Mechanical Ventilation in the Intensive Care Unit

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ABSTRACT

Pressure injuries are a common complication among mechanically ventilated ICU patients because prolonged immobilization and impaired tissue perfusion make the skin highly susceptible to damage. Conventional repositioning may destabilize critically ill patients, creating interest in gentler alternatives such as micromovement. The objective of this case report was to describe the application of micromovement repositioning in a mechanically ventilated ICU patient and to observe its effects on skin integrity, Braden Scale scores, and hemodynamic stability. A 67-year-old male with pneumonia, NSTEMI, hypertension, and type 2 diabetes mellitus underwent hourly 15° lateral tilting for three days, accompanied by daily assessments of sacral skin condition, PI risk, and hemodynamic parameters. The sacral lesion remained stable without enlargement or tissue loss, skin moisture was preserved, and the Braden Scale score improved from 10 to 12. Hemodynamic parameters stayed within normal limits throughout the intervention, indicating good tolerance. In conclusion, micromovement helped maintain skin integrity and did not cause physiological instability, suggesting its potential as a safe complementary strategy for pressure injury prevention in critically ill patients.

Keywords: micromovement; pressure injury; intensive care unit; mechanical ventilation; Braden Scale; skin integrity

INTRODUCTION

Skin integrity impairment due to pressure injuries (PIs) continues to represent one of the most persistent and clinically significant complications among critically ill patients in the Intensive Care Unit (ICU). The problem is particularly pronounced in individuals who require mechanical ventilation and experience prolonged immobilization, conditions that inherently increase the duration and intensity of pressure exerted on vulnerable tissue surfaces [1,2]. Sustained external pressure compromises capillary perfusion, disrupts microcirculatory flow, and ultimately predisposes patients to tissue ischemia and necrosis when not adequately mitigated [3].

Patients with pneumonia who depend on mechanical ventilation constitute a subgroup at exceptionally high risk for PI development. Their clinical condition is often characterized by hypoxia, elevated metabolic demands, and complete immobilization, all of which accelerate tissue breakdown and impede normal skin repair mechanisms. The risk is further amplified in individuals with comorbidities such as diabetes mellitus and hypoalbuminemia, where impaired microvascular function and reduced protein reserves diminish the body's regenerative capacity and delay wound healing [4,5]. Early clinical manifestations of PI typically include non-blanchable erythema, localized skin discoloration over bony prominences, dryness, and, if pressure persists, progression to deeper tissue injury involving subcutaneous layers and muscle fascia [6].

ICU patients are widely recognized as a highly vulnerable population for PI development due to the complexity of their clinical conditions, the intensity of therapeutic interventions, and the prolonged duration of bed rest required during critical illness [7]. Globally, the prevalence of PI among ICU patients has reached 16.2%, with the risk estimated to be approximately 3.8 times higher than that observed in non-ICU hospitalized patients [8]. In Indonesia, reported PI incidence among patients experiencing extended bed rest ranges from 15.8% to 38.18%, underscoring the magnitude of the problem within national healthcare settings [9]. These figures collectively highlight that PI prevention remains a substantial challenge in critical care nursing practice, requiring continuous refinement of strategies and innovations in patient care [10].

A variety of preventive measures have been integrated into routine clinical practice, including scheduled repositioning every two hours, utilization of pressure-relieving mattresses, application of silicone cushions, and meticulous monitoring of skin moisture and tissue integrity [3,11]. Despite their widespread use, these conventional approaches exhibit notable limitations when applied to mechanically ventilated ICU patients. Significant positional changes may precipitate hemodynamic instability, oxygen desaturation, or ventilator-patient asynchrony, thereby restricting the feasibility of frequent repositioning in this population [12]. Moreover, repositioning intervals of two hours allow pressure to remain concentrated on specific tissue areas for extended periods, during which optimal pressure redistribution may not occur, increasing the likelihood of ischemic injury [13].

To address these limitations, micromovement has emerged as an alternative repositioning technique designed to provide more continuous and gentle pressure redistribution. Micromovement involves minimal angular adjustments of approximately 15° to the right and left, performed alternately every hour for five minutes. This approach aims to reduce the duration of uninterrupted pressure exposure while maintaining patient stability and minimizing physiological disturbances [14]. Evidence from perioperative settings indicates that micromovement is significantly more effective than the curvilinear supine position in reducing PI risk during prolonged surgical procedures, suggesting its potential applicability in other immobilized patient populations [15]. Gradual, low-angle repositioning is believed to be better tolerated among critically ill patients because it minimizes abrupt shifts in intrathoracic pressure, reduces the likelihood of respiratory compromise, and maintains hemodynamic stability during positional changes [16,17].

However, despite its theoretical advantages, clinical reports specifically examining the use of micromovement in mechanically ventilated ICU patients remain scarce. Most existing studies have focused on perioperative or non-ICU immobilized populations, whose physiological profiles differ substantially from those of critically ill patients requiring continuous ventilatory support. As a result, the safety, feasibility, and clinical benefits of micromovement in ICU settings remain insufficiently documented. This gap in the literature underscores the need for detailed clinical observations and case-based evaluations to better understand the potential role of micromovement in PI prevention among high-risk ICU patients.

Therefore, this case report aims to describe the implementation of micromovement in a mechanically ventilated ICU patient at high risk for pressure injury and to evaluate its effects on Braden Scale scores, sacral skin condition, and hemodynamic stability throughout the observation period.

METHODS

This study employed a single-case report design using a comprehensive nursing care approach for a male patient, Mr. T, aged 67 years (weight 68 kg, height 162 cm, BMI 25.9 kg/m²). The patient was admitted to the Intensive Care Unit (ICU) at Klaten Hospital on April 17, 2026, with a primary diagnosis of pneumonia accompanied by non-ST elevation myocardial infarction, hypertension, and type 2 diabetes mellitus. Upon admission, the patient presented with impaired consciousness and acute respiratory failure requiring invasive mechanical ventilation. These clinical characteristics placed the patient at high risk for pressure injury development, thereby justifying the implementation of targeted preventive interventions.

Micromovement intervention

The primary intervention administered in this case was micromovement repositioning, a technique designed to provide gentle, frequent pressure redistribution while minimizing physiological disturbances. The intervention was performed by the researcher every hour for three consecutive days. Repositioning was conducted alternately to the right and left using pillow support to achieve controlled angular adjustments.

The sequence of actions began with the patient in a neutral supine position. During the first hour, the patient was tilted approximately 15° to the right and maintained in that position for five minutes before being returned to the neutral position. In the second hour, the patient was tilted 15° to the left for five minutes and subsequently returned to the neutral position. This alternating pattern was repeated hourly throughout the intervention period [14].

Prior to each micromovement session, the researcher conducted a structured assessment that included sacral skin inspection, Braden Scale scoring, and evaluation of hemodynamic stability. Hemodynamic parameters monitored included blood pressure, mean arterial pressure (MAP), heart rate, respiratory rate, oxygen saturation, and ventilator–patient synchrony. The intervention was discontinued immediately if any of the following occurred: a decrease in oxygen saturation greater than 4% from baseline, MAP <65 mmHg, increased respiratory distress, or the onset of arrhythmia.

Throughout the observation period, the patient continued to receive standard ICU care that could influence pressure injury risk. This included personal hygiene measures, monitoring of skin moisture, enteral nutrition via a nasogastric tube (NGT), pharmacological therapy appropriate to the patient's medical conditions, and continuous hemodynamic monitoring. No specialized protective dressings were applied to the sacral area during the intervention period, allowing direct observation of skin changes attributable to micromovement.

Braden scale assessment

Pressure injury risk was evaluated daily using the Braden Scale, which assesses six domains: sensory perception, moisture, activity, mobility, nutrition, and friction/shear. The total score is interpreted as follows: <9 (Very High risk), 10–12 (High risk), 13–14 (Moderate risk), 15–18 (Low risk), and >19 (Very Low risk) [13]. Sacral skin condition was assessed through direct inspection, focusing on changes in skin color, lesion size, moisture level, and any signs of progressive tissue damage. Hemodynamic stability was defined as the absence of clinically significant changes in blood pressure, MAP, heart rate, respiratory rate, and oxygen saturation before and after each micromovement session.

Data collection and analysis

Clinical data were collected through direct patient assessment, physical examination, and review of medical records, including laboratory results, chest radiographs, and integrated progress notes from April 20–22, 2026. The observed variables included Braden Scale scores, sacral skin condition, hemodynamic parameters, and supportive examination findings relevant to the patient's clinical status. Data analysis was conducted descriptively using a narrative approach to document changes in the patient's condition during the implementation of the micromovement intervention.

Ethical Considerations

Ethical principles were strictly upheld throughout the conduct of this case report. The study adhered to the ethical standards of the Declaration of Helsinki and followed institutional guidelines for clinical case documentation. Permission to use patient data was obtained from the ICU management of Klaten Hospital, and all information was anonymized to ensure confidentiality. The patient's identity was protected by replacing personal identifiers with coded initials, and no photographs or sensitive personal information were included.

Given the patient's impaired consciousness and inability to provide informed consent, consent for participation and data use was obtained from the patient's legally authorized representative. The intervention posed minimal risk, as micromovement is a non-invasive repositioning technique integrated within routine nursing care. Continuous monitoring ensured patient safety, and the intervention was halted immediately if any signs of physiological instability emerged. The case report was prepared solely for academic and clinical improvement purposes, without any commercial intent.

RESULTS

Patient information

A 67-year-old male patient was admitted to the ICU for seven days with a diagnosis of pneumonia complicated by NSTEMI, hypertension, and type 2 diabetes mellitus. The patient experienced decreased consciousness and respiratory failure requiring mechanical ventilation. The patient was completely dependent for activities of daily living and required an endotracheal tube (ETT), a nasogastric tube (NGT), and a permanent urinary catheter.

Clinical findings

On initial examination, the patient was in a semi-comatose state with a Glasgow Coma Scale (GCS) score of E2VETM2. Examination of the integumentary system revealed dry, scaly skin on the back and a 5 × 4 cm area of non-blanchable erythema on the sacrum, with grayish to black discoloration in the center. The skin surrounding the lesion appeared dry with no open wounds. The initial Braden Scale score was 10, indicating a high risk of PI.

Nursing interventions carried out from April 23–25, 2026, focused on preventing pressure injuries through the implementation of scheduled micromovement repositioning, accompanied by skin condition assessments and risk assessments using the Braden Scale (Table 1).

Table 1. Nursing interventions

Date	Main intervention	Assessment	Evaluation
Thursday, April 23, 2026	Repositioning was performed by changing the patient's position to the right and left lateral positions with a 15° tilt using a pillow every 1 hour	Assessment of the sacral skin and bony prominence areas using the <i>Braden Scale</i>	Skin condition was evaluated following the intervention
Friday, April 24, 2026	Repositioned the patient to the right and left lateral positions with a 15° tilt using a pillow every 1 hour	Skin condition and PI risk were assessed using the <i>Braden Scale</i>	Monitoring was conducted for changes in skin color, temperature, and tissue damage
Saturday, April 25, 2026	Repositioned the patient to the right and left lateral positions with a 15° tilt using a pillow every 1 hour	Skin condition and PI risk were assessed using the <i>Braden Scale</i>	Evaluation focused on the progression of skin condition and the patient's tolerance of the intervention

Skin integrity outcome

A three-day evaluation showed that the condition of the sacral skin remained stable, with no progression of the lesion. The 5 × 4 cm area of non-blanchable erythema identified during the initial assessment did not expand, showed no tissue loss, and did not develop into an open wound. Discoloration in the sacral area remained localized and was not accompanied by an increase in the degree of tissue damage. Skin moisture in the sacral area was maintained throughout the observation period. Daily assessments showed no maceration or excessive moisture that could worsen the risk of PI. These findings indicate that skin integrity was maintained during the intervention.

The Braden Scale score increased from 10 on the first day to 12 on the second day, then remained at 12 on the third day, indicating a high-risk classification (Table 2). The change in score primarily occurred in the sensory perception domain, which increased from 1 to 2, and the moisture domain, which increased from 2 to 3. Although the patient remained in the high-risk group for PI, this increase in score indicates improvement in modifiable risk factors.

Table 2. Changes in Braden Scale scores

Risk factors	Braden Scale score		
	Thursday, April 23, 2026	Friday, April 24, 2026	Saturday, April 25, 2026
Sensory perception	1	2	2
Moisture Skin	2	3	3
Activity	1	1	1
Mobility	1	1	1
Nutrition	4	4	4
Friction	1	1	1
Total	10	12	12

Hemodynamic status and laboratory findings

The patient remained hemodynamically stable throughout the observation period. Blood pressure ranged from 120/82 to 138/95 mmHg, heart rate ranged from 80 to 99 beats/min, and body temperature remained between 36.4°C and 37.2°C. No clinically significant hemodynamic deterioration was observed during the intervention period, as shown in Figure 1.

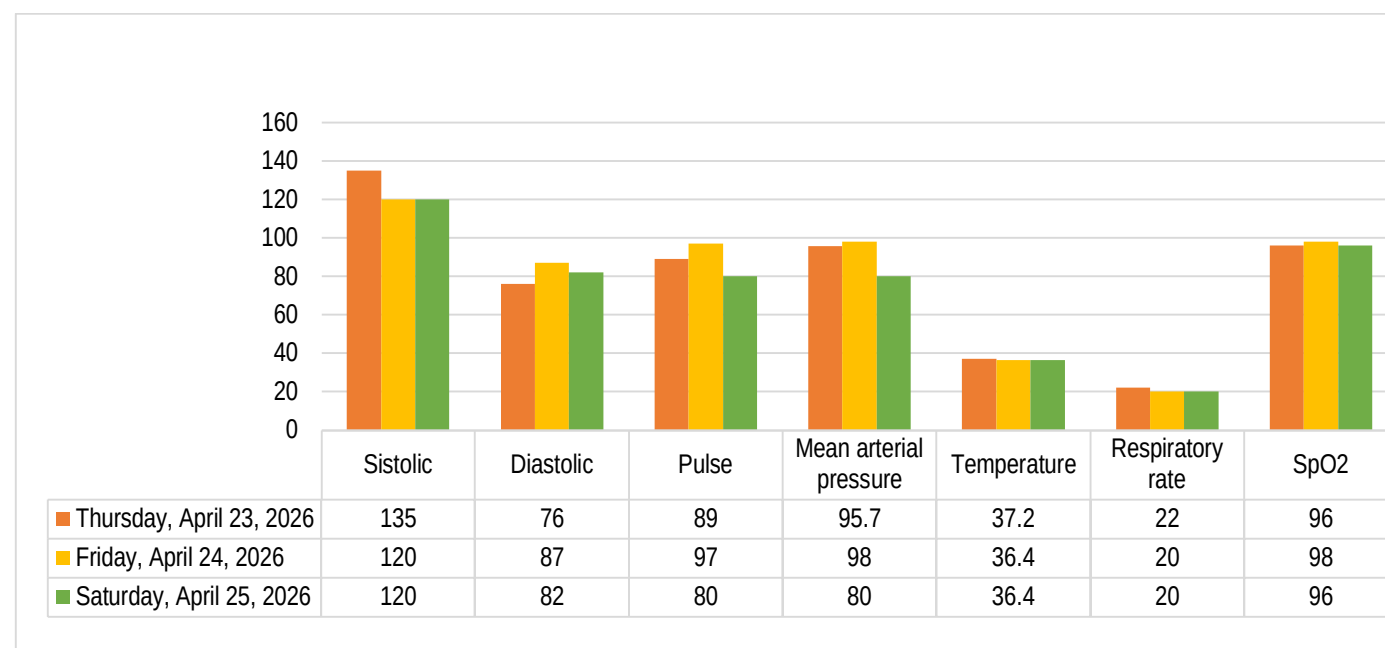


Figure 1. Hemodynamic changes

An evaluation of changes in the patient's laboratory parameters over three days was conducted to assess the patient's systemic response, the results are presented in Table 3. Laboratory test results indicating an infection showed a white blood cell count of $21.0 \times 10^3/\mu\text{L}$, while an albumin level of 2.10 g/dL indicated inadequate nutritional status. Arterial blood gas analysis showed a pH of 7.484-7.536 and a pCO_2 of 28.5-29.2 mmHg.

Table 3. Changes in laboratory results

Parameters	Thursday, April 23, 2026	Friday, April 24, 2026	Saturday, April 25, 2026
White Blood Cells	N/A	$21.0 \times 10^3/\mu\text{L}$	N/A
Albumin	N/A	2.10 g/dL	N/A
pH	7.484	N/A	7.536
pCO_2	28.5 mmHg	N/A	29.2 mmHg
HCO_3	21.6 mmol/L	N/A	25.0 mmol/L

DISCUSSION

The clinical findings in this case demonstrated that the sacral pressure injury did not progress despite the patient's critical condition, prolonged immobilization, and multiple systemic risk factors that typically predispose ICU patients to rapid deterioration of skin integrity. At baseline, the patient presented with a 5×4 cm area of non-blanchable erythema accompanied by central grayish-black discoloration, indicating early tissue compromise and potential deep tissue involvement. Under usual circumstances, such lesions in critically ill patients tend to worsen due to sustained pressure, impaired perfusion, and systemic instability. However, throughout the three-day observation period, the lesion remained stable: there was no expansion of the affected area, no transition to an open wound, and no evidence of progressive tissue necrosis. The surrounding skin also remained intact, with moisture levels maintained within an optimal range and no signs of maceration. The Braden Scale score increased from 10 to 12, reflecting improvements in sensory perception and moisture control, both of which are modifiable risk factors that contribute to enhanced tissue tolerance. These findings collectively suggest that, even in the context of mechanical ventilation and prolonged immobilization, skin integrity can be preserved when pressure redistribution is performed consistently and physiological stability is maintained [11,16].

Nevertheless, the stable skin condition observed in this case cannot be attributed solely to the micromovement intervention. The patient simultaneously received a comprehensive set of standard ICU interventions, including routine skin hygiene, moisture monitoring, enteral nutritional support, pharmacological therapy tailored to his medical conditions, and continuous hemodynamic surveillance. Each of these interventions plays a role in preventing pressure injuries, and their combined effect likely contributed to maintaining skin integrity during the observation period. Therefore, while micromovement may have supported pressure redistribution, its specific contribution cannot be isolated or definitively determined. The increase in the Braden Scale score should be interpreted cautiously, as it reflects improvements in certain domains but does not necessarily indicate a direct causal relationship with micromovement.

The patient remained in the high-risk category for PI because domains related to mobility, activity, and friction did not improve. These domains are heavily influenced by the patient's underlying clinical condition, including mechanical ventilation, decreased consciousness, systemic infection, and metabolic disturbances. Such factors are well-established contributors to PI development and often persist despite preventive interventions [18]. In critically ill patients, PI risk assessment should therefore emphasize not only numerical scores but also the stability of tissue condition and the absence of lesion progression during intensive care [13,19]. In this case, the lack of lesion progression is clinically meaningful, as it indicates that tissue perfusion and tolerance were sufficiently preserved despite multiple risk factors.

Micromovement may have contributed to this stability by facilitating more continuous pressure redistribution. Previous studies have shown that small-angle repositioning can reduce localized pressure, maintain microcirculatory flow, and prevent prolonged ischemia in immobilized patients [14,15,20]. Continuous pressure redistribution is recognized as a critical component of PI prevention, particularly in patients with severely limited mobility [21]. Importantly, the micromovement intervention did not produce significant hemodynamic changes. Blood pressure, heart rate, respiratory rate, and oxygen saturation remained stable throughout the intervention period, and no episodes of desaturation, hypotension, arrhythmia, or ventilator asynchrony were observed. These findings support the notion that minimal-angle repositioning is well tolerated in mechanically ventilated patients, aligning with previous research indicating that gradual, low-angle repositioning minimizes respiratory and circulatory disturbances [22,23]. Studies have also reported that gradual mobilization strategies maintain physiological stability without increasing the risk of complications in critically ill patients [12,24].

Another important clinical finding in this case was the presence of severe hypoalbuminemia (albumin 2.10 g/dL) and diabetes mellitus, both of which significantly increase the risk of PI. Hypoalbuminemia reduces oncotic pressure, promotes interstitial edema, impairs tissue oxygenation, and delays wound healing, thereby increasing susceptibility to ischemic injury [25]. Diabetes mellitus further compromises microvascular circulation, impairs leukocyte function, and slows tissue repair, making the skin more vulnerable to pressure-related damage [26]. The combination of malnutrition, systemic infection, and metabolic disorders is known to impair tissue resilience and increase PI risk in ICU patients [27]. Given these conditions, the absence of lesion progression in this patient is particularly noteworthy and suggests that the combination of preventive measures—including micromovement—may have contributed to maintaining tissue stability.

Despite these positive findings, this case report has several limitations. The patient received multiple concurrent ICU interventions, making it difficult to isolate the specific effect of micromovement on skin integrity. The observation period was limited to three days and did not include continuous 24-hour monitoring, which may have overlooked subtle changes in tissue condition or hemodynamic status. Additionally, the findings are based on a single patient and therefore cannot be generalized to the broader population of critically ill patients. Larger studies with controlled designs are needed to determine the effectiveness, safety, and feasibility of micromovement as a PI prevention strategy in ICU settings.

CONCLUSION

The use of micromovement in ICU patients on mechanical ventilation shows promise in maintaining skin integrity without causing hemodynamic disturbances. The absence of pressure injury development and the improvement in Braden Scale scores during the observation

period support the use of this intervention as a pressure injury prevention strategy. Further research with a stronger design and a larger sample size is needed to explore the effectiveness of micromovement in preventing pressure injuries.

Ethical consideration, competing interest and source of funding

- The ethical approval: Ethical approval for this study was granted by the Health Research Ethics Committee of the Yogyakarta Ministry of Health Health Polytechnic under ethics number No. DP.04.03/e-KEPK.1/928/2026.
- There is no conflict of interest related to this publication.
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