MEDICAL SCIENCE

Use of Behavioural Pain Scale in assessing pain during physical therapy procedures in sedated, mechanically ventilated patients in ICU: A cross-sectional observational study

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To Cite:
Sinha S, Malekar S, Sinha RK. Use of Behavioural Pain Scale in assessing pain during physical therapy procedures in sedated, mechanically ventilated patients in ICU: A cross-sectional observational study. *Medical Science* 2023; 27: e350ms3201
doi: https://doi.org/10.54905/disssi.v27i139.e350ms3201

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Peer-Review History
Received: 08 June 2023
Reviewed & Revised: 12/June/2023 to 09/September/2023
Accepted: 13 September 2023
Published: 18 September 2023

Peer-review Method
External peer-review was done through double-blind method.

Medical Science
pISSN 2321–7359; eISSN 2321–7367

DISCOVERY SCIENTIFIC SOCIETY

ABSTRACT

Background: Critically ill patients who are sedated and mechanically ventilated, experience significant pain during physical therapy procedures but cannot communicate effectively due to sedation. Identification and evaluation of pain with validated behavioral observation tools in patients unable to self-report pain improve quality of care by administration of appropriate analgesia or sedation during routine physical therapy care of ventilated patients. *Aims and Objectives:* This study aimed to assess pain in sedated, mechanically ventilated patients using the Behavioural Pain Scale (BPS) during physical therapy procedures like body positioning and tracheal suctioning. *Materials and Methods:* Following ethical approval, 50 adult patients, sedated and mechanically ventilated, admitted in the ICUs in a tertiary care teaching hospital were assessed for pain severity using BPS during routine physical therapy procedures. Patients ≥18 years of age, both male and female, with Glasgow Coma Scale of (GCS) < 10, were included in the study. Patients with Ramsay Sedation Scale (RSS) of 3, 4, and 5, mechanically ventilated for at least 48 hours, who were unable to verbalize, patients who were undergoing routine physical therapy that included body positioning and tracheal suctioning for removal of secretion were included. Patients below 18 years of age, able to verbalize pain, and GCS score of ≤ 3, were excluded from the study. *Conclusion:* BPS is recommended for better pain evaluation during physical therapy procedures in sedated, mechanically ventilated adult patients in the ICU.

Keywords: Pain, Behavioural Pain Scale, Mechanical Ventilation, ICU, Physical Therapy Procedures.

1. INTRODUCTION

As per the International Association for Study of Pain, pain is an unpleasant sensory and emotional experience associated with or resembling actual or potential tissue damage (Raja et al., 2020). Pain is a significant problem among mechanically ventilated patients in ICU (Mitra et al., 2020). Pain is felt during rest and procedures like a change of body position, joint mobilizations, muscle stretching, and tracheal suctioning. 80% of ICU-discharged hospitalized patients have painful memories and discomfort associated with intubation. 38% of patients remember the pain as their worst ICU memory even after six months (Shaikh et al., 2018). Physical therapy procedures act as stressors but no standard protocol for analgesia or sedation management during physiotherapy exists (Everingham et al., 2010). Pain during physical therapy may adversely affect the treatment outcomes. Physical therapists and other caregivers must use structured, valid, and reliable instruments to assess pain in the ICU, in a routine manner. Many studies have reinforced the importance of pain assessment instruments and their use by health professionals in the ICU (Hora TCNS da and Alvis IGN, 2020).

The need for direct patient communication is self-evident (Patel and Kress, 2012). Self-reporting of pain is the gold standard of pain assessment (Gerber et al., 2015). Mechanically ventilated patients cannot communicate effectively due to tracheal intubation, sedation, reduced level of consciousness, and administration of paralyzing drugs. The ability of such patients to self-report pain is limited. Visual Analog Scale (VAS) and Numeric Rating Scale (NRS) are commonly used self-reported pain assessment tools in patients who can communicate. When the patient cannot verbalize, reliable pain assessment tools for patients with diminished ability for communication have to be used (Naithani et al., 2008). Studies have shown that certain observable behaviors may be valid indicators of pain. The Behavioural Pain Scale (BPS) was developed by (Payen et al., 2001). It is used for assessing pain in patients who have undergone abdominal surgery or multiple traumas.

The BPS has also been used to evaluate pain in sedated, mechanically ventilated patients, unable to verbalize pain. BPS is a unidimensional, 12-item clinical observation tool that assesses pain on three behavioral indicators- patient's facial expression, lower limb movements, and tolerance of mechanical ventilation. Each behavioral indicator contains four descriptors rated on a 1-4 scale. The score ranges from 3 (no pain) to 12 (highest pain). The scale has high inter-rater reliability (Al-Sutari et al., 2014). Studies have shown that BPS is an appropriate tool for evaluating pain in uncommunicative ICU patients (Oliveira et al., 2019). Unrelieved pain can cause multiple physiological and psychological complications.

Pain decreases patient cooperation with various care procedures, such as turning and physical therapy. It is reported that more than 30% of ICU patients have significant pain at rest, and more than 50% of ICU patients have significant pain during routine care like turning procedures (Allam, 2022). Pain remains under-evaluated and undertreated in sedated, intubated, and mechanically ventilated patients who cannot verbalize. Studies have shown that the BPS can be used to assess pain during routine medical and nursing procedures, but no study has used BPS to assess pain during standard physical therapy procedures. The purpose of this observational study, sampled from a population of sedated and mechanically ventilated critically ill patients, was to assess the usefulness of BPS in evaluating pain in sedated, mechanically ventilated patients during routine physical therapy procedures.

2. MATERIALS AND METHODS

This cross-sectional, single-center observational study was conducted for two months in medical, surgical, and renal ICUs of a tertiary teaching hospital in India. After the approval by the Institutional Ethical Committee, informed consent was obtained from a responsible family member of each patient. They were explained the purpose of the study and the type of data to be collected and assured of the confidentiality of the data. This study did not require deviation from the routine patient care prescribed to the patients in ICU. Patients 18 years and older, male and female, Glasgow Coma Scale of < 10, were included in the study. Sedated patients with Ramsay Sedation Scale of 3, 4, and 5 (avoiding too agitated or deeply sedated patients) and mechanically ventilated for at least 48 hours, who were unable to verbalize and were undergoing routine physical therapy that included body positioning and tracheal suctioning for removal of secretion for a wide range of diagnostic conditions were included in the study.

Patients below 18 years of age, able to verbalize pain, GCS score of ≤ 3 (patients in a deep coma), patients with quadriplegia, peripheral neuropathy, and on neuromuscular blocking agents or drugs that can inhibit expression of pain behavior, discontinued mechanical ventilation due to weaning or brain death and those who were not undergoing routine physiotherapy following mechanical ventilation, were excluded from the study. 137 patients were admitted to the ICUs during the period of study. 71 patients fulfilled the inclusion criteria. Consent could not be obtained from 18 patients. Two were extubated and one expired before the data collection. Data was collected for the remaining 50 patients between October 2022 and December 2022 (Figure 1). A structured, observational method was used for data collection. Physical therapy procedures were carried out by two

physiotherapists who were routinely involved in the treatment of ICU patients. They were also trained in BPS administration. None of the BPS administrators were blinded to the study.

Data was collected with the help of three instruments. The first instrument comprised of patient's demographic data, diagnostic categories, and physiological variables like systolic and diastolic blood pressure and heart rate, duration of mechanical ventilation, and type of analgesia used during mechanical ventilation. Demographic data (Table 1) was collected from hospital records within 24 hours of ICU admission. The second instrument comprised the Glasgow Coma Scale (GCS) score to assess patients' level of consciousness, the Ramsay Sedation Scale (RSS) score to assess patients' depth of sedation, and the CAM ICU scale to evaluate the presence of delirium.

Patients with RSS scores of 3, 4, 5 only was included in the study. None of the patients showed ICU delirium. The third instrument comprised the BPS score of each patient during rest, change of body position, and tracheal suctioning. The validity and reliability of the instruments were evaluated by three therapists, experienced in the physical therapy management of ICU patients. Patients' systolic and diastolic blood pressure and heart rate were measured during rest, change in body position, and tracheal suctioning. Patients' pain was evaluated using the BPS. BPS includes three behavioral indicators-facial expression, upper limb movements, and compliance with a ventilator (Table 2). A guide for BPS administration was prepared for the investigators (Table 3). All investigators adhered to it. Observations were recorded between 8 a.m. and 12 noon.

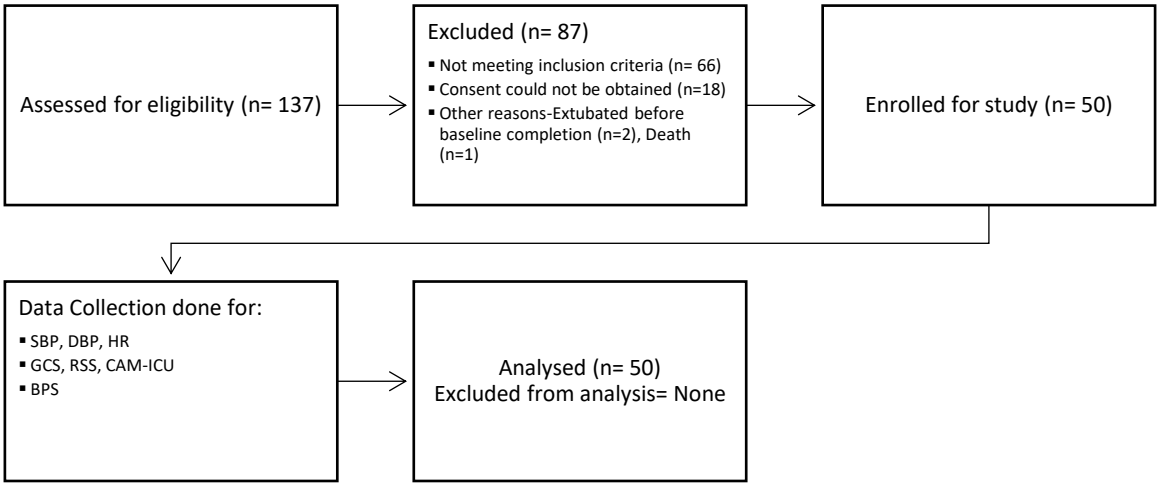


Figure 1 Flow diagram showing enrolment, data collection, and analysis

3. RESULTS

This study objectively evaluated the usefulness of the BPS in evaluating pain during physical therapy in sedated, mechanically ventilated patients in ICU, who are unable to verbalize. The mean age of patients was 54.36±18.29. 70% of the patients included in this study were males. 50% of the patients were 50 years or above. Patients with a wide range of diagnostic conditions were included in the study (Table 4). Most patients (54%) received opioid analgesics (fentanyl, midazolam, serenace, calmpose) following intubation. 44% of patients received paracetamol or metamizole. 2% of patients did not receive analgesia.

Table 1 Demographic characteristics of patients at baseline

Variables	Result (n=50)
Age (in years) mean ± SD	54.36±18.29
Gender	*n (%)*
Female	15 (30%)
Male	35 (70%)
Type of condition	*n (%)*
Medical	42 (84%)
Surgical	8 (16%)
Mode of ventilation	*n (%)*
SIMV	14 (28%)

BiPAP	4 (8%)
CPAP	11 (22%)
VC/AC	18 (36%)
NIV	3 (6%)
Co analgesia	*n (%)*
Fentanyl	18 (36%)
Midazolam	7 (14%)
Serenace	3 (6%)
Calmpose	5 (10%)
Paracetamol	17 (34%)

Table 2 The Behavioural Pain Scale

Item	Description	Score
Facial expression	Relaxed	1
	Partially tightened	2
	Fully tightened	3
	Grimacing	4
Upper limbs	No movement	1
	Partially bent	2
	Fully bent with finger flexion	3
	Permanently retracted	4
Compliance with ventilator	Tolerating movement	1
	Coughing with movement	2
	Fighting ventilator	3
	Unable to control ventilation	4

Table 3 A Guide to BPS for Evaluators

Item	Description	Score
Facial expression	Relaxed look, calm expression. No frowning, squinting, or jaw-locking	1
	Tense, frowning, and intermittent jaw locking	2
	Frowning, squinting, and jaw-locking most of the time	3
	Facial distortion and clenching of teeth	4
Upper limbs	Relaxed, no tension or resistance to passive motion	1
	Slight increase in muscle tone and resistance to passive motion	2
	Strong contraction of fingers and extremities, resistance to passive motion	3
	Strong contraction of fingers and extremities, high resistance to passive motion	4
Compliance with ventilator	Calm and relaxed	1
	Not very comfortable. Mildly agitated, calms upon touch or voice	2
	Agitated and uncomfortable. Does not calm upon interaction	3
	Highly agitated, unable to be controlled	4

Table 4 Diagnostic Category-Wise Distribution of Patients and RSS Score

Diagnostic Category	No. of Patients	RSS Score (Mean ± SD)
General surgery	2	3.50±0.70
Oncological surgery	6	3.66±0.81
Neurological	4	4.25±0.95
Cardiac	6	4.16±0.75
Orthopaedic	2	4.50±0.70
Respiratory	2	4.00±0.00
Orthopaedic surgery	4	4.00±0.81
Metabolic	2	4.50±0.70
Drug-induced poisoning	3	3.66±0.57
Septicaemia	2	4.00±0.00
Multiple trauma	4	3.75±0.95
Hepatobiliary	3	4.33±1.15
Reproductive	7	4.00±1.00
Burns	3	4.00±0.81

Table 5 Physiological parameters during rest, body positioning, and tracheal suctioning

Items	During Rest (Mean±SD)	During Body Positioning (Mean±SD)	During Tracheal Suctioning (Mean±SD)
Systolic Blood Pressure	128±18.29	136±12.06	142±13.23
diastolic Blood Pressure	84±11.23	88±8.97	98±10.33
Heart Rate	84.24±8.16	96.89±8.32	102.34±5.18

The findings of this study show that the physiological parameters like SBP, DBP, and HR were minimal at rest but increased during body positioning and were maximum during tracheal suctioning (Table 5). The mean BPS score at rest was 6.59±0.42, which indicates the presence of some pain even at rest. The mean pain score during a change of body positioning and tracheal suctioning was significantly higher than at rest (Table 6). The difference was statistically significant. Pain assessment of patients with and without analgesia showed that patients on analgesia experienced significantly less pain than those without analgesia during rest and physical therapy procedures (Table 7).

Table 6 BPS at Rest, Tracheal Suctioning and Body Positioning

Items	At Rest n (%)	During Body Positioning n (%)	During Tracheal Suctioning n (%)	*X*2	p-value
Facial expressions					
Relaxed	32 (64%)	7 (14%)	1 (2%)	80.954	< 0.0001
Partially Tight	8 (16%)	20 (40%)	3 (6%)		
Fully Tight	4 (8%)	13 (26%)	24 (48%)		
Grimace	6 (12%)	10 (20%)	22 (44%)		
Upper limbs					
No Movement	24 (48%)	8 (16%)	2 (4%)	33.929	< 0.0001
Partially Bent	12 (24%)	10 (20%)	18 (36%)		
Fully Bent	10 (20%)	26 (52%)	22 (44%)		
Permanently Retracted	4 (8%)	6 (12%)	8 (16%)		
Compliance with ventilatio					
Tolerating Movement	28 (56%)	5 (10%)	2 (4%)	66.597	< 0.0001
Coughing	13 (26%)	20 (40%)	8 (16%)		

Fighting	6 (12%)	22 (44%)	24 (48%)		
Unable To Control Ventilation	3 (6%)	3 (6%)	16 (32%)		

Table 7 Pain assessment of patients with and without analgesia

Items	Degree of Pain	Not on Analgesia	On Analgesia	X2	p-value
At Rest	Painless	2 (25%)	31 (73.80%)	14.196	0.0027
	Mild	4 (50%)	11 (26.19%)		
	Moderate	1 (12.5%)	0 (0%)		
	Severe	1 (12.5%)	0 (0%)		
During Body Positioning	Painless	0 (0%)	12 (28.57%)	13.508	0.0037
	Mild	3 (37.5%)	8 (19.04%)		
	Moderate	3 (37.5%)	20 (47.61%)		
	Severe	2 (25%)	0 (0%)		
During Tracheal Suctioning	Painless	0 (0%)	12 (28.57%)	9.519	0.0231
	Mild	2 (25%)	12 (28.57%)		
	Moderate	3 (37.5%)	16 (38.09%)		
	Severe	3 (37.5%)	2 (4.76%)		

Most patients showed relaxed facial expressions during rest, partially tight during body positioning, and fully tight and grimacing during tracheal suctioning (Figure 2). During the change of body position, the mean BPS score was 7.58±1.02, which indicated moderate pain. The upper limb indicator for most patients was- no movement at rest, partially bent during body position and fully bent during tracheal suctioning (Figure 3). During tracheal suctioning, the mean BPS score was 9.14±1.26 indicating severe pain. The facial expression indicator for most patients was grimacing, the upper limb indicator was fully tight and compliance with the ventilator indicator showed patients fighting the ventilator (Figure 4).

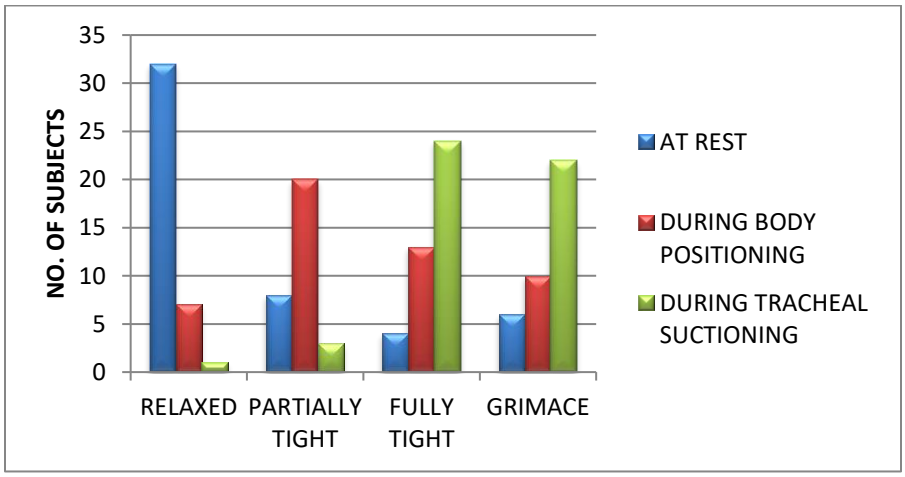


Figure 2 Facial Expressions at Rest, Body Positioning and Tracheal Suctioning

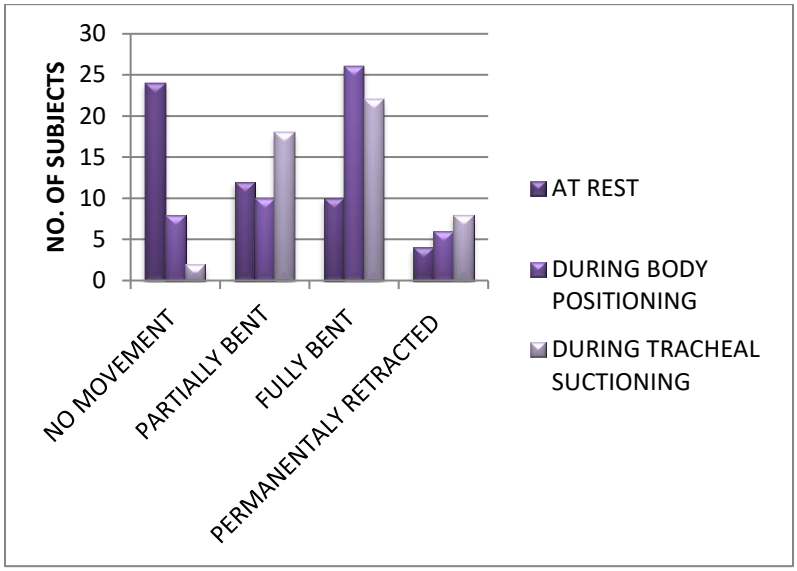


Figure 3 Upper Limb Movements at Rest, Body Positioning and Tracheal Suctioning

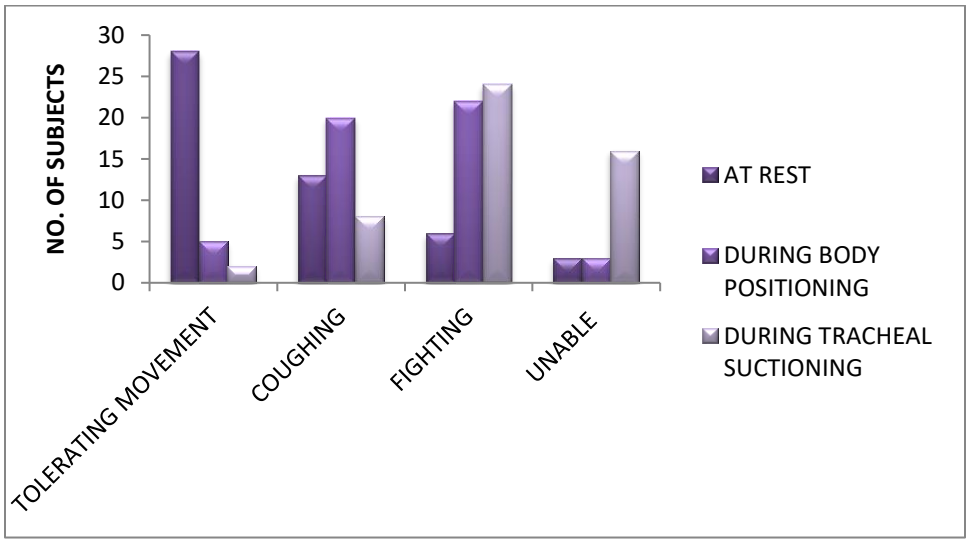
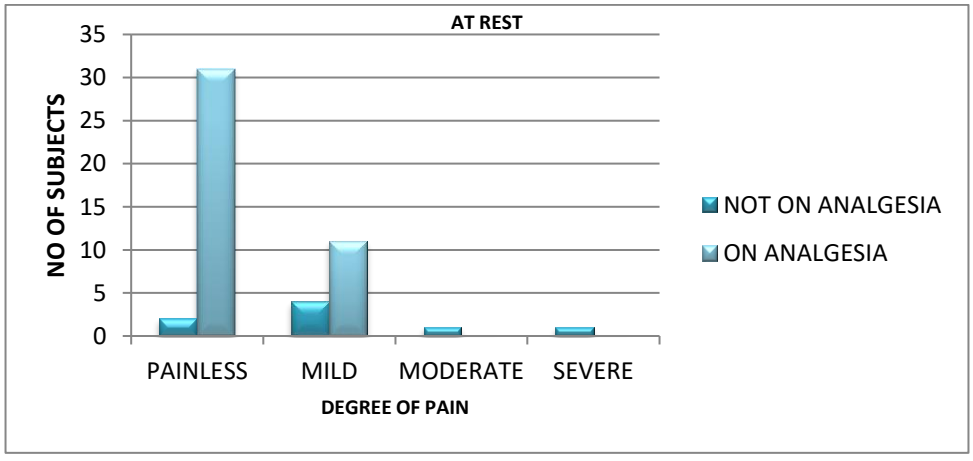


Figure 4 Compliance with Ventilator at Rest, Body Positioning and Tracheal Suctioning



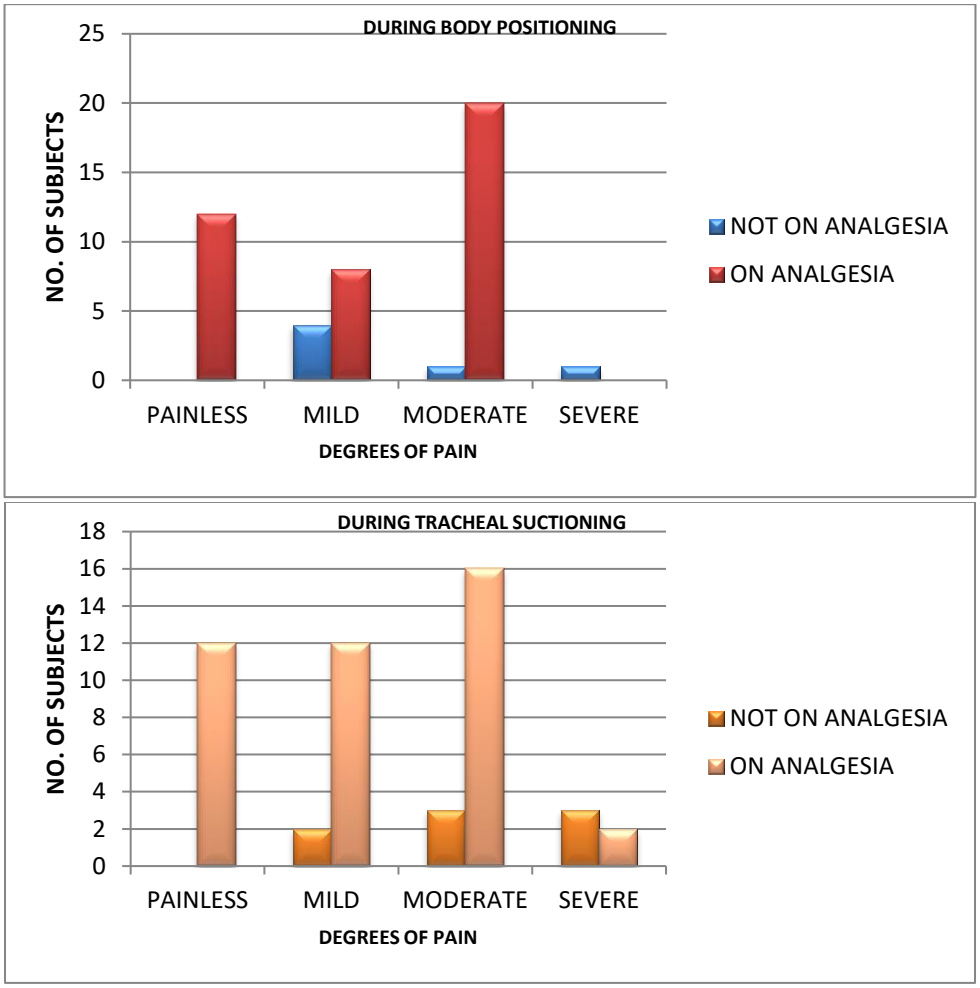


Figure 5 Degree of Pain at Rest, Body Positioning, and Tracheal Suctioning for Patients on Analgesia and Not on Analgesia

Comparison of the degree of pain at rest, body positioning, and tracheal suctioning for patients on analgesia and not on analgesia shows that most patients on analgesia experienced significantly less amount of pain during rest, body positioning, and tracheal suctioning than those not on analgesia (Figure 5).

4. DISCUSSION

Mechanically ventilated patients who are sedated and unable to self-report, require instruments that detect behaviors associated with pain. Observation of facial expression is a method used for pain assessment in ventilated subjects. During painful procedures, an increase in facial movements – eyes closed, brow lowered, eyelid tightened, cheeks raised, and parted lips are the indicators. Upper limb movements, muscle rigidity, and compliance with mechanical ventilator are other behavioral indicators of pain in sedated intubated patients (Azevedo-Santos and DeSantana, 2018). This study aims to evaluate the usefulness of BPS in evaluating pain at rest and during physical therapy procedures like change of body position and tracheal suctioning in sedated and mechanically ventilated patients in ICU, unable to verbalize pain.

The results of this study show that despite sedation or administration of analgesia, pain is not adequately relieved in mechanically ventilated patients. Therefore, the use of appropriate pain assessment instruments for evaluating pain is required. It implies that maximum pain was experienced during tracheal suctioning. Studies have reported tracheal suctioning invoking significant changes in physiological parameters (Jeitziner et al., 2012).

This study found a positive correlation between pain intensity and an increase in heart rate and diastolic BP during physical therapy interventions, like body positioning and tracheal suctioning. These findings are consistent with international reports of the association of heart rate and BP with pain. Underestimation of a patient's pain is a well-known problem. However, while using the BPS, there is also a likelihood of over-estimation of patients' pain. Therefore, using the BPS with other pain scales may provide a more reliable assessment of a patient's pain (Ahlers et al., 2010).

Limitations of the study

This study has a few limitations. As it was a single-center study, the sample size was small. Patients with a wide range of diagnostic categories, different durations of ICU stay, and analgesia dosage were included in the study. We have not correlated the BPS score with the sedation level of the patients. However, patients with GCS ≤ 3 who could be unresponsive to pain were excluded from the study.

5. CONCLUSION

Almost all mechanically ventilated patients in the ICU have pain. Evaluation of pain is difficult in sedated patients who are unable to self-report. Appropriate instruments for pain evaluation should be used for such patients. In uncommunicative patients, physiological parameters and behavioral indicators are used to evaluate pain. The results of this study indicate that sedated mechanically ventilated patients experience pain during routine physical therapy procedures like body positioning and tracheal suctioning.

BPS may be used by physical therapists to assess pain in sedated mechanically ventilated patients. This would help in the appropriate evaluation of pain and ensure better pain management by administration of adequate analgesia during such procedures. As this is the first study to evaluate the effectiveness of BPS for evaluating pain during physical therapy procedures in sedated, mechanically ventilated patients in ICU, further studies may be undertaken on the perception of physiotherapists working in ICU towards acceptability and ease of application of BPS for evaluation of pain in sedated, mechanically ventilated patients in critical care settings.

Acknowledgment

The authors express their gratitude to the medical and nursing staff of the medical, surgical, and renal ICUs of the hospital. The authors are grateful to the patients and their family members who extended cooperation in providing all relevant information related to the study.

Author contributions

Author 1 conceived the idea, performed the analysis, and prepared the manuscript. Author 2 performed the interventions, collected the data, and contributed data analysis tools. Author 3 served as a scientific advisor and critically reviewed the study proposal.

Ethical approval

The study proposal was approved by the Institutional Ethics Committee of Pravara Institute of Medical Sciences (Deemed to be University), Loni, Maharashtra, India on 19-10-2022 (Reg. No. COPT/MPT/2022/23).

Informed consent

Informed consent was obtained from a family member of all individual patients as the patients were sedated and unable to verbalize. They were informed about the purpose and rationale of the study and the anonymity of data before collecting patients' responses. Consent was verbal as the data was anonymous in every aspect. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

Abbreviations

BPS - Behavioural Pain Scale
ICU - Intensive Care Unit
GCS - Glasgow Coma Scale
RSS - Ramsay Sedation Scale
CAM - ICU Scale. The Confusion Assessment Method for the Intensive Care Unit

Funding

This study has not received any external funding.

Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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