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Comparison of Pain Assessment Using The Numeric Rating Scale And Qnox Index in Postoperative Patients Undergoing General Anesthesia at The Main Teaching Hospital in North Sumatera

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A B S T R A C T

Introduction: Postoperative pain affects many patients undergoing surgery, and while the Numeric Rating Scale (NRS) is commonly used for pain assessment, it lacks objectivity. The qNOX index, an alternative based on EEG signals, may offer a more objective measure. This study aims to compare the effectiveness of the qNOX index and NRS in assessing postoperative pain in patients with general anesthesia.

Methods: A cross-sectional analysis was conducted in the recovery room of patients undergoing general anesthesia. Pain was assessed at 15 and 60 minutes post-surgery using both NRS and the qNOX index. A sample size of 38 patients was determined using G*Power. Data were analyzed with paired t-tests and the Wilcoxon test, with significance defined as $p < 0.05$.

Results: The mean age of the sample was 43.03 ± 13.56 years, with 68.4% experiencing moderate pain. Both NRS and qNOX scores were lower at 60 minutes compared to 15 minutes (NRS: 6.26 ± 1.54 vs. 4.79 ± 1.58, $p < 0.001$; qNOX: 87.08 ± 8.67 vs. 82.29 ± 11.23, $p < 0.001$). NRS showed greater sensitivity to changes in pain over time compared to qNOX (r -0.68 vs. -0.77).

Conclusion: NRS proved more effective than the qNOX index in assessing postoperative pain.

INTRODUCTION

Pain is an unpleasant sensory and emotional experience that can occur due to tissue damage or the potential for tissue damage. Pain often serves as a clinical manifestation of a pathological process and can trigger bodily responses that disrupt comfort, cause distress, or suffering.[1] Postoperative pain, classified as acute pain, is experienced by the majority of patients following surgery, with a global prevalence of around 80%. This pain can significantly impact a patient's quality of life, hinder recovery, and potentially evolve into chronic pain if not properly managed.[2]

In Indonesia, studies indicate that many postoperative patients experience moderate to severe pain, with approximately 30–50% of these individuals suffering from persistent postoperative pain (PPP), primarily due to inadequate analgesic management.[3] Accurate pain assessment is crucial for determining pain intensity and selecting effective treatment. Common methods for pain assessment include the Numeric Rating Scale (NRS) and the qNOX index.[4]

While NRS is frequently used to measure pain, some studies suggest that it does not always accurately reflect pain intensity due to differing interpretations between healthcare providers and patients.[4] On the other hand, the qNOX index, measured using the CONOX device based on EEG signals and advanced digital algorithms, is emerging as an alternative method for assessing postoperative pain.[5] However, research comparing the effectiveness of NRS and the qNOX index remains limited. Therefore, this study aims to compare the effectiveness of pain assessment using the NRS and qNOX index in postoperative patients with general anesthesia at Haji Adam Malik Hospital, Medan.

METHODS

This study employed a cross-sectional observational design, where data were collected once from each sample at a specific point in time. The analysis was conducted on a homogeneous group of patients who met the inclusion criteria. Pain intensity was assessed using both the qNOX index and Numeric Rating Scale (NRS). Assessments were made 15 and 60 minutes after patients entered the recovery room, while they were fully conscious. The objective of this study was to compare the pain scores obtained using the qNOX index and NRS in postoperative patients at Haji Adam Malik General Hospital.

The study was conducted in the recovery room at Haji Adam Malik General Hospital, Medan, following the approval of the ethical clearance and research permit from the hospital's ethics committee. The research was carried out between April and May 2024. The study population consisted of patients

scheduled for elective surgery under general anesthesia at RSUP HAM. The sample size was calculated using the G*Power application, with 36 samples for the dependent T-test (for normally distributed data) and 38 samples for the Wilcoxon test (for non-normally distributed data). The final sample size chosen was 38 patients, as it provided the higher number. The inclusion criteria were patients aged 18–60 years, with stable hemodynamics and ASA I-III status, undergoing elective surgery with general anesthesia. Exclusion criteria included patients with unstable hemodynamics, allergies to anesthesia drugs, chronic pain history, or other conditions that could impair communication. Data were analyzed using SPSS software, with hypothesis testing performed using paired T-tests and Wilcoxon tests. A p-value < 0.05 was considered statistically significant.

RESULTS

This study analyzed data from 38 postoperative patients who met the inclusion criteria. The mean age of participants was 43.03 ± 13.56 years, with the majority being female (57.9%). The mean weight was 62.42 ± 11.68 kg, and the mean height was 160.24 ± 6.03 cm. Most patients had an ASA score of 3 (median: 3, range: 2–3), indicating mild to moderate systemic disease. The surgeries were primarily gastrointestinal (42.1%), followed by orthopedic (21.1%), gynecological (10.5%), oncology (10.5%), urology (7.9%), cardiothoracic (5.3%), and ENT (2.6%). The majority of surgeries lasted between 120 and 150 minutes (84.2%) (Table 1).

Table 1. Characteristics of demographic data

Variable	n (%)
Age (Mean ± SD)* (years)	43.03 ± 13.56
Gender	
Male	16 (42.1)
Female	22 (57.9)
Height (cm) (Mean ± SD)	160.24 ± 6.03
Weight (kg) (Mean ± SD)	62.42 ± 11.68
ASA Score (Median (min – max))	3 (2-3)
Duration of Surgery	
< 120 minutes	6 (15.7)
120-150 minutes	32 (84.2)
Type of Surgery	
Gastrointestinal	16 (42.1)
Urology	3 (7.9)
Orthopaedic	8 (21.1)
Gynaecology	4 (10.5)
ENT (Ear, Nose, and Throat)	1 (2.6)
Oncology	4 (10.5)
Thoracic and Cardiovascular	2 (5.3)

Postoperative hemodynamic parameters showed significant improvements over time. The median heart rate decreased from 88.5 beats per minute (range: 65–98) at 15 minutes to 77.45 ± 8.67 beats per minute at 60 minutes. Systolic and diastolic blood pressures also declined slightly, reflecting stabilization. Oxygen saturation remained consistently high at 99% throughout the observation period, indicating adequate oxygenation (Table 2).

Table 2. Haemodynamic Parameters

Variable	n (%)
Heart Rate	
15 minutes (Median (min – max))	88.5 (65 – 98)
60 minutes (Mean ± SD)	77.45 ± 8.67
Respiratory Rate	
15 minutes (Median (min – max))	18 (16–22)
60 minutes (Median (min – max))	18 (15–21)
SpO2 (%)	
15 minutes (Median (min – max))	99 (95–100)
60 minutes (Median (min – max))	99 (96–100)
Systolic Blood Pressure (mmHg)	
15 minutes (Mean ± SD)	122.21 ± 12.18
60 minutes (Mean ± SD)	118.65 ± 11.96
Diastolic Blood Pressure (mmHg)	
15 minutes (Mean ± SD)	78.11 ± 5.55
60 minutes (Median (min – max))	76 (52 – 89)

Pain levels were evaluated using the Numeric Rating Scale (NRS) and the qNOX index at 15 and 60 minutes postoperatively. At 15 minutes, the median NRS score was 7 (range: 0–8), decreasing to 5 (range: 0–9) at 60 minutes. Similarly, the qNOX index declined from a median of 89 (range: 66–99) to 82 (range: 50–99) (Table 3).

Statistical analysis revealed significant reductions in both NRS and qNOX scores over time (NRS: 6.26 ± 1.54 vs. 4.79 ± 1.58, $p < 0.001$; qNOX: 87.08 ± 8.67 vs. 82.29 ± 11.23, $p < 0.001$). Effect size

calculations indicated that NRS was more sensitive to pain changes over time compared to the qNOX index (-0.77 vs. -0.68) (Table 4).

Table 3. Pain Assessment using the qNOX Score and NRS Score

Variable	n = 38
qNOX Score	
15 minutes (Median (min – max))	89 (66 – 99)
60 minutes (Median (min – max))	82 (50 – 99)
qCON Score	
15 minutes (Mean ± SD)	89.37 ± 6.06
60 minutes (Median (min – max))	76 (52 – 89)
Numeric Rating Scale Score	
15 minutes (Median (min – max))	7 (0 – 8)
60 minutes (Median (min – max))	5 (0 – 9)
Postoperative Pain	n (%)
Mild pain	3 (7.9%)
Moderate pain	26 (68.4%)
Severe pain	9 (23.7%)

The majority of patients experienced moderate pain (68.4%), while 23.7% reported severe pain and 7.9% reported mild pain. Pain intensity decreased significantly over time, as reflected by both assessment tools. NRS was more effective in capturing subjective changes in pain levels, likely due to its reliance on patient-reported outcomes. In contrast, the qNOX index provided a physiological measure of pain, which was less sensitive to subtle changes but useful for objective assessment.

Table 4. Comparison of Pain Assessment Over Time Using the Numeric Rating Scale and qNOX Index

Variable	Time (*mean* ± SD)		Z*	*p-value*	*Effect Size*[a]
	15 Minute	60 Minute			
qNox	87,08 ± 8,67	82,29 ± 11,23	-4,203[b]	< 0,001	-0,68
NRS	6,26 ± 1,54	4,79 ± 1,58	-4,713[b]	< 0,001	-0,77

*Wilcoxon Test

DISCUSSION

This study aims to evaluate the effectiveness of the Numerical Rating Scale (NRS) and the qNOX index in assessing postoperative pain in patients undergoing surgery with general anesthesia. Based on the research findings, the majority of the participants were female (57.9%) with an average age of 43.03 ± 13.56 years, reflecting that the productive age group (35-50 years) is often the demographic undergoing invasive medical procedures. Despite having relatively better physiological function, this age group is frequently influenced by lifestyle factors such as stress, smoking habits, and alcohol consumption, which can increase the risk of chronic diseases and necessitate further medical interventions.

The results show that most patients (42.1%) underwent gastrointestinal surgery with a duration of 120-150 minutes, and nearly 70% reported experiencing moderate postoperative pain. This is consistent with findings from other studies, which indicate that postoperative pain is a common issue that impacts patients' quality of life. Some studies, such as those conducted by Suarjaya and Chan, suggest that longer surgery durations are associated with an increased incidence of postoperative pain. This highlights the importance of better monitoring and management of pain, particularly in patients undergoing major or lengthy surgical procedures.[6,7]

Postoperative analgesia, consisting of ketorolac and paracetamol, resulted in a reduction in both NRS pain scores and the qNOX index at 60 minutes compared to 15 minutes, with a more noticeable decrease in NRS scores. The NRS scale, which measures pain intensity subjectively, was found to be more effective in reflecting patients' pain perception, while the qNOX index, which focuses on changes in EEG signals in response to pain stimuli, is influenced by the patient's level of consciousness and depth of anesthesia. This suggests that while the qNOX provides objective data, its effectiveness in assessing postoperative pain is limited due to the influence of other factors, such as anesthetic depth and medication use.[8]

Acute postoperative pain is a complex physiological response that serves as a biological protection mechanism but can lead to complications if not well-managed. The reduction in NRS and qNOX scores after the administration of postoperative analgesics indicates that the combination of ketorolac and paracetamol is effective in alleviating pain in a short period. However, even though analgesic administration can decrease pain intensity, poorly controlled pain can develop into chronic pain, potentially affecting the recovery process and patients' quality of life.[9]

This study demonstrates that NRS is more effective than qNOX in assessing postoperative pain. This may be attributed to the simplicity and direct nature of the NRS in representing the level of pain experienced by the patient, whereas qNOX provides more data on the neurological response to pain stimuli, which is influenced by the patient’s level of consciousness.[10] The use of NRS for postoperative pain monitoring is more flexible and can be easily applied in various clinical settings, including recovery rooms and intensive care units (ICUs).[11]

Several previous studies have also shown the superiority of NRS in detecting postoperative pain, with relatively high sensitivity and specificity. Nonetheless, the use of qNOX may still be useful in monitoring anesthetic depth and pain responses during procedures, although it should be noted that this device is highly influenced by factors such as anesthetic depth and electromyographic (EMG) activity in patients receiving neuromuscular blocking agents.[12]

The complementary strengths of NRS and qNOX suggest that integrating both tools could enhance the accuracy and comprehensiveness of pain assessment. For instance, combining the subjective insights from NRS with the objective data from qNOX could mitigate the weaknesses of each tool and provide a balanced view of patient pain levels. This dual approach could be particularly beneficial in cases where patients are unable to self-report accurately due to cognitive or language barriers.[13]

The study also has several limitations, including a relatively small sample size (38 patients) and data collection from only a single healthcare center. Variations in other perioperative characteristics, such as the type of surgery and its duration, could affect the results of this study. The use of standardized preventive and preemptive analgesia may reduce bias, but other factors, such as anesthesia type and surgical techniques, may also play a role in postoperative pain perception.

Overall, while the qNOX index can provide an objective overview of the pain response based on EEG signal changes, NRS remains a more effective and reliable method for assessing postoperative pain. These findings emphasize the importance of a multidimensional approach in pain management, considering both subjective patient assessments and the objective data provided by monitoring devices like qNOX. Further research with a larger sample size and the determination of cut-off values for NRS and qNOX is expected to provide deeper insights into the effectiveness of both tools in clinical practice.

CONCLUSION

This study compares the NRS and qNOX index for postoperative pain assessment. NRS is sensitive but subjective, while qNOX provides objective data but less sensitivity. Combining both may improve pain management. Persistent moderate-to-severe pain highlights the need for better analgesic protocols and personalized care. Future research should validate these findings and explore long-term outcomes.

CONFLICT OF INTEREST

The authors have no conflicts of interest regarding this investigation.

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AUTHOR'S CONTRIBUTIONS

FM: Concept and design of study, acquisition of data, data analysis, interpretation of data, drafting the manuscript, final approval.

APL: acquisition of data, data analysis, drafting the manuscript, revised the manuscript, final approval.

QFT: Drafting the manuscript, final approval.

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