

Development and Validation of a Thai Version of the Critical-Care Pain Observation Tool-Neuro (Th-CPOT-Neuro) in Thai Neurosurgical Patients Unable to Self-Report

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Received 6 October 2025 • Revised 22 January 2026 • Accepted 23 February 2026 • Published online 28 October 2026

Abstract:

Objective: This study aimed to translate the English version of the Critical Care Pain Observation Tool-Neuro (CPOT-Neuro) to a simplified Thai version (Th-CPOT-Neuro) and to validate and investigate the reliability of the Thai version.

Material and Methods: The primary English version of the CPOT-Neuro proposed by Gélinas was used for reference. The Th-CPOT-Neuro was developed using forward translation and back translation methods proposed by the World Health Organization. Content validity of the Th-CPOT-Neuro was established using the content validity index (CVI) as appraised by three specialists. Discriminative validation of the Th-CPOT-Neuro was evaluated during painful and non-painful routine procedures. The Kappa coefficient was used to test the inter-rater reliability of the Th-CPOT-Neuro.

Results: The scale-level CVI (S-CVI) of the Thai version of the CPOT-Neuro was 0.82, which is above the lower limit of acceptability for the S-CVI (0.80). Inter-rater reliability of the Th-CPOT-Neuro scores was supported with intraclass correlation coefficients >0.86. Discriminative validation of the Th-CPOT-Neuro was supported with higher scores during painful procedures compared to baseline at rest, both before and at the peak opioid analgesic effect (p-value<0.01).

Conclusion: The Th-CPOT-Neuro has good psychometric properties to assess pain in Thai neurosurgical patients unable to self-report. Implementation of the Th-CPOT-Neuro to assess pain in the local Thai context is therefore recommended.

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J Health Sci Med Res
doi: 10.31584/jhsmr.20261483
www.jhsmr.org

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Keywords: CPOT-Neuro, development, Neurosurgical patients, Thai, validation

Introduction

Pain in neurological patients is highly prevalent and often underdiagnosed, particularly in patients who cannot communicate their pain¹. Due to an altered level of consciousness and severity of the condition, neurosurgical patients who are unable to precisely self-report their pain are vulnerable to inadequate pain assessment. Pain assessment scales that represent specific pain behaviors in this group are therefore required to accurately detect pain²⁻⁴. The French-Canadian and English revised versions of the Critical-Care Pain Observation Tool-Neuro (CPOT-Neuro) were recently developed from the original Critical-Care Pain Observation Tool (CPOT) to assess pain presence in patients who are critically ill from a brain injury⁵. Psychometrics testing revealed the validity and reliability of the CPOT-Neuro to assess pain among brain-injured patients in the intensive care unit (ICU) at various levels of consciousness.

The original English tool is composed of pain-related behaviors in patients who are critically ill from a brain injury, including facial expression, autonomic responses, body movements, compliance with the ventilator for intubated patients or vocalization for non-intubated patients, and muscle tension. All items are similar to the original CPOT, except autonomic responses, which were newly added into the CPOT-Neuro^{2,4}.

The predictive behaviors of self-reported pain intensity observed during standard care procedures among this group of patients are brow lowering, facial expressions, and tearing⁶. The CPOT-Neuro also has the ability to discriminate between non-nociceptive and painful procedures that include before and after opioid administration. Nociceptive or painful procedures refer to treatments, diagnostic, therapeutic, and routine care, including other invasive and noninvasive procedures (e.g.,

turning, endotracheal tube suctioning, dressing change) associated with pain or increased pain intensity². Whilst non-nociceptive procedures refer to procedures or care-related procedures that are not likely or less likely to induce or increase pain (e.g., non-invasive blood pressure with cuff inflation, eye care, temperature measurement)².

The validation and feasibility of the CPOT-Neuro also appeared superior to the CPOT in the assessment of pain in patients who are critically ill from a brain injury²⁻⁴. Implementation of the CPOT-Neuro into daily practice to optimize pain assessment in patients who are critically ill from a brain injury is strongly recommended⁴. However, the CPOT is still widely used to assess pain in neurosurgical patients in Thailand^{7,8}. To our knowledge, the CPOT-Neuro has not been used by healthcare professionals to assess pain in Thai neurosurgical patients.

The CPOT-Neuro was primarily developed in French-Canadian and English versions in the Western care context². Implementation of the CPOT-Neuro into a specific cultural or linguistic Thai setting requires appropriate translation to maintain conceptually equivalent, equally natural, practical performance, and acceptability by the target users⁹. A study to translate the CPOT-Neuro into a Thai version was conducted using the forward translation method¹⁰. The method used to translate the Thai CPOT-Neuro in this previous study was only the initial step of the systematic translation and cross-cultural adaptation procedure⁹. This poses a certain question regarding the cross-cultural and conceptual equivalence of the target language versions of the instrument as accepted by native users. Adaptation of the CPOT-Neuro from the original English version requires a rigorous translation process as well as the use of natural and acceptable language for the broader nursing staff in a Thai hospital context. This study aimed to develop a Thai version of the CPOT-Neuro

using a well-established translation method and assess its psychometric properties for healthcare provider convenience and better comprehension, as well as to improve the quality of care through pain assessment.

Material and Methods

Design and translation process

The primary English version of the CPOT-Neuro proposed by Gélinas² was used for reference. The process of translation, cross-cultural adaptation, and validation of instruments according to the WHO Guidance⁹ – Translation of Survey Instruments was employed to systematically develop the Th-CPOT-Neuro. The process included four stages: 1) forward translation, 2) expert panel, 3) back translation, 4) pre-testing and cognitive interviewing, and 5) release of the final version.

1) Forward translation

The English version of the CPOT-Neuro was independently translated by a native Thai nurse educator who was also knowledgeable of the English-speaking culture and familiar with the terminology used in the tool. All items in the primary English version were included in the Thai translation, with a written report provided. The translation focused on the conceptual equivalent of a word or phrase and not a word-for-word or verbatim translation. Table 1 includes the original English version of the CPOT-Neuro for forward translation.

2) Expert panel

A bilingual English and Thai expert panel was established that consisted of the first translator in the forward translation stage, a pain medicine specialist (pain management doctor), an expert with experience in instrument development and translation, and pain researchers. The researchers held the meeting for the panel of experts. The expert panel compared the existing Th-CPOT-Neuro derived from the forward translation with the previous versions of Th-CPOT-Neuro from the study entitled “Pain Assessment of Patients with Traumatic

Brain Injury in the Intensive Care Unit”¹⁰. The expert panel identified, discussed, and resolved the discrepancies, including inadequate expressions/concepts of the translation between the forward translation version and the previous version. The expert panel also questioned some words or expressions of the forward translation version and suggested alternatives to achieve semantic, idiomatic, cultural, and conceptual equivalence. The panel of experts identified problematic content, suggested alternatives, and found solutions regarding inadequate expressions or concepts of the translation. A written report provided the documentation of this process. A synthesized translated version of the CPOT-Neuro was produced after a reconciliation meeting between the expert panel and the researchers.

3) Back translation

The key terms and concepts of the Th-CPOT-Neuro were selected for translation back into English by an independent native English speaker/translator who had no knowledge of the CPOT-Neuro and was blinded to the tool. As in the forward translation, conceptual and cultural equivalence, not linguistic equivalence, were emphasized. Discrepancies as well as problematic words or phrases were discussed by the first translator, the expert panel, and the researchers until a satisfactory version or a pre-final version was achieved.

4) Pre-testing and cognitive interviewing

The pre-final version of the Th-CPOT-Neuro tool was pre-tested on the target population. Pre-test respondents included trained registered nurses and neurosurgical patients unable to self-report. The translated tool was systematically debriefed to the nurse respondents. The researchers conducted cognitive interviews using a verbal probing method for clarity of content and structure, and included an assessment of the respondents’ experience of the content. The nurse respondents were asked to check for flaws or unacceptable/offensive words or phrases in the translated tool and offer their recommendations for modifications of the words or phrases. The nurse

respondents were also asked to choose alternatives that were clearer, had a better fit, or were more specific to their everyday language. A summary of the problems found during the pre-testing of the instrument, as well as the modifications proposed, was documented.

5) Final version

The final version of the Th-CPOT-Neuro was eventually completed and released as the last step of the translation process. The reliability and the validity of the final version of the Th-CPOT-Neuro were tested and analyzed.

Psychometric properties evaluation

Content validity

The content validity of the translated version of the Th-CPOT-Neuro was evaluated using the content validity index (CVI) by a panel of three specialists: a neurosurgeon, a pain medicine specialist, and a nurse educator. The researchers provide the tables for evaluating whether the content measured was in accordance with the attributes or aspects to be measured. The Th-CPOT-Neuro was considered content valid when the items relevantly measured the construct. Content validation should receive some constructive feedback for developing measurement tools. Validation of the content emphasized the efficacy of the content and the degree of its proportion with the sensitivity, specifications, and conditions of neurosurgical patients. The researchers also asked for constructive feedback from the specialists regarding the objective criteria of the items and the quality of the translated tool.

Discriminant validity

The discriminant validity of the Th-CPOT-Neuro was measured to determine the ability of the tool to discriminate between different levels of pain intensity across several procedures and time points. The procedures and time points included at rest, before, and during nociceptive procedures (turning, endotracheal suctioning, trapezius squeeze test), and before and at the peak effect of opioid analgesics.

The measurements were completed by trained registered nurses. Each assessment was independently observed for at least one minute by two trained registered nurses at the patient's bedside using the Th-CPOT-Neuro. Observation times were selected based on procedures rather than individual patients. Therefore, one patient could be observed repeatedly across different procedures and time periods, provided that each observation corresponded to a distinct procedure and assessment time.

Reliability testing

Interrater reliability testing, or agreement between two raters, was employed to ensure the consistency of the Th-CPOT-Neuro scores by different observers. The raters included ten registered nurses who attended training sessions and practiced the scoring on the use of the Th-CPOT-Neuro. A pair of raters simultaneously collected data on the same observation at the same moment using the same tool. Two nurses (in pairs) independently scored the Th-CPOT-Neuro for each predetermined procedure. The consistency and the degree of agreement between two nurse raters' Th-CPOT-Neuro scores were measured using an intraclass correlation coefficient (ICC) or Kappa coefficient to determine interrater reliability. The nurse respondents were also interviewed concerning the clarity, understandability, appropriateness, and suitability of the terminology and language used in the Th-CPOT-neuro, including their recommendations for a particular phrase or term.

Participants

A non-probability purposive sampling method with well-defined criteria was employed to recruit registered nurses and neurosurgical patients. Neurosurgical patients over 18 years of age and unable to communicate their pain, admitted to the Neuro Trauma ICU (NT-ICU), Surgical Respiratory Care Unit (SRCU), trauma ward, and neurosurgical ward of a university hospital in Thailand

during the data collection period were included in the study.

Ten registered nurses who: a) worked as a team member and participated in the pain management continuous quality improvement (CQI) project for neurosurgical patients (implemented across a two-year period), b) provided direct care for neurosurgical patients for at least one year, c) used the CPOT with neurosurgical patients, and d) attended an annual CPOT training workshop were enrolled in the study.

A 180-min Th-CPOT-Neuro training session was conducted for the nurse participants by 2 nursing researchers, according to the approaches proposed by the original tool developer².

Laminated and color versions of the Th-CPOT-Neuro and its instruction materials were provided for the nurse participants. An interactive description of the instructions, scale, focusing on newly added items, and a demonstration on how to use the Th-CPOT-Neuro were delivered to the nurse participants. Adherence to the instructions on the use of the CPOT-Neuro, as suggested by the original developers, was clearly explained and emphasized to the nurse participants as follows: (1) observe the patient at rest for one minute to determine a baseline value for the scale, (2) observe and detect the patient's reaction to pain during standard procedures that cause pain (e.g., turning, endotracheal suctioning, wound care), (3) assess treatment efficacy by evaluating the patient before and at the peak effect of an analgesic, (4) record the highest score observed for each item for a total score in a range from 0 to 8, and (5) lastly, evaluate muscle tension by performing passive flexion and extension of the patient's arm to feel any resistance to movement².

Then, a practical exercise consisting of a set of 10 short case scenarios was used for the nurses to score the pain of each case using the tool. The researchers conducted individual feedback and discussion of the scores with each participant, followed by a group discussion and reflection.

Five patient video clips were sequentially used to practice scoring with the Th-CPOT-Neuro and to ensure

the capability of the nurse participants at the end of the training session. Moving to the following patient video clip was allowed if the total score difference did not exceed one point. The Th-CPOT-Neuro capability was approved if they achieved zero points out of a total score difference for every single patient.

Sample size estimation

Ten registered nurses were included in the process of testing the tool, according to the suggestions in the WHO Translation of Survey Instruments guideline⁹. The required sample size for the discrimination validation testing of the tool was calculated using G*Power 3.1.9.7 for Windows. A previous study entitled "Validation of the CPOT-Neuro in brain-injured adults in the intensive care unit: A prospective cohort study²" was used to determine the power at 0.80, with an effect size of 0.70; the error level (alpha) was 0.05. The sample size determination was 19. The G*Power 3.1.9.7 for Windows of the same study² was also used to determine the sample size for testing inter-rater reliability using the same power, effect size, and error level. Nine sample sizes were determined. The estimated sample size was increased by 10% to prevent missing data. The target sample sizes for the inter-rater reliability and discrimination validation testing were 10 and 21, respectively.

Study settings

This study was conducted in the Neuro Trauma ICU (NT-ICU), Surgical Respiratory Care Unit, Trauma Ward, and Neurosurgical Ward of a university hospital in Thailand. The validity and reliability testing of the Thai version of the CPOT-Neuro was carried out from September 18 to December 8, 2024.

Ethical considerations

This research required committee review and approval since it involved human subjects. Permission and ethical approval were obtained from the Human Research

Ethics Unit (HREU), Faculty of Medicine. Permission to translate the English version of the CPOT-Neuro was granted by the tool developers. Ethical principles in conducting the research were employed at every step of the study, especially during data collection, analysis, and interpretation. Validity and reliability testing of the new tool were conducted after getting permission from the HREU and each study unit. The staff of each study unit was well informed by the researchers. An in-depth interview with each registered nurse was conducted after obtaining written informed consent from the individual participants. Data of all participants were kept confidential in a locked cabinet that only the researchers could access. All data will be destroyed after the publication of the study, using the standard university policy as agreed by the HREU.

Thai version of the CPOT-Neuro

Like the original English version, the Th-CPOT-Neuro consists of five domains related to pain behaviors: (1) facial expression, (2) autonomic responses (tearing, or facial flushing, or both), (3) body movements, (4) compliance with ventilator for intubated patients or vocalization for non-intubated patients, and (5) muscle tension. Similarly, each item is scored from 0 to 2 for a possible total score of 0 to 8 (Appendix 1). Facial expression, autonomic responses, and muscle tension are rated from 0 (absent) to 1 (present). While body movements and ventilator compliance/vocalization are rated from 0 to 2. According to Gélinas and others², a score of 0 is given when the patient's face exhibits no muscle tension. However, a score of 1 is given when the eyebrows are lowered, and a score of 2 is given when contraction of the upper face or grimacing is observed. A score of 1 is given in the presence of one or the other autonomic responses of tearing or face flushing, while 0 is given when both responses are absent. A score of 0 is given when a patient is immobile, while a score of 1 is given for non-purposeful movements or not directed towards the pain site. A score of 2 is given when

the patient exhibits purposeful movements to the pain site or attempts to touch tubes. In mechanically ventilated patients, a score of 0 is given for easy ventilation or no alarm activation. However, a score of 1 is given when the patient triggers an alarm, but the alarm spontaneously stops, and a score of 2 is given when the patient fights the ventilator with management required. Importantly, the endotracheal position should be checked, and secretions should be cleared prior to recording the score. In non-intubated patients, a score of 0 is given in the absence of sound or a normal talking tone. However, a score of 1 is given when sighing or moaning is audible, and a score of 2 is given when the patient verbally complains of pain. A score of 0 is given when no resistance is felt during the passive movements or when the patient is turned in bed. A score of 1 is given when there is resistance during movements or turning, or the patient is tense or rigid. A higher total score indicates more intense behavioral reactions. A cut-off score of >2 indicates the presence of pain^{2,11}. Natural and acceptable language, according to each item as used in the target context, as suggested by the registered nurse representatives, was incorporated in this Thai version to be more suitable for the bedside users (Appendix 2).

Data analysis

The R programming language was used to analyze the data of this study. Descriptive statistics were used to analyze and describe the socio-demographic and medical characteristics and clinical data of the brain-injured patients. The ICC was used to assess the inter-rater reliability of two different raters to measure subject similarity or measurement error of the Th-CPOT-Neuro. The Wilcoxon matched-pairs signed-rank test was used to measure the discriminative validation of the Th-CPOT-Neuro across the exposures.

Results

Characteristics of the study participants

The participants of this study included 21 neurosurgical

patients and 10 neurosurgery registered nurses. The majority of the patients were male (n=13, 61.9%), with a mean age of 51.6 years (range 21–94 years). Most of the sample patients were diagnosed with traumatic brain injury (n=14, 66.7%) and were admitted to the NT-ICU (n=16, 76.2%). A total of 15 (71.4%) patients were intubated with mechanical ventilation. Out of 21 patients, 13 (61.9%) had a Glasgow Coma Scale score of 6–10 and had undergone brain surgery (Table 1).

Sociodemographic information of the nurse participants is displayed in Table 2. Of the 10 registered nurses trained to use the Th-CPOT-Neuro, 9 (90%) used the Th-CPOT-Neuro with the neurosurgical patients at the

bedside during the validation testing period. The ages of the nurse participants ranged from 30 to 40 years. The nurse participants were 90% female and 100% had completed a bachelor's degree in nursing. The years of working experience as a neurosurgery nurse ranged between 8 and 16 years. The mean years of experience in using CPOT in assessing pain in neurosurgical patients was seven years (Table 2).

Content validity of the Th-CPOT-Neuro

The CVI scores were calculated from responses of three specialists (a nurse educator and two physicians) to determine the relevance of content and agreement of

Table 1 Socio-demographic and clinical characteristics of the study samples

Characteristics	n	%	Mean	S.D.	Range
Patients with brain injuries					
Age (years)	21		51.6	21.1	21–94
Sex					
Male	13	61.90			
Female	8	38.10			
Diagnosis					
Traumatic brain injury	14	66.66			
Cerebral aneurysm	2	9.52			
Brain tumor	5	23.81			
Mechanically ventilated	15	71.43			
Glasgow coma scale (score)					
3–5 NT	2	9.52			
6–10 NT	13	61.90			
13–14	6	28.57			
Surgery/Intervention					
Craniectomy	5	23.80			
Craniotomy	5	23.80			
Burr holes	1	4.80			
Aneurysm clipping	1	4.80			
Cerebral embolization	1	4.80			
Admission unit					
Neuro-trauma intensive care unit	16	76.19			
Surgical respiratory care unit	2	9.52			
Trauma ward	2	9.52			
Neurosurgical ward	1	4.76			

S.D.=standard deviation, NT=non-testable on verbal response (V) due to intubation

Table 2 Socio-demographic of neurosurgery registered nurses

Characteristics	n	%	Mean	S.D.	Range
Age (years)	10		34.6	3.16	30–40
Sex					
Male	1	10			
Female	9	90			
Highest degree in nursing					
Bachelor	10	100			
Experience as a neurosurgery nurse (years)	10		11.5	2.67	8–16
Experience in using CPOT in assessing pain in neurosurgical patients (years)	10		7.0	0.00	7–7

S.D.=standard deviation, CPOT=Critical-Care Pain Observation

the specialists with the Th-CPOT-Neuro. The specialists were asked to complete a self-administered questionnaire on the relevance of the items in the tool to be graded on a Likert-type scale from 1 (not relevant/totally disagree) to 4 (highly relevant/totally agree). The specialists were also asked to give their opinions and recommendations regarding the feasibility of adapting the Th-CPOT-Neuro in the local clinical practice and whether it was simple, accurate, quick, and easy to use. The self-administered questionnaire was sent by e-mail and mail to their work address, with a return method and envelope provided. The proportion of the responses of 3 and 4 by the specialist on the 4-point Likert scale was used to calculate the CVI. The acceptable CVI value was established to be >0.8. The responses from the specialists are presented in Table 3. Overall, the CVI of the Th-CPOT-Neuro yielded 0.82. Contraction of the upper face or grimacing, tolerating the ventilator or movement, and verbal complaints/crying out were considered to be somewhat relevant by one expert. Additional comments and suggestions were made and highlighted by the experts, including alternatives, the consistency of the words and terms used, limitations, potential problems, and considerations regarding the implementation and adaptation of the tool. Table 4 presents comments provided by the

specialists about the relevance and clarity of the Th-CPOT-Neuro. All comments and suggestions were discussed with the panel of experts prior to the development of the modified final version of the Th-CPOT-Neuro (Appendix 2) and used for psychometric testing of the tool.

Inter-rater reliability

Pain in 21 participants during non-nociceptive (rest, before nociceptive procedures) and nociceptive exposures (turning, endotracheal suctioning, wound dressing changes, venipuncture, trapezius squeeze test, Foley catheter insertion), including before and at the peak of an analgesic effect, was independently assessed by two trained registered nurses to determine inter-rater reliability. Table 5 shows inter-rater reliability measured for the Th-CPOT-Neuro. Inter-rater reliability of the Th-CPOT-Neuro scores of the raters was supported with ICC scores >0.86 (ICC=0.86–0.91) (p-value<0.001). The inter-rater reliability ICC scores were the highest during the trapezius squeeze test and Foley catheter insertion (ICC=1) (p-value<0.001). The lowest ICC of inter-rater reliability was identified during wound dressing changes (ICC=0.86) (p-value<0.001) (Table 5).

Table 3 Responses from the specialists

Item	Level of expert opinion											
	Specialist 1				Specialist 2				Specialist 3			
	1	2	3	4	1	2	3	4	1	2	3	4
Facial expression				/				/			/	
Relaxed/neutral				/				/			/	
Brow lowering				/			/				/	
Contraction of upper face or grimacing		/						/			/	
Absence				/			/				/	
Presence				/				/			/	
Absence of movements				/				/		/		
Non-purposeful movements				/				/		/		
Purposeful movements of protection and/or restlessness/agitation				/				/		/		
Tolerating ventilator or movement		/					/				/	
Activating alarms				/			/				/	
Fighting ventilator				/			/				/	
Talking in a normal tone or no sound				/				/			/	
Sighing, moaning				/				/			/	
Verbal complaints, crying out		/					/				/	
Relaxed				/				/			/	
Tense, rigid				/				/			/	

Specialist 1=neurosurgeon, Specialist 2=pain medicine specialist, Specialist 3=nurse educator, 1=not relevant, 2=somewhat relevant, 3=quite relevant, 4=highly relevant

Table 4 Example texts from the specialists for the relevance and clarity of the Th-CPOT-Neuro

Comment	Specialist No.	Illustrative Texts
Common spoken language used for ease of understanding	1	<p>Contraction of upper face or grimacing “กล้ามเนื้อใบหน้าส่วนบนเกร็งตัว/หน้าบูดบึ้ง”</p> <p>Brow lowering and eye tightening (wincing), grimacing “ขมวดคิ้วและการเกร็งรอบดวงตา/หน้าย่น/หน้าบูดบึ้ง”</p> <p>Presence of tearing, or face flushing, or both “น้ำตาไหลและ/หรือหน้าแดง”</p> <p>Non-purposeful cautious or slow movements “เคลื่อนไหวโดยไม่มีจุดหมายหรืออย่างระมัดระวัง/ช้าๆ”</p> <p>Trying to reach, touch, or rub the pain site, withdrawing a tube, pulling tube, or both and attempting to sit up, thrashing, not following commands, and striking at staff “พยายามเอื้อมมือหรือสัมผัส/ถูบริเวณที่ปวด หรือ ถอยหนี ดึงท่อหรือสายยาง หรือพยายามลุกนั่ง หรือ พาดแขนขาไปมา พาดแขนใส่เจ้าหน้าที่ หรือ ไม่ทำตามสั่ง”</p> <p>Tolerating ventilator or movement “ทนต่อการใช้เครื่องช่วยหายใจหรือการเคลื่อนไหว”</p> <p>Easy ventilation, no alarms “ตั้งค่าเครื่องช่วยหายใจได้ง่าย หรือ เครื่องช่วยหายใจไม่ร้องเตือน”</p> <p>Blocking ventilation, alarms frequently activated “เครื่องช่วยหายใจตีไม่เข้า หรือเครื่องช่วยหายใจร้องเตือนบ่อยครั้ง”</p> <p>Verbal complaints, crying out “บ่นปวด/ร้องส่งเสียง”</p> <p>Verbal complaints of pain (ouch!) Crying out “บ่นปวด (อ๊อย! หรือร้องส่งเสียง)”</p>
	2	<p>Lowering of the eyebrows “อาจเลือกใช้คำใดคำหนึ่งระหว่าง ขมวดคิ้ว หรือ คิ้วขมวด”</p> <p>Absence of both responses “ไม่มีการตอบสนองทั้งสองปฏิกิริยา”</p> <p>Easy ventilation, no alarms “ปรับตั้งเครื่องช่วยหายใจให้เข้ากับผู้ป่วยได้ง่าย เครื่องช่วยหายใจไม่ร้องเตือน”</p> <p>Alarms activate but stop spontaneously “เครื่องช่วยหายใจมีการร้องเตือนแต่หยุดได้เอง”</p> <p>Blocking ventilation, alarms frequently activated “การหายใจมีการปิดกั้นระบายอากาศ กระตุ้นเครื่องช่วยหายใจให้ร้องเตือนบ่อยครั้ง”</p> <p>Verbal complaints, crying out “บ่น/คร่ำครวญ หรือ ส่งเสียงร้องออกมา”</p>
Limitations and suggestions for quality use of the Th-CPOT-Neuro	3	<p>In case of patients with facial palsy, contraction of the upper face or grimacing should be observed and noted from the normal side with no facial palsy. “Cannot evaluate” should be added to the scoring system for an item that is either not applicable or not available in patients who cannot move. For example, score “0” could be the result of paralysis and not because of absence of pain</p>

Specialist 1=neurosurgeon, Specialist 2=pain medicine specialist, Specialist 3=nurse educator, Th-CPOT-Neuro=Thai Version of the Critical-Care Pain Observation Tool-Neuro

Discriminative validation

The Th-CPOT-Neuro scores across varying exposures measured the reliability of each measure that included turning, endotracheal suctioning, and wound dressing changes that represented routine practice in patient care. Before and at the peak of an analgesic effect were also independently assessed by two registered nurse

ratars. Nine to twelve observations of each exposure were recorded and included in the analysis. The total scores obtained during these different exposures were compared to determine discriminant validation (Table 6). Total Th-CPOT-Neuro scores were significantly higher during all selected painful procedures in both data sets (p -value<0.01). At the peak of an analgesic effect, the total

Table 5 Measures of inter-rater reliability for the Th-CPOT-Neuro across exposures

Item	First Rater						Second Rater						ICC	p-value
	Frequency (n)	CPOT-Neuro score					Frequency (n)	CPOT-Neuro score						
		Median	Range	IQR	Mean	S.D.		Median	Range	IQR	Mean	S.D.		
Rest	145	0	0-7	0-2	0.88	1.18	145	0	0-7	0-2	0.86	1.17	0.906	<0.001
	Turning													
Before	16	1	0-2	0-2	0.94	0.85	16	0.5	0-2	0-2	0.81	0.91	0.92	<0.001
	During	31	5	1-8	4-6	4.77	1.52	31	4	0-8	3.5-6	4.55	1.82	0.915
Endotracheal suctioning														
	Before	17	2	0-5	0-2	1.53	1.50	17	1	0-5	0-2	1.29	1.57	0.926
During	36	6	3-8	5-7	6.16	1.29	36	6	2-8	5-7	6.05	1.49	0.915	<0.001
Wound dressing changes														
	Before	7	2	0-5	1-2	1.86	1.57	7	2	0-4	1-2.5	1.86	1.35	0.864
During	11	5	1-7	3.5-6	4.73	1.90	11	4	1-7	3-6	4.45	1.97	0.964	<0.001
Venipuncture														
	Before	2	0	0-0	0-0	0	0	2	0	0-0	0-0	0	0	-
During	5	4	3-7	3-5	4.4	1.67	5	4	3-7	3-6	4.6	1.82	0.967	<0.001
Trapezius squeeze														
	Before	0	-	-	-	-	0	-	-	-	-	-	-	-
During	4	6	5-8	5.75-6.5	6.25	1.26	4	6	5-8	5.75-6.5	6.25	1.26	1	<0.001
Foley catheter insertion														
	Before	3	3	0-4	1.5-3.5	2.33	2.08	3	3	0-3	1.5-3	2	1.73	0.955
During	5	5	5-8	5-6	5.8	1.30	5	5	5-8	5-6	5.8	1.30	1	<0.001
Opioid administration														
	Before	23	5	1-7	4-6.5	4.96	1.72	23	5	1-7	4-6	4.61	1.69	0.912
Peak	25	0	0-3	0-1	0.76	0.93	25	0	0-3	0-2	0.76	0.96	0.911	<0.001

ICC=intraclass correlation coefficient, IQR=interquartile range, S.D.=standard deviation, Th-CPOT-Neuro=Thai Version of the Critical-Care Pain Observation Tool-Neuro

Table 6 Measures of discriminative validation for Th-CPOT-Neuro across exposures

Item	First rater		p-value	Second rater		p-value
	CPOT-Neuro scores			CPOT-Neuro scores		
	Median	IQR		Median	IQR	
Turning (n=9)			<0.01			<0.01
Before	1	0-2		0	0-2	
During	5	4-7		4	4-6	
Endotracheal suctioning (n=9)			<0.01			<0.01
Before	2	2-2		2	1-2	
During	6	5-7		6	5-7	
Opioid administration (n=12)			<0.01			<0.01
Before	5	3.75-5.25		4.5	3.75-5	
Peak	1	0-2		1	0-2	

Comparison using the Wilcoxon matched-pairs signed-rank test, IQR=interquartile range, Th-CPOT-Neuro=Thai Version of the Critical-Care Pain Observation Tool-Neuro, CPOT=Critical-Care Pain Observation

Th-CPOT-Neuro scores were significantly lower compared to before the analgesic administration (p -value<0.01). Table 5 displays the data that compare the CPOT-Neuro scores at each time point across all exposures as observed and recorded by two raters.

Discussion

The French-Canadian and English CPOT-Neuro scoring methods were developed and recommended to validly and precisely assess pain in critically ill, brain-injured patients in the ICU^{2,11}. Development and validation of this tool in the Thai version were therefore systematically conducted to accomplish an alternative tool specific to patient conditions to attain a more accurate observation of pain. The findings of this study provide further support for the validity and reliability of the CPOT-Neuro among patients with brain injury who are unable to self-report, as revealed in a previous study¹⁰.

The results of this current study provide support for the highly discriminant validity of the original CPOT-Neuro in discriminating the presence of pain at different levels, as well as between painful and non-painful procedures². The

significant difference between the Th-CPOT-Neuro scores before and the peak of analgesic effect indicates its ability to assess the treatment efficacy found in the previous study². Previous trials of the CPOT-Neuro were conducted with brain-injured patients who were admitted to the ICU^{2,4,5}. The high discriminative validity and the strong interrater reliability of the Thai version tested with the specific group of Thai patients outside an ICU may indicate its appropriateness for use outside of a critical care context. Future adaptation of the tool for populations outside of the ICU context should be studied¹².

Good validity ($S-CVI=0.82$)¹³ and good reliability ($ICC>0.86$)¹⁴ of the Th-CPOT-Neuro provided evidence to support the rigorous and applicable process of the WHO Guidance – Translation of Survey Instruments, assuring the quality and cultural adaptation of the translated version¹⁵. This translation guideline focuses on maintaining conceptually equivalent and culturally relevant versions of different languages, or the target version, in any target country and culture in which the tool is intended for use⁹. Employing this translation process contributed to the item equivalence of the concept domains and semantic

equivalence with the items in the original version, including appropriateness for use in the target culture¹⁵. Adaptation of the CPOT-Neuro Thai version for the assessment of pain in this specific group is expected to be effective and successful in the foreseeable future. Previous studies revealed that the CPOT-Neuro was better, more feasible, and more useful in the assessment of pain among brain-injured patients than the original CPOT⁴. Considering the significantly higher CPOT-Neuro scores during routine, common, and standard care procedures, comprehensive procedural pain management of neurosurgical patients is of the utmost importance. The Th-CPOT-Neuro should be used as an alternative to the traditional CPOT by Thai clinicians and bedside nurses to better understand the pain experience of neurosurgical patients who are unable to self-report.

Limitations

This study had some inherent limitations and constraints that were faced during the research process. Although the analysis revealed good validity ($S-CVI=0.82$) and reliability ($ICC>0.86$) of the Th-CPOT-Neuro, regardless of the admission unit, observations outside the ICU were fewer in number ($n=5$, 23.8%). Further validation with sufficient proportions of sampling outside the ICU context is required. The Th-CPOT-Neuro was systematically developed using the WHO Guidance – Translation of Survey Instruments to maintain its cross-cultural validation; however, the lack of qualified and certified pain medicine and nursing specialists, as well as the shortage of skilled professional and bilingual translators in the target context, were problems faced by the researchers. Moreover, the CPOT-Neuro is not well known and is not used either in this local context or by the pain specialists. A replication study testing the content validation of the revised CPOT-Neuro Thai version using at least five qualified and certified experts is recommended.

Another limitation can be derived from the nature of an English word with multiple Thai words and meanings. Each content expert, as well as the expert panels, selected the meaning or word according to their individual background. The expert panel's back translation was extremely time-consuming. We need to go beyond the original translator, experts in health, and experts with experience in instrument development and translation, according to the guidelines. The panel should include insider clinicians with the background and bedside experience of pain assessment and management in this specific patient group. In addition, in one observational situation, the raters assessed an intubated patient without mechanical ventilation. This situation was not available in the tool, and it was beyond their training. In that type of situation, scoring errors or biases could be generated. A revised version of the Th-CPOT-Neuro is needed to cover all situations.

Conclusion

The Thai version of the CPOT-Neuro was found to accurately, adequately, and consistently measure pain, differentiate between painful and non-nociceptive procedures, and evaluate analgesic efficacy in neurosurgical patients unable to report pain. Replacing the original Th-CPOT with the Th-CPOT-Neuro for Thai neurosurgical patients is recommended. Furthermore, it should be modified to fit with nursing practices in Thailand. Future research focused on the feasibility and clinical utility of the Th-CPOT-Neuro is required. A retrospective descriptive study of medical records to describe the pain assessment and management practices in this group of patients should be conducted prior to the implementation of Th-CPOT-Neuro.

References

1. Vadivelu N, Kai AM, Tran D, Kodumudi G, Legler A, Ayrian E. Options for perioperative pain management in neurosurgery. *J Pain Res* 2016;9:37-47. doi: 10.2147/JPR.S85782.

2. Gélinas C, Bérubé M, Puntillo KA, Boitor M, Richard-Lalonde M, Bernard F, et al. Validation of the Critical-Care Pain Observation Tool-Neuro in brain-injured adults in the intensive care unit: A prospective cohort study. *Crit Care* 2021;25:142–57. doi: 10.1186/s13054-021-03561-1.
3. Herr K, Anderson AR, Arbour C, Coyne PJ, Ely E, Gélinas C, et al. Pain assessment in the patient unable to self-report: Clinical practice recommendations in support of the ASPMN 2024 position statement. *Pain Manag Nurs* 2024;25:551–68. doi: 10.1016/j.pmn.2024.09.010.
4. Richard-Lalonde M, Bérubé M, Williams V, Bernard F, Tsoller D, Gélinas C. Nurses' evaluations of the feasibility and clinical utility of the use of the critical-care pain observation tool-neuro in critically ill brain-injured patients. *Sci Nurs Health Pract* 2019;2:1–18. doi: 10.7202/1076466ar.
5. Nguyen V, Richard-Lalonde M, Gélinas C. Interrater agreement between bedside and video raters using the CPOT-Neuro for pain assessment in critically ill patients with a brain injury. *Nurs Rep* 2024;14:212–9. doi: 10.3390/nursrep14010017.
6. Gélinas C, Joffe AM, Szumita PM, Payen JF, Bérubé M, Shahiri TS, et al. A psychometric analysis update of behavioral pain assessment tools for noncommunicative, critically ill adults. *AACN Adv Crit Care* 2019;30:365–87. doi: 10.4037/aacnacc2019952.
7. Chaleewong N, Chaiviboontham S, Christensen M. Knowledge, attitudes, and perceived barriers regarding pain assessment and management among Thai critical care nurses: A cross-sectional study. *Intensive Crit Care Nurs* 2024;84:103764. doi: 10.1016/j.iccn.2024.103764.
8. Thikom N, Thongsri R, Wongcharoenkit P, Khruamingmongkhon P, Wongtangman K. Incidence of inadequate pain treatment among ventilated, critically ill surgical patients in a Thai population. *Pain Manag Nurs* 2021;22:336–42. doi: 10.1016/j.pmn.2020.09.010.
9. World Health Organization. Process of translation and adaptation of instruments. [homepage on the Internet]. Geneva: World Health Organization; 2020. [cited 2023 Sep 20] Available from: http://www.who.int/substance_abuse/research_tools/translation/en/
10. Prasertsri N, Leuangsomnapa Y, Khetkam S. Pain assessment in brain-injured patients in the intensive care unit. *J Ministry Public Health Nurs* 2023;33:14–21.
11. Gélinas C, Puntillo KA, Boitor M, Bérubé M, Topolovec-Vranic J, Ramelet AS, et al. Content validation of behaviours and autonomic responses for the assessment of pain in critically ill adults with a brain injury. *Aust Crit Care* 2018;31:145–51. doi: 10.1016/j.aucc.2017.10.002.
12. Khanna P, Pandey RK, Chandralekha C, Sharma A, Pangasa N. Comparison between critical-care pain observation tool and physiologic indicators for pain assessment in the critically ill, mechanically ventilated adult patients. *Saudi J Anaesth* 2018;12:384–8. doi: 10.4103/sja.SJA_642_17.
13. Polit DF, Beck CT, Owen SV. Is the CVI an acceptable indicator of content validity? appraisal and recommendations. *Res Nurs Health* 2007;30:459–67. doi: 10.1002/nur.20199.
14. Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *J Chiropr Med* 2016;15:155–63. doi: 10.1016/j.jcm.2016.02.012.
15. Cruchinho P, López-Franco MD, Capelas ML, Almeida S, Bennett PM, Miranda da Silva M, et al. Translation, cross-cultural adaptation, and validation of measurement instruments: A practical guideline for novice researchers. *J Multidiscip Healthc* 2024;17:2701–28. doi: 10.2147/JMDH.S419714.

Appendix 1 CPOT-Neuro English version and the Thai version

รายการ (Item)	พฤติกรรมที่สัมพันธ์กับความปวด (Pain-related behaviors)	คะแนน (Score)	คำอธิบาย (Description)
การแสดงสีหน้า Facial expression	ผ่อนคลาย/ปกติ Relaxed/neutral	0	ไม่มีการตึงตัวของกล้ามเนื้อใบหน้า No facial muscle tension
	คิ้วขมวด Brow lowering	1	ขมวดคิ้ว Lowering of the eyebrows
	มีการหดตัวของใบหน้าส่วนบน หรือ หน้าบูดบึ้ง หน้าย่น เบะปาก Contraction of the upper face or grimacing	2	ขมวดคิ้วและการตึงรอบดวงตา หรือ หน้าบูดบึ้ง หน้าย่น เบะปาก Brow lowering and eye tightening (wincing), or grimacing
น้ำตาไหล หน้าแดงร้อน Tearing/face flushing	ไม่มี Absent	0	ไม่มีทั้งสองปฏิกิริยา Absence of both responses
	มี Present	1	น้ำตาไหลและ/หรือหน้าแดงร้อน Presence of tearing, or face flushing, or both
การเคลื่อนไหวร่างกาย Body movements	ไม่เคลื่อนไหว Absence of movements	0	ไม่เคลื่อนไหว ไม่ขยับ Immobile, not moving
	เคลื่อนไหวโดยไม่มีจุดหมาย มีการรอนแวน Non-purposeful movements	1	เคลื่อนไหวโดยไม่มีจุดหมาย ขำ ๆ ะมัดระวัง หรือ งอ แขนขา ไม่เอื้อมไปยังบริเวณที่ปวด Non-purposeful cautious and slow movements or limb flexion not aimed at reaching the pain site
	เคลื่อนไหวอย่างมีจุดหมาย ปกป้องบริเวณที่ปวด และ/หรือ ดิ้นกระสับกระส่าย Purposeful movements of protection, restlessness, or agitation, or both	2	พยายามเอามือไปยัง/สัมผัส/ถู บริเวณที่ปวด ถอยหนี และ/หรือ ดึงท่อ พยายามลุกนั่ง ฟาดแขนขาไปมา อาจฟาดไปยังเจ้าหน้าที่ ไม่ทำตามสั่ง Trying to reach, touch, or rub the pain site, withdrawing or pulling a tube, attempting to sit up, thrashing, not following commands, or striking at staff
การหายใจสัมพันธ์กับเครื่องช่วยหายใจ Compliance with Ventilator	ทนต่อการใช้เครื่องช่วยหายใจ/การเคลื่อนไหว Tolerating ventilator or movement	0	ตั้งค่าเครื่องช่วยหายใจให้เข้ากับการหายใจได้ง่าย เครื่องช่วยหายใจไม่ร้องเตือน Easy ventilation, no alarms
	กระตุ้นให้เครื่องช่วยหายใจร้องเตือน Activating alarms	1	อาจกระตุ้นให้เครื่องช่วยหายใจร้องเตือน แต่หยุดได้เอง Alarms may be activated but stop spontaneously
	หายใจต้านเครื่องช่วยหายใจ Fighting ventilator	2	เครื่องช่วยหายใจตีไม่เข้า กระตุ้นให้เครื่องช่วยหายใจร้องเตือนบ่อยครั้ง Blocking ventilation, alarms are frequently activated
การส่งเสียง/เปล่งเสียง (ไม่ใช่ท่อช่วยหายใจ) Vocalization	พูดน้ำเสียงปกติ หรือ ไม่มีเสียง Talking in a normal tone or no sound	0	พูดคุยด้วยน้ำเสียงปกติ หรือ ไม่มีเสียง Normal tone or no sound
	ถอนหายใจ/ร้องครวญคราง Sighing, moaning	1	ถอนหายใจ/ร้องครวญคราง Sighing, moaning
	ใช้คำที่บ่งถึงความปวด หรือ ส่งเสียงร้องออกมา Verbal complaints, crying out	2	ใช้คำที่บ่งถึงความปวด เช่น อู๊ หรือ ส่งเสียงร้องออกมา Verbal complaints of pain (ouch!), crying out
ความตึงตัวของกล้ามเนื้อ Muscle tension	คลายตัว Relaxed	0	ไม่มีแรงต้านเมื่อจับให้เคลื่อนไหว No resistance to passive movements
	มีการตึงตัว เกร็ง Tense, rigid	1	มีแรงต้านเมื่อจับให้เคลื่อนไหว Resistance to passive movements
Total		8	

CPOT=Critical-Care Pain Observation

Appendix 2 Modified version of the Th-CPOT-Neuro

รายการ (Item)	พฤติกรรมที่สัมพันธ์กับความปวด (Pain-related behaviors)	คะแนน (Score)	คำอธิบาย (Description)
การแสดงสีหน้า Facial expression	ผ่อนคลาย/ปกติ Relaxed/neutral	0	ไม่มีการดึงตัวของกล้ามเนื้อใบหน้า No facial muscle tension
	คิ้วขมวด Brow lowering	1	Lowering of the eyebrows
	มีการหดตัวของใบหน้าส่วนบน หรือ หน้าผาดั้ง หน้าผาแบน	2	คิ้วขมวด/เกร็งรอบดวงตา/หน้าผาแบน/หน้าผาดั้ง Brow lowering and eye tightening (wincing), grimacing
น้ำตาไหล หน้าแดงร้อน Tearing/face Flushing	Contraction of the upper face or grimacing	0	ไม่มีการตอบสนองทั้งสองปฏิกิริยา
	ไม่มี Absent	1	Absence of both responses
	มี Present	0	หน้าตาไหลและ/หรือหน้าแดงร้อน Presence of tearing, or face flushing, or both
การเคลื่อนไหวร่างกาย Body movements	ไม่เคลื่อนไหว	0	ไม่เคลื่อนไหว ไม่ขยับ Immobile, not moving
	Absence of movements	1	เคลื่อนไหวโดยไม่เจตนาหรือเคลื่อนไหวอย่างระมัดระวัง/ช้าๆ เคลื่อนไหวโดยไม่เจตนาหรือเคลื่อนไหวอย่างระมัดระวัง/ช้าๆ Non-purposeful cautious/slow movements or limb flexion not aimed at reaching pain site
	Non-purposeful movements	2	พยายามเอื้อมมือหรือสัมผัสกับบริเวณที่ปวด หรือ ถอยหนี ดึงท่อ/สายยาง หรือ พยายามผลัก หรือ พาดแขนขาไปมา/พาดใส่เจ้าหน้าที่ หรือ ไม่ทำตามสิ่ง Trying to reach, touch, or rub the pain site, withdrawing the tube or pulling the tube, attempting to sit up, thrashing, not following commands, or striking at staff
การหายใจสัมพันธ์กับเครื่องช่วยหายใจ Compliance with Ventilator	Purposeful movements of protection, restlessness, or agitation	0	ปรับตั้งค่าเครื่องช่วยหายใจให้เข้ากับผู้ป่วยได้ง่าย เครื่องช่วยหายใจไม่ร้องเตือน Easy ventilation, no alarms
	ทนต่อการใช้เครื่องช่วยหายใจ/การเคลื่อนไหว Tolerating ventilator or movement	1	เครื่องช่วยหายใจมีการร้องเตือน แต่หยุดได้เอง Alarms may be activated but stop spontaneously
	กระตุ้นให้เครื่องช่วยหายใจร้องเตือน Activating alarms	2	การหายใจมีการปิดกั้นการระบายอากาศ กระตุ้นเครื่องช่วยหายใจให้มีการร้องเตือนบ่อยครั้ง Blocking ventilation, alarms frequently activated
การส่งเสียง/เปล่งเสียง (ไม่ใช่ท่อช่วยหายใจ) Vocalization	หายใจเสียงปกติ หรือ ไม่ส่งเสียง Talking in a normal tone or no sound	0	พูดด้วยน้ำเสียงปกติ หรือ ไม่ส่งเสียง Normal tone or no sound
	ถอนหายใจ/ร้องครวญคราง Sighing, moaning	1	ถอนหายใจ/ร้องครวญคราง Sighing, moaning
	บ่นรำคาญ หรือ ส่งเสียงร้องออกมา Verbal complaints, crying out	2	ใช้คำที่บ่งถึงความปวด เช่น โหยย โหยย บ่นปวด หรือ ส่งเสียงร้องออกมา Verbal complaints of pain (ouch!), crying out
ความตึงตัวของกล้ามเนื้อ Muscle tension	คลายตัว Relaxed	0	ไม่มีความตึงตัวให้เคลื่อนไหว No resistance to passive movements
	มีการตึงตัวเกร็ง Tense, rigid	1	มีความตึงตัวให้เคลื่อนไหว Resistance to passive movements
Total		8	

Th-CPOT-Neuro=Thai Version of the Critical-Care Pain Observation Tool-Neuro