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ACUTE PAIN ASSESSMENT IN NONVERBAL SEDATED PATIENTS IN THE EARLY POSTOPERATIVE PERIOD

Anaesthesiology

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ABSTRACT

Background: Acute pain management is based on self-reporting of pain, leading to inadequate treatment in patients who cannot vocalise their pain due to sedation or mechanical ventilation in the postoperative period. We designed this study to compare and assess the use of two behavioural pain scales, Critical Care Pain Observation Tool (CPOT) and Non-verbal Pain Scale-revised (NVPS-R) in such patients. **Method:** A prospective, observational study was conducted on 94 adults who underwent major abdominopelvic surgeries, unable to verbalise pain in early postoperative period (2 hours) after arrival to Post Anesthesia Care Unit (PACU). The sedation level of patients was evaluated first by using Richmond Agitation Sedation Scale (RASS); if RASS scores were -4 to -1, then the pain was scored using both scales, i.e. CPOT and NVPS-R, at 7-time points (0,15,30,45,60,90 minutes of arrival to PACU). **Results:** Both pain scores showed significant pain in >80% of patients for first 45 minutes, peaking at 30 minutes, after arrival to PACU and decreased thereafter. However, only 34% received analgesia, while 46% of patients were not treated for pain. Both scales exhibited a strong correlation at all time points. CPOT, using vocalisation parameter, is a better indicator of acute pain as the physiological parameters of NVPS-R were inconsistent with significant pain on the scales.**Conclusions:** Either CPOT or NVPS-R can assess pain in sedated patients in the early postoperative period. However, CPOT is more reliable with vocalisation indicator, whereas physiological indicators of NVPS-R can be influenced by other factors besides pain.

KEYWORDS

Postoperative pain, Post Anesthesia Care Unit (PACU), Behavioural pain scales, Critical Care Pain Observation Tool (CPOT), Non-verbal Pain Scale-revised (NVPS-R), Richmond Agitation Sedation Scale (RASS), Sedated patients, Non-verbal patientss

INTRODUCTION

McCaffery expounded pain as a subjective entity which enabled healthcare providers to intervene and treat patients based on the self-report of the pain experience [1,2]. Later, the International Association for the Study of Pain (2010) specified, "an individual's inability to express or report pain does not negate the possibility of experiencing pain and requirement of appropriate pain relief" [3]. In such circumstances, patients' behavioural reactions shall be considered surrogate measures of pain as long as their motor function is intact [4]. Data suggest that 80% of patients experience pain postoperatively, out of which 11-30% experience severe pain [5]. During the peri-anaesthesia period, especially during the first few hours of the postoperative period, the administration of anaesthetics and sedative agents interferes with the level of consciousness and alters the patient's ability to communicate, which makes pain assessment difficult. This points to the need for accurate and reliable instruments for better evaluation and pain control in such patients. For sedated patients and postoperative patients who cannot verbalise their pain, the ASPMN published a position statement in 2006 that proposed a comprehensive, stratified approach to the assessment of pain, providing a substructure for the decision-making process in the management of pain [1,6].

Most existing pain assessment scales are formulated for patients who can respond to assessment commands verbally [7], including postoperative patients after general anesthesia. Therefore, behavioural pain scales were developed comprising physiological, body language and behavioural changes [8], which are now highly recommended for assessing acute pain in nonverbal patients by the Critical Care Medicine Association, American Society of Anesthesiologists, and American Pain Society [9]. The most validated behavioural pain rating scales are the Behavioural Pain Scale (BPS), Pain Behavioral Assessment Instrument (PBAT), Pain Assessment, Intervention, and Notation (PAIN) Algorithm, Non-Verbal Pain Scale (NVPS-R) and Critical-Care Pain Observation Instrument (CPOT).

Critical care pain observation tool (CPOT): The CPOT has been tested in verbal and non-verbal patients [10,11] as it was devised for intubated and non-intubated patients in critical care. It has four parameters, each scoring from 0 to 2: (a) facial expressions, (b) movements, (c) muscle tension, (d) vocalisation for non-intubated patients or ventilator compliance for intubated patients. Total scores depict significant pain presence if the score is 3-8 and no pain if the score is 0-2.

INDICATOR	SCORE		DESCRIPTION
Facial expression	Relaxed, neutral	0	No muscle tension observed
	Tense	1	Frowning, brow lowering, orbit tightening, and levator contraction or any other change (e.g., opening eyes or tearing during nociceptive procedures)
	Grimacing	2	All previous facial movements plus eyelids tightly closed (the patient may present with mouth open or biting the endotracheal tube)
Body movements	Absence of movements or normal position	0	Does not move at all (does not necessarily mean absence of pain) or normal position (movements not aimed toward the pain site or not made for the purpose of protection)
	Protection	1	Slow, cautious movements, touching or rubbing the pain site, seeking attention through movements
	Restlessness	2	Pulling the tube, attempting to sit up, moving limbs or thrashing, not following commands, striking at staff, trying to climb out of bed
Compliance with the ventilator (mechanically ventilated patients)	Tolerating ventilator or movement	0	Alarms not activated, easy ventilation
	Coughing but tolerating	1	Coughing, alarms may be activated but stop spontaneously
	Fighting ventilator	2	Asynchrony; blocking ventilation, alarms frequently activated
or			
Vocalization (nonventilated patients)	Talking in normal tone or no sound	0	Talking in normal tone or no sound
	Sighing, moaning	1	Sighing, moaning
	Crying out, sobbing	2	Crying out, sobbing
Muscle tension	Relaxed	0	No resistance to passive movements
Evaluation by passive flexion and extension of upper limbs when patient is at rest or evaluation when patient is being turned	Tense, rigid	1	Resistance to passive movements
	Very tense or rigid	2	Strong resistance to passive movements, incapacity to complete them
TOTAL		0-8	

Figure I. *Critical-care Pain Observation Tool*

Non-verbal pain scale revised (NVPS-R): The original NVPS contained behavioural parameters, i.e. facial expressions, guarding and activity, with physiological parameters, including heart rate, blood pressure, and respiratory rate, ranked in order of severity. Later, a physiologic II category was introduced, consisting of autonomic indicators such as dilated pupils, flushing, diaphoresis or pallor. The NVPS was revised in 2003, and autonomic indicators were substituted with the respiratory category (respiratory rate, pulse oxygen saturation). It was renamed NVPS-R [7]. Each domain was ranked 0 to 2, rendering a total score between 0-2, indicating no pain and 3-10, indicating a significant pain. The revised scale was validated to be a more reliable scale than the original one for sedated patients on mechanical ventilation in the ICU [12,13].

CPOT has shown superior reliability and validity in critically ill adults and postoperative neurosurgical and trauma patients who are unable to report their pain [14]. In some recent studies, the NVPS-R was a valid observational pain scale. However, a comparison between CPOT and NVPS-R in the early postoperative period in sedated patients has not

been studied. We designed this study (1)To assess the use of Critical Care Pain Observation Tool (CPOT) and Non-Verbal Pain Scale-Revised (NVPS-R) in non-verbal sedated patients in the early postoperative period. (2) To compare the use of these two behavioural acute pain assessment scales (CPOT and NVPS-R) and evaluate differences between the pain scores for non-verbal sedated patients during the early postoperative period.

Categories	0	1	2
Revised-NVPS*			
Face	No particular expression or smile	Occasional grimace, tearing, frowning, wrinkled forehead	Frequent grimace, tearing, frowning, wrinkled forehead
Activity (movement)	Lying quietly, normal position	Seeking attention through movement or slow, cautious movement	Restless, excessive activity and/or withdrawal reflexes
Guarding	Lying quietly, no positioning of hands over areas of body	Splinting areas of the body, tense	Rigid, stiff
Physiologic I (vital signs)	Stable vital signs (no change as past 4 h)	Change over past 4 h in any of the followings SBP >20 mmHg HR >20/min	Change over past 4 h in any of the followings SBP >30 mmHg HR >25/min
Respiratory	Baseline RR/SpO_2 Compliant with ventilator	RR >10 above baseline, or 5% SpO_2 or mild asynchrony with ventilator	RR >20 above baseline, or 10% SpO_2 or severe asynchrony with ventilator
Original-NVPS**			
Face	No particular expression or smile	Occasional grimace, tearing, frowning, wrinkled forehead	Frequent grimace, tearing, frowning, wrinkled forehead
Activity (movement)	Lying quietly, normal position	Seeking attention through movement or slow, cautious movement	Restless, excessive activity and/or withdrawal reflexes
Guarding	Lying quietly, no positioning of hands over areas of body	Splinting areas of the body, tense	Rigid, stiff
Physiologic I (vital signs)	Stable vital signs (no change as past 4 h)	Change over past 4 h in any of the followings SBP >20 mmHg HR >20/min RR >10/min	Change over past 4 h in any of the followings SBP >30 mmHg HR >25/min RR >20/min
Physiologic II	Warm, dry skin	Dilated pupils, perspiring, flushing	Diaphoretic, pallor

*Adopted from Wegman DA. (2003)[15] **Adopted from Odhner *et al.* (2003).[16] NVPS: Non-verbal pain scale. RR: Respiratory rate. HR: Heart rate. SBP: Systolic blood pressure

Figure 2. *Non-verbal Pain Scale- Revised*

MATERIALS AND METHODS

A prospective, observational study registered with clinical trials registry (CTRI/2019/05/019228) was conducted in the post-anaesthesia care unit (PACU) after approval from the Institutional Ethics Committee. A total of 94 patients, aged more than 18 years, who provided written, informed consent, undergoing major abdominopelvic surgeries under general anaesthesia, unable to verbalise or indicate pain by using a conventional verbal scale upon arrival in the PACU, having a Richmond Agitation sedation Scale (RASS) score of -4 to -1 (deep, moderate and light sedation, drowsy), were recruited using non-probability convenient sampling. Pregnant patients and patients with a previous diagnosis of chronic cognitive impairment (Dementia, Alzheimer's) or neurological impairment (upper limbs amputations, paraplegia, quadriplegia or stroke) were excluded from the study due to the variability in behaviours presented as it would have disrupted the patient's motor functions and the behaviours evaluated could not have been observable with the non-verbal pain instruments (NVPS-R and CPOT).

We noted the patient's demographic and clinical data, including age, gender, admission number, primary diagnosis, comorbidities, surgery performed, duration of surgery, type of anaesthesia administered and analgesic regimen (none, Analgesia only, Sedation only, Sedation and Analgesia). Baseline parameters (heart rate, respiratory rate, saturation, systolic and diastolic blood pressure). After the participants had arrived at the post-anaesthesia care unit, RASS was applied first for every participant to measure the level of Sedation. If the participant showed a RASS between -1 to - 4, indicating a level of sedation from light to deep, then we applied both CPOT and the NVPS-R and noted the following parameters: Heart Rate, NIBP (systolic and diastolic), Respiratory rate, Oxygen saturation, Facial expression, Body movements, Compliance with ventilation/Vocalization, Muscle tension.

This assessment was done at 0,15, 30, 45, 60, 90, and 120 minutes of arrival in PACU in the immediate postoperative period (patients were assessed every 15 minutes until an hour passed, then every 30 minutes until another hour passed, for a total of seven assessments with each instrument during 2 hours) The number, type and timing of analgesia administered throughout this period (2 hours) were also recorded.

Score	Classification	(RASS)
+4	Combative	Overtly combative or violent; immediate danger to staff
+3	Very agitated	Pulls on or removes tube(s) or catheter(s) or has aggressive behavior toward staff
+2	Agitated	Frequent non-purposeful movement or patient–ventilator dyssynchrony
+1	Restless	Anxious or apprehensive but movements not aggressive or vigorous
0	Alert and calm	Spontaneously pays attention to caregiver
-1	Drowsy	Not fully alert, but has sustained (more than 10 seconds) awakening, with eye contact, to voice
-2	Light sedation	Briefly (less than 10 seconds) awakens with eye contact to voice
-3	Moderate sedation	Any movement (but no eye contact) to voice
-4	Deep sedation	No response to voice, but any movement to physical stimulation
-5	Unarousable	No response to voice or physical stimulation

Figure 3. *Richmond Agitation Sedation Scale (RASS)*

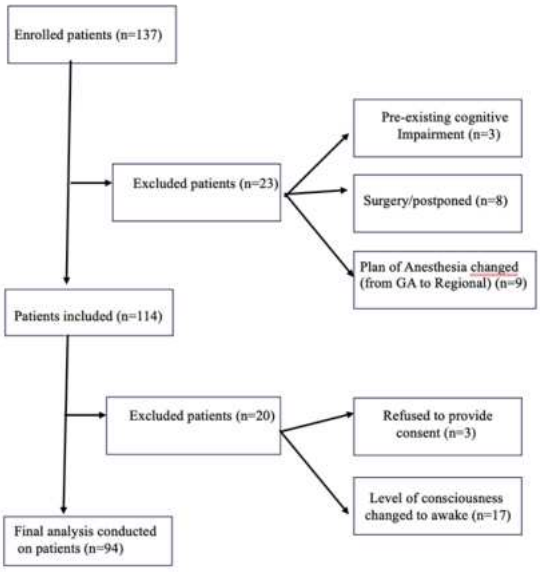

Figure 4: *Enrolment of patients for the study*

RESULTS

Demographics: The mean age of patients was 41.89 15.02 years, with a male preponderance (60.6% males). 66% of patients had mild systemic diseases/controlled comorbidities (ASA II).

Clinical parameters: The mean baseline heart rate was 94.73 19.60 beats/minute; after shifting to the PACU, it was 10-12% higher than the baseline for the first 45 minutes and decreased to nearly the same as baseline at 60 and 120 minutes. The highest variation was seen at 0 and 15 minutes, for which shifting, movements, and pain may be responsible, possibly. Mean systolic blood pressure showed a variation of 2-4% for the first 30 minutes (the highest at 30 minutes), and after 30 minutes, it was similar to the baseline measurement. There were insignificant changes in diastolic blood pressure (1-2%), oxygen saturation and respiratory rate (<1%).

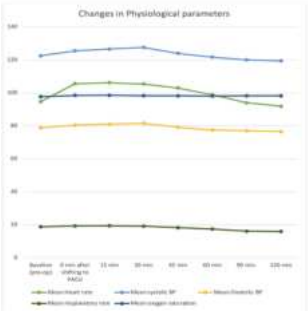

Figure 5: *Changes in the physiological parameters*

Analgesia: All patients received intravenous Fentanyl for analgesia in combination with Tramadol in 5%, Paracetamol in 97%, NSAIDs in 28%, and Buprenorphine in 2%. 71% of patients received analgesia 30 minutes before extubation in the Operating Room. Only 34% of patients received analgesia in the early postoperative period, of which 18% received analgesia 30 minutes after shifting to the PACU, and 12% received it 15 minutes after shifting to the PACU.

Table 1: Characteristics of study participants and analgesia

Variables	Total [n (%)]
Gender: • Male • Female	 57 (60.6) 37 (39.4)
Age (years)	41.89 (Range 20-75)
American Society of Anaesthesiologists Physical Status Classification System: • ASA I - Healthy patient • ASA II - Controlled comorbidity • ASA III - Uncontrolled comorbidity • ASA IV - Life-threatening disease	 14 (14.9) 62 (66) 7 (7.5) 11 (11.7)

Intraoperative analgesia:	
• Fentanyl	94 (100)
• Acetaminophen	92 (97.9)
• NSAIDs	26 (27.7)
• Tramadol	5 (5.3)
• Buprenorphine	1 (1.1)
Timing of analgesia prior to extubation:	
• 15 min	23 (24.4)
• 30 min	67 (71.3)
• 45 min	1 (1.1)
• 60 min	3 (3.2)
Postoperative analgesia:	
• Tramadol	27 (28.7)
• Diclofenac	4 (4.3)
• Fentanyl	1 (1.1)
Timing of analgesia after arrival to PACU:	
• Immediate	1 (1.1)
• 15 min	11 (11.7)
• 30 min	18 (18.1)
• 45 min	1 (1.1)
• 60 min	1 (1.1)

RASS score: Most patients were moderately sedated immediately after shifting to the PACU (63.8%). At 15 minutes, 52% were moderately sedated, and nearly 15% were deeply sedated. The level of consciousness changed from deep sedation to light sedation after 30 to 45 minutes of shifting to PACU for the majority of patients. At 90 and 120 minutes, most patients were drowsy or arousable.

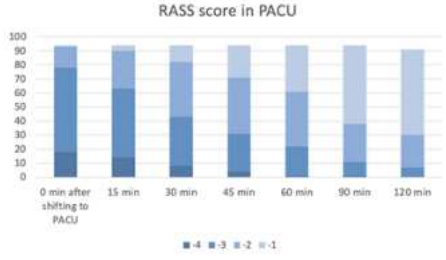

Figure 6: *Timewise distribution of patients on RASS scale*

Pain Scores: Most patients had significant pain at 0,15,30,45 minutes after shifting to the PACU, with the mean CPOT score highest at 30 minutes (3.94 1.16), representing that more than 80% of patients had significant pain immediately after shifting to the PACU and continued to have pain till 45 minutes peaking at 30 minutes (91% patients). Values started to decline from 45 to 120 minutes, so values were lowest at 90 and 120 minutes (mean scores 1.85 0.98 and 1.63 0.96 at 90 and 120 minutes, respectively). NVPS-R scores had a similar trend, i.e. scores were high for the first 45 minutes (highest at 30 minutes - mean score 4.32 1.17), and after that, the trend was downhill till 120 minutes, indicating that only 18% of patients experienced significant pain at 90 and 120 minutes.

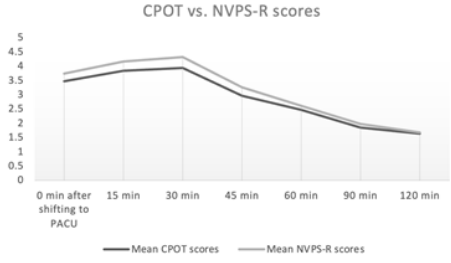

Figure 7: *Trend of score on CPOT & NVPS-R Scales*

Mean NVPS-R scores were higher at all measurement time points when compared to CPOT scores. Both the scores exhibited a similar trend. Both scores showed a strong correlation at all time points with a correlation coefficient of 0.7-0.8, which implies that they can be used for pain measurement and are good predictors of pain. The difference between both scales was statistically significant ($p<0.001$) at 0, 15, 30, and 45 minutes after shifting to the PACU. To evaluate the difference between both scales (vocalisation parameter of CPOT versus physiological parameters of NVPS-R), patients with significant pain were included for further analysis. It was found that vocalisation was more frequently noted in patients with high scores indicating significant pain (75-98%). In contrast, physiological changes of NVPS-R varied at different time points, disagreeing with the scores.

DISCUSSION

Unmitigated pain can contribute to the development of several multisystem effects such as an increase in physiological parameters, atelectasis, blood clots, pneumonia, vasoconstriction, decreased tissue-oxygen partial pressure, hyper-metabolism resulting in hyperglycaemia, delayed wound healing and wound infection. These multisystem effects adversely affect postoperative outcomes [15-19]. Therefore, a valid, reliable, and feasible pain assessment tool is essential for assessing and managing pain. Currently, the gold standard instrument for pain assessment is the Numeric Rating Scale (NRS) among the patients who can report their pain [20]. However, in the early postoperative period, the residual effects of general anaesthesia and sedative medications might interfere with cognitive functions, making it onerous for patients to verbally self-report their pain [9]. The communication barrier between such patients and clinicians can be bridged by using behavioural instruments to assess pain at regularly established intervals, leading to better pain management.

Of the various behavioural pain scales developed for use in critically ill, non-verbal, sedated patients, we studied CPOT and NVPS-R in the early postoperative period (for initial 2 hours after shifting to the post-anaesthesia care unit) to assess pain in post-surgical sedated patients so that either of them can be applied for adequate assessment and pain relief. The two scales vary based on physiological parameters in NVPS-R and vocalisation indicator in CPOT. In our study, both pain scales showed a similar trend of increasing for the first 30 minutes, reaching a peak at 30 minutes and declining to a minimum at 120 minutes in the immediate postoperative period. NVPS-R showed a slightly higher score than CPOT at all measurement time points, which can be attributed to the physiological parameters that are a component of NVPS-R. Though the heart rate was significantly higher than the baseline at 0 and 15 minutes, the total scores were high at 30 minutes, suggesting the patient had displayed some behaviours that were a part of both pain scales. Similarly, respiratory rate, saturation, and systolic and diastolic blood pressures were consistently higher than baseline for the first 30 minutes, but the scores peaked at 30 minutes. This can also be due to the weaning-off effect of intra-operative analgesia and change in the level of consciousness (from deep/moderate sedation to light Sedation). Thus, physiological indicators cannot be relied upon solely for assessing pain, warranting an assessment of behaviours. **Asgar H** observed hemodynamic parameters in postoperative surgical patients with acute pain but found no significant association [21]. CPOT, using the vocalisation parameter, is a better indicator of acute pain than the physiological parameters of the NVPS-R in sedated patients in the early postoperative period. Both the scales exhibited strong correlation at all time points, suggesting that either can be used for pain assessment in non-verbal patients. **Chanques G et al.** compared three pain scales, namely Behavioural Pain Scale (BPS), Critical Care Pain Observation Tool (CPOT) and Non-verbal Pain Scale (NVPS), and concluded that BPS, CPOT and NVPS demonstrated good inter-rater reliability in both intubated and non-intubated ICU patients unable to self-report their pain intensity. However, BPS and CPOT had significantly higher inter-rater reliability, internal consistency and responsiveness than NVPS [22]. Similarly, **Stites M et al.** studied Critical Care Pain Observation Tool(CPOT), Behavioural Pain Scale (BPS), Non-Verbal Pain Scale (NVPS), PAIN algorithm, and Non-Verbal Pain Assessment Tool (NPAT) in critically ill patients. They concluded that a regular pain assessment with any observational pain scale can decrease the length of stay and duration of ventilation in the ICU and increase patient satisfaction. In agreement with our study, CPOT has shown superior reliability and validity in critically ill non-verbal patients [8]. **Topolovec-Vranic J. et al.** compared the validity and clinical utility of the revised Non-Verbal Pain Scale (NVPS-R) and the Critical Care Pain Observation Tool (CPOT) in trauma and neurosurgical patient population and their findings corroborated with our study [23].

Out of 94 patients studied, only 32 patients received analgesia in the postoperative period based on sighing/moaning/crying. Scores showed significant pain on both scales in >90% of patients, but only 34% of patients received analgesia, which implies an additional 46% of patients would have benefitted had their pain been evaluated and managed using a behavioural pain scale. Patients who received pain medication showed decreased pain scores after analgesia administration, suggesting that these pain scales were reliable

indicators of pain and that patients could benefit from their use. **Kapoustina et al.** examined the validity of behaviours and fluctuations in vital parameters for pain assessment in the neurosurgical ICU. They suggested that behaviours were valid indicators of pain and that valid observational pain scales must be used in nonverbal patients for pain evaluation [24].

There were a few limitations to this study. Patients with cognitive and neurological impairments were not included in this study, although an inability to exhibit behaviours that were a part of these scales does not negate the presence of pain in such a population. Secondly, all patients selected in this study had undergone abdominopelvic surgeries, which limits the generalisation of the results to other populations with different characteristics and undergoing other major surgeries.

CONCLUSION

A pivotal clinical approach towards effective pain management is an optimal and early pain evaluation that will relieve acute pain and aid the patient in achieving the desired level of comfort to function adequately, which translates to early discharge, fewer costs for the patient and the institution, and a decrease in complications, morbidity and mortality. Using valid and reliable pain assessment scales while patients are still under sedation in the PACU via the development of institutional protocols will help to accomplish this goal. Either CPOT or NVPS-R can be used to assess pain in sedated patients in the early post-op period. However, CPOT may slightly be a better pain scale with vocalisation as an indicator, whereas physiological indicators of NVPS-R are inconsistent in the early postoperative period and can be influenced by other factors besides pain. Therefore, these vital sign indicators included in the NVPS-R need further research and validation to ensure optimal pain assessment, as our findings do not support their exclusive use in postoperative patients.

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Conflicts of Interest: There are no conflicts of interest.

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