Pain Management Nursing xxx (xxxx) xxx

Contents lists available at ScienceDirect

Pain Management Nursing

journal homepage: www.painmanagementnursing.org

Original Article

Incidence of Inadequate Pain Treatment among Ventilated, Critically Ill Surgical Patients in a Thai Population

Napat Thikom, RN [*], Ruangkhaw Thongsri, MD [†], Piyawan Wongcharoenkit, RN [*], Phannita Khruamingmongkhon, RN [*], Karuna Wongtangman, MD [†]

[*] Division of Nursing, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok, Thailand
[†] Department of Anesthesiology, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok, Thailand

ARTICLE INFO

Article history:
Received 2 March 2020
Received in revised form
1 September 2020
Accepted 27 September 2020

ABSTRACT

Background: Inadequate pain treatment during intensive care unit stays causes many unfavorable outcomes. Pain assessment in mechanically ventilated patients is challenging because most cannot self-report pain. The incidence of pain among Thai surgical intensive care unit (SICU) patients has never been reported.
Aims: To determine the inadequate pain control incidence among ventilated, critically ill, surgical patients.
Design: Prospective, observational study.
Setting: SICU of a university-based hospital during November 2017–January 2019.
Participants: Patients aged > 18 years, admitted to the SICU for a foreseeable duration of mechanical ventilation > 24 hours were included.
Methods: On post-admission Day 2, each was assessed for pain at rest (every 4 hours) and during bed-bathing using the Critical Care Pain Observation Tool (CPOT; Thai version) or the 0–10 numeric rating scale (NRS). CPOT scores > 2 or NRS scores > 3 signified inadequate pain control, while a RASS score ≤ -3 was defined as overtreatment.
Results: 118 were included. The inadequate-pain-management incidence was 34% (n = 40) at rest and 29% (n = 34) during bed-bathing. The severe-pain incidence (NRS > 6, or CPOT > 5) was 5.9% (n = 7). Our incidence of overtreatment was 1.7%. The demographic data and ICU complication-rates of patients with adequate and inadequate pain treatment were similar.
Conclusions: Pain assessment tools in critically ill patients should be developed and validated to the language of the tool users in order to determine the incidence of pain accurately. The inadequate-pain-treatment incidence in ventilated critically ill, Thai surgical patients was lower than previously reported from other countries.

Background

The International Association for the Study of Pain defines pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage” (p 250) (Merskey et al., 1979). Adult, critically ill patients routinely experience pain, both at rest and during common care procedures (Devlin et al., 2018). The stress response to pain may result in high levels of catecholamine, cortisol, and antidiuretic hormone (Whipple et al., 1995). In addition, pain-induced reflex responses may alter respiratory mechanics, increase cardiac oxygen consumption, and cause skeletal muscle contraction, all leading to complications that may prolong hospital stays and increase health care costs (Follin & Charland, 1997). Moreover, pain in ICU patients can cause sleep disruptions and psychological anxiety, all of which may affect patients’ quality of life after ICU discharge (Timmers et al., 2011).

Despite the many advances in the management of pain in critical care settings, the pain experienced by ICU patients still poses unique challenges for ICU clinicians for a number of reasons. These include the many obstacles to patient-healthcare provider communications; the multitude of pharmacodynamic and pharmacokinetic changes in critically ill patients that can make it difficult for

Address correspondence to Karuna Wongtangman, MD, Department of Anesthesiology, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.
E-mail address: karuna.won@mahidol.ac.th (K. Wongtangman).

https://doi.org/10.1016/j.pmn.2020.09.010
1524-9042/

intensivists to prescribe pain medications (Devlin, 2008); and pain not being a priority when the rapid stabilization of medical and surgical conditions demands immediate attention. Given that these events may overlap, it is not surprising that there has been little improvement in the rates of unresolved pain in critical care settings, and that failure to control pain persists (Stevens & Edwards, 1994; Chanques et al., 2007).

The incidence of pain in previous studies ranged from 33% to 77% (Puntillo, 1990; Stevens & Edwards, 1994; Desbiens et al., 1996; Carroll et al., 1999; Puntillo et al., 2001; Chanques et al., 2007; Gélinas, 2007 & Payen et al., 2007), with most of the publications reporting pain incidence in Western countries. However, the findings of those studies may no longer be current or applicable to patients; subsequent to the publication of the Clinical Practice Guidelines for the Management of Pain, Agitation, and Delirium in Adult Patients in the Intensive Care Unit in 2013, ICU clinicians have increasingly directed attention to the pain management of patients (Barr et al., 2013). Furthermore, pain response is affected by multiple psychological factors including cultural differences, cognitive appraisal, and coping style (Haythornthwaite, 2013). For example, we have observed that some patients, especially elderly patients, are too shy to talk about themselves or their degree of pain. Although the Thai Surgical Intensive-Care-Unit (SICU) study reported that 85.2% of patients received analgesics (Nimmaanrat et al., 2016), the incidence of pain in the Thai intensive care population has never been reported due to a lack of effective assessment tools. Subsequent to the Thai-SICU study, however, the Thai version of the Critical-Care Pain Observation Tool (CPOT) was validated (Wongtangman et al., 2017). Our objective was to assess the incidence of inadequate pain treatment experienced by adult Thai SICU patients.

Methods

Study Design

This was a single-center, prospective, observational study. It was conducted at the surgical ICU of Thailand's university-based national tertiary referral center. This closed, 7-bed unit admits all surgical patients at the center other than cardiothoracic, neurologic, and trauma surgery patients, since we have special units for those types of surgery. Patient care at the ICU is managed by a critical-care anesthesiologist. Local treatment guidelines for the management of pain, agitation, and delirium were not in place during the data acquisition period. The protocol was approved by our Institutional Review Board, protocal number 513/2560(EC2) and certificate of approval number Si 572/2017.

Inclusions and Exclusions

During the 15-month study period (November 2017-January 2019), we enrolled all consecutive patients aged >18 years admitted to the surgical ICU for a foreseeable duration of mechanical ventilation of more than 24 hours. Patients were excluded if their physical responses to pain could not be reliably assessed (e.g., owing to quadriplegia, limb or facial injuries, administration of neuromuscular blockers, or stroke-related limb paresis). Written informed consent was obtained from the patients or their relatives prior to inclusion in the study.

Data Collection

For each patient, we recorded their demographic data (age, sex, body mass index, type of ICU admission, and Acute Physiology and Chronic Health Evaluation (APACHE) II score) and perioperative data (type of surgery, choice of anesthesia, and anesthetic used during operation). Pain assessments were done on postadmission day 2 at rest (every 4 hours) and during bed bathing. Richmond Agitation-Sedation Scale (RASS) scores were also collected concurrently to detect overtreatment. The analgesic medication were recorded at first and second days after admission and the pain assessments were done in the seconday after admission. Patients were followed up until their discharge from the surgical ICU. In cases of prolonged ICU stays, the patients' data retrieval was concluded on Day 30. Mortality rates and, among survivors, the incidences of acquired complications (ventilator-associated pneumonia, gastroduodenal hemorrhage, venous thromboembolism, and colonization of central venous catheters) were collected.

Outcome Measures

The primary study outcome was the incidence of inadequate pain treatment in the surgical ICU. The pain assessments were done prospectively by experienced research nurses who had previously been trained and shown good intraclass correlation (intraclass correlation coefficient 0.91; 95% CI 0.90-0.93), during earlier research on the validation of Thai version CPOT (Wongtangman et al., 2018). All of the CPOT and NRS assessments were conducted on postadmission day 2 at rest (every 4 hours) and during bed bathing. With communicative patients, their pain levels were evaluated via the 0-10 visually enlarged laminated numeric rating scale (NRS; Payen et al., 2001; Chanques et al., 2010), with 0 representing "no pain" and 10 representing "the worst pain imaginable." In the case of intubated or tracheotomized patients who were unable to use the NRS, the Thai version of CPOT was employed instead (Payen et al., 2001; Wongtangman et al., 2017). CPOT is a unidimensional measure designed for use in intubated and nonintubated ICU patients. It evaluates four behavioral domains, including facial expressions, body movements, muscle tension, and compliance with ventilator for intubated patients or vocalization for nonintubated patients. Each of the four CPOT domains is scored 0-2, giving a total score range of 0-8 (Gélinas et al., 2019). The cut point for inadequate pain treatment is an NRS score of > 3 or a CPOT score of > 2, while the cut point for severe pain is an NRS score of > 6 or a CPOT score of > 5 at any assessment point (Severgnini et al., 2016). Overtreatment was considered to have occurred if a patient's RASS score was ≤ -3 (Barr et al., 1995).

We chose to assess pain on postadmission day 2 for three reasons. Firstly, a large number of patients in our ICU need only simple hemodynamic or respiratory support and can be discharged from the ICU after 1 day. With their simple postoperative care, we thought that this group of patients would be more representative of the acute postoperative pain population rather than the ICU population. Moreover, we assumed that the pain incidence would be at its maximum on day 2 (Gélinas et al., 2006; Chanques et al., 2007); this is because on the first postoperative day, some patients would experience the residual effects of anesthesia, and some might have medical or surgical conditions that require intensive care or sedation. Finally, the DOLOREA study (Payen et al., 2007) determined that patients who received analgesic drugs on day 2 after admission along with pain assessments were found to experience better outcomes (indicated by shorter durations of mechanical ventilation). Unfortunately, that study did not mention whether the patients who experienced pain on Day 2 of their ICU admission had adverse outcomes.

The secondary study outcomes were to compare the risk factors and outcomes of the patients who received adequate pain treatment and those who did not. The outcomes of interest included the mortality rates and, among survivors, the incidences of acquired

Please cite this article as: Thikom, N et al., Incidence of Inadequate Pain Treatment among Ventilated, Critically Ill Surgical Patients in a Thai Population, Pain Management Nursing, https://doi.org/10.1016/j.pmn.2020.09.010

complications (ventilator-associated pneumonia, gastroduodenal hemorrhage, venous thromboembolism, and colonization of central venous catheters). Ventilator-associated pneumonia was defined as a new parenchymal opacity being observed in a chest radiograph of the lungs, plus at least two of the following three criteria: (1) a temperature < 36°C or > 38°C; (2) a leukocyte count < 4,000/ml or > 10,000/ml; and (3) purulent secretions from the endotracheal tube (Cook et al., 1998). A gastroduodenal hemorrhage was defined by esophagogastroduodenoscopy, or by the combination of grossly visible blood from an enterally placed tube with subsequent transfusions of 2 or more units of packed erythrocytes. Thromboembolic events were defined by the presence of a venous thrombosis proven by Doppler ultrasonography or venography, or by the presence of a pulmonary embolism established by a pulmonary angiography or contrast-enhanced spiral computed tomography of the thorax. Central venous catheter colonization was defined by the isolation of at least one organism at a concentration of ≥103 colony-forming units/ml from a catheter tip culture (Brun-Buisson el al., 1987).

Statistical Analyses

The sample-size calculation to estimate the incidence of a binary outcome in the population used the formula $n = (Z_{1 - \alpha/2})^2 p(1 - p)/d^2$. A previous study found the incidence of pain in the ICU to be about 50%-60% (Puntillo et al., 1990; Desbiens et al.,1996; Carroll et al.,1999; Chanques et al., 2007); d = allowable error (precision) = 0.1; and α = the probability of a type I error = 0.05 (2-sided). The sample size calculated with this formula was 96. To accommodate data collection losses, the size was subsequently expanded by about 20%, giving a total of 115 patients needed.

Continuous variables with normal and abnormal distributions were compared with Student's *t* test or the Mann-Whitney U test, and they were presented as either mean ± standard deviation (SD) or median and interquartile range (IQR), as appropriate. The qualities of the discrete variables were compared using Fischer's exact test or the χ-square test, and the results were expressed as number and percentage. Statistical significance was considered to exist at a *p* value of < 0.05. We used the statistical software package SPSS Statistics for Windows, version 18.0 (SPSS Inc., Chicago, IL, USA).

Results

During the study period, 389 patients were eligible for the study. Of those, 271 patients were excluded. In all, 708 pain assessments from the remaining 118 patients were analyzed (Fig. 1). The percentage of patients who experienced inadequate pain treatment on at least one occasion was 33.8% (n = 40) at rest and 28.8% (n = 34) during bed bathing. Twenty-four (20.3%) patients experienced inadequate pain treatment both at rest and during bed bathing. Overtreatment was found in two (1.7%) patients (mean RASS of −3 and −4), and their CPOT scores were each 0. Of those who experienced inadequate pain control at rest, the median (IQR) score for the NRS was 5 (4.75, 5) whereas for the CPOT, it was 3 (3, 5). The incidence of severe pain at rest was 5.9% (n = 7). In our cohort, 8 patients were diagnosed with chronic pain; of those, 4 (50%) patients experienced inadequate pain control at rest, while 4 (50%) patients experienced inadequate pain control during bed bathing. Compared to the patients who did not have chronic pain, the incidences of inadequate pain control at rest and during bed bathing were higher, but the differences were not statistically significant ($p = .44$ and .23, respectively).

We excluded two patients who demonstrated overtreatment from the secondary analysis due to the differences in pathophysiology (Devlin, 2008). 116 patients were analyzed for secondary outcomes. All patients were undergoing surgery during the admission period; 54 (46.55%) were admitted to the ICU after a planned surgery; 45 (38.79%) were admitted to the ICU following an emergency surgery; and 17 (14.66%) were admitted subsequent to a postoperative complication that had arisen more than 24 hours after their surgery had been completed. In our comparison of the patients in the adequate and inadequate pain treatment groups at rest, we found no differences in their demographics in terms of age, sex, body mass index, APACHE II scores, type of admission, type of surgery, or choice of anesthesia (Table 1). Inadequate pain treatment at rest was reported by 28 patients (24.1%) between 7 a.m. and 3 p.m., 15 patients (12.9%) from 3 p.m. to 11 p.m., and 17 patients (14.7%) from 11 p.m. to 7 a.m. ($p = .05$). Of the patients who experienced inadequate pain control at rest, 62.5% (n = 25) reported suffering from pain at one out of the five assessments; another 20% (n = 8) were suffering at two out of the five assessments. No patient experienced inadequate pain at rest for all their assessments.

From the total of 708 assessments, the NRS was used as the assessment tool for 495 (69.9%) assessments, whereas the CPOT was used with 213 (30.0%) assessments. Out of 118 patients, 44 were evaluated with NRS only, 17 were evaluated with CPOT only, and 57 were evaluated with both NRS and CPOT (NRS 4 [1, 5], CPOT 2 [1, 5]). Although the overall incidence of inadequate pain treatment demonstrated by the CPOT (18.3%) was greater than that for the NRS (13.3%), the difference was not significant ($p = .09$; Table 2). Data on the use of sedatives and opioids are shown in Figure 2.

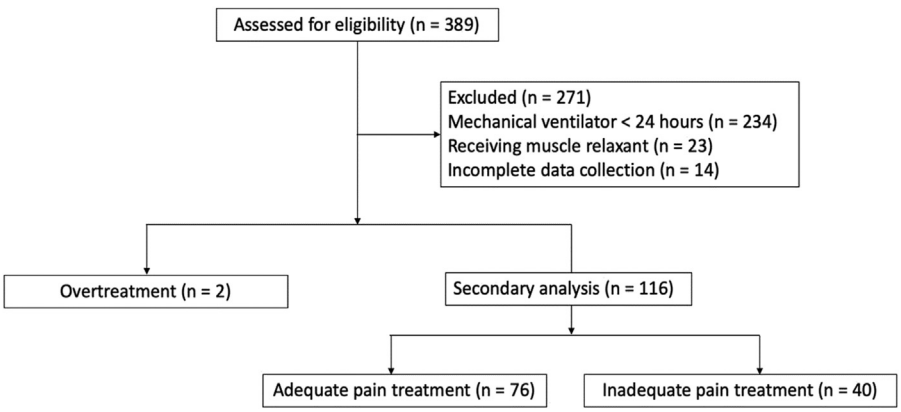

Figure 1. Flowchart of patient enrollment.

Please cite this article as: Thikom, N et al., Incidence of Inadequate Pain Treatment among Ventilated, Critically Ill Surgical Patients in a Thai Population, Pain Management Nursing, https://doi.org/10.1016/j.pmn.2020.09.010

Table 1
Comparison of the Patient Characteristics of the Adequate and Inadequate Pain Treatment Groups at Rest

Characteristics	Inadequate (n = 40)	Adequate (n = 76)	*p* Value
Sex: male, n (%)	21 (52.5%)	39 (51.3%)	1.000
Age (years)	63.0 ± 13.4	67.2 ± 19.7	.226
BMI (kg/m^2)	25.0 ± 6.5	26.6 ± 7.4	.225
Type of admission, n (%)			.463
After surgery	30 (80.0%)	67 (88.2%)	
Planned surgery	18 (45.0%)	36 (47.4%)	
Emergency surgery	14 (35.0%)	31 (40.8%)	
After postoperative complications	8 (20.0%)	9 (11.8%)	
APACHE II score	10 (7-16)	12 (8-17)	.305
Type of surgery, n (%)			.283
Open thoraco-abdominal surgery	14 (35.0%)	36 (47.4%)	
Orthopedic surgery	4 (10.0%)	2 (2.6%)	
Endoscopic surgery	18 (45.0%)	31 (40.8%)	
Other	4 (10.0%)	7 (9.2%)	
Duration of surgery (min)	160 (62.5-367.5)	117.5 (62.5-302.5)	.160
Choice of anesthesia, n (%)			.553
With regional anesthesia	6 (15.0%)	8 (10.5%)	
Without regional anesthesia	68 (89.5%)	34 (85.0%)	

p values for χ square test (categorical variables) and Mann-Whitney U test (continuous variables).
Data are presented as mean ± SD, n (%) or median (IQR) unless otherwise indicated.
BMI = body mass index; APACHE II = Acute Physiology and Chronic Health Evaluation II.

Fentanyl was the most commonly used agent (70%-90%), with morphine being used 2%-15% of the time. Other sedatives (midazolam and propofol) were used relatively little. Paracetamol (1 g) was given to two patients in the inadequate pain treatment group. No nonsteroidal, anti-inflammatory drugs were administered during the research. The proportions of patients receiving fentanyl, morphine, midazolam, and propofol decreased progressively and significantly over the first two days (χ square test for trend, $p < .05$). There were no significant differences in the narcotic and sedative medications used by the adequate and inadequate pain-control groups on Days 1 and 2 (Table 3).

The ICU mortality rate was five (12.5%) for the inadequate treatment group and three (3.9%) for the adequate treatment group ($p = .122$). The ICU lengths of stay, durations of mechanical ventilation, and complication types after 30 days for the two groups were not statistically significantly different (Table 4).

Discussion

The incidence of inadequate pain control in our research was about 30%, both at rest and during bed bathing. We were unable to demonstrate any difference in the ICU complication rates of patients with adequate versus inadequate pain treatment.

The incidence of pain has ranged widely from study to study; whereas other studies have reported that 33%-77% of critically ill patients experience pain (Puntillo, 1990; Stevens & Edwards, 1994; Desbiens et al., 1996; Carroll et al., 1999; Puntillo et al.,2001; Chanques et al., 2007; Gélinas, 2007; Payen et al., 2007), the incidence in our population was lower. A number of possible explanations exist for the large discrepancies, such as differences in the various studies' protocols, populations, pain definitions, methods, frequencies of pain assessment, and types of procedure inducing pain (Table 5). Since we did not include cardiothoracic, neurologic, or trauma surgery patients in our study, the incidence of inadequate pain control might be different.

Table 2
Incidence of Inadequate Pain Control Among 708 Assessments

Pain Assessment	NRS (n = 495)	CPOT (n = 213)	*p* Value
At rest	46/410 (11.2%)	25/180 (23.9%)	<.001
Procedural	20/85 (23.5%)	14/33 (42.4%)	.043
Total	66/495 (13.3%)	39/213 (18.3%)	.086

p values for χ square test.
Data are presented as n (%).
NRS = numeric rating scale; CPOT = Critical-Care Pain Observation Tool.

Because behavioral pain assessment tools have only relatively recently been developed and validated (Payen et al., 2001; Aïssaoui et al., 2005; Gélinas et al., 2006; Young et al., 2006; Gélinas & Johnston, 2007; Stites, 2013), all of the studies from the 1990s used patient recall to evaluate the incidence of pain in this population (Puntillo, 1990; Desbiens et al., 1996; Carroll et al., 1999). Reconstructed memory appears to influence retrospective pain reports. In interviews conducted 3-16 months after hospitalizations, Puntillo et al. (2014) asked patients to recall their ICU procedural pain intensity. The results revealed that the patients reported higher pain scores than they had previously done during their ICU stays. To date, only two other studies have used both the NRS and a behavioral pain scale to assess the incidence of pain at rest, as was done with our study. One was the DOLOREA study (Payen et al., 2007), which found that 33% of ventilated patients experienced pain at rest, while 56% experienced it while receiving routine care. The other was the research by Chanques et al. (2007), which established an incidence of pain at rest of 51%.

We reported a lower incidence of pain during procedural care. Bed bathing had been selected as being representative of the procedural care routinely administered to the ICU patients. Different care procedures cause different levels of pain. We chose bed bathing (including turning and positioning the patients (Puntillo et al., 2016) as representative for procedural pain because this procedure is always done for every patient in a predictable nonemergency setting. The DOLOREA study (Payen et al., 2007) identified endotracheal suctioning and mobilization during standard care as the most frequently reported painful procedures. Another study reported a mean verbal NRS score of 4.13 (SD of 3.35) for the turning of 46 patients (Siffleet et al., 2007). On the other hand, the EUROPAIN study (Puntillo et al., 2014) documented chest tube removal, wound drain removal, and arterial line insertion as the most painful procedures reported by ICU patients, with median NRS scores of 4-5. That research also reported a median NRS score of 3 for the turning and positioning of patients. Given those findings, our incidence of procedural pain might have been more than 29% if we had included all of the possible care procedures.

Please cite this article as: Thikom, N et al., Incidence of Inadequate Pain Treatment among Ventilated, Critically Ill Surgical Patients in a Thai Population, Pain Management Nursing, https://doi.org/10.1016/j.pmn.2020.09.010

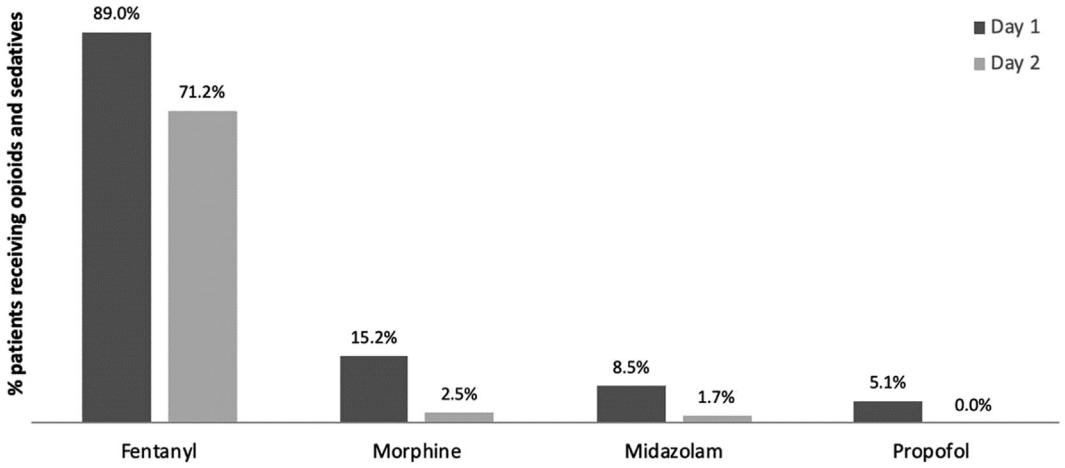

Figure 2. Drugs used for sedation and analgesia on day 1 and day 2 of the intensive care unit stay.

Pain patterns are highly individualized, with patients having subjective perceptions and exceedingly variable levels of toleration (Devlin et al., 2018). Cultural and coping-style differences may be contributing factors (Haythornthwaite, 2013). Two explanations exist for the pain perceptions experienced by Thais. One is based on a worldview in which the idea of karma is important, while the other is based on the difference between pain and suffering (Stonington, 2015). Thai patients typically have the perception that when someone undergoes surgery, they must experience some level of pain as part of karma (a Buddhist concept of cause and effect based on a belief that one's actions shape one's future consequences). Furthermore, nonreporting of pain is not the same as a lack of pain among Thai patients due to features of their culture. They consider that their experience of physical pain should not necessarily translate to suffering mentally with the pain ((Chatchumni, Namvongprom, Eriksson, & Mazaheri, 2016)). The patients' expectations that they would experience some pain after their surgery might have influenced their perceived pain intensity, given that only 5.9% of them reported severe pain. A further study should be undertaken to ascertain whether this Thai coping style has any effect on the quality of life of Thai patients after their ICU discharge.

The management of pain in Thai patients is made even more complex because of Thai culture. A paper examining pain management in a Thai context stated that nurse-patient communications are typically not direct interchanges between patients and nurses, but rather take the form of messages relayed by intermediaries ((Chatchumni, Namvongprom, Eriksson, & Mazaheri, 2016)). This approach is a pragmatic solution to the problem of Thai patients frequently being too shy to talk to nurses on their own. However, this reluctance on the part of the patients also means that they might not report their pain levels to nurses during pain assessments in an ICU setting (where relatives usually do not stay for extended periods). A previously mentioned paper supported our finding that the incidence of inadequate pain control at rest was significantly higher when the behavioral pain scoring system (CPOT, 23%) was used than when the patients self-reported their pain levels (NRS, 11.2%; Table 2).

Complications arising from the overtreatment of pain and sedation include prolonged mechanical ventilation and associated problems such as ventilator-associated pneumonia, respiratory depression, prolonged cognitive impairments, delirium, brain or other neurologic injuries, unnecessary testing for altered mental status, prolonged ICU stays, and circulatory depression (Girard et al., 2008; Kumar and Brennan, 2009). A deep state of sedation was found in 57% (258 of 451) of assessed patients on Day 2 by the DOLOREA study. That research reported that midazolam was the most commonly used agent for sedation (65%-70%), with propofol being used 20% of the time. Since the publication of Clinical Practice Guidelines for the Sustained Use of Sedatives and Analgesics in the Critically Ill Adult in 2002 (Jacobi et al., 2002) and its subsequent revisions in 2013 (Barr et al., 2013), a paradigm shift has occurred among attending physicians. This has resulted in an initial focus on the management of pain, followed by the goal-directed delivery of psychoactive medications to avoid oversedation and promote earlier extubations. Although our ICU did not have any protocols for the management of pain, agitation, or delirium, our study showed that fentanyl was the most commonly used medication; midazolam and propofol were used less often than reported by other studies. Our incidence of overtreatment was also surprisingly low (1.7%; 2 out of 118 patients), compared with 40%-50% in an earlier report (Payen et al., 2007). Furthermore, most of our patients (69.9%) were able to report their pain levels themselves (using the NRS), with only 30% of the assessments in our study employing the CPOT as a tool. This finding was comparable to a previous report that 65.1% of patients were able to speak or otherwise communicate (Puntillo et al. 2014).

Table 3
Comparison of Daily Sedative and Opioid Dosages for Patients in the Adequate and Inadequate Pain Treatment Groups

	Day 1		*p* Value	Day 2		*p*-Value
	Adequate (n = 76)	Inadequate (n = 40)		Adequate (n = 76)	Inadequate (n = 40)	
Fentanyl equivalents (mcg/kg/d)	11.93 (1.16-40.73)	10.0 (0.31-41.08)	.597	1.62 (0-10.91)	1.40 (0-8.33)	0.757
Propofol (mg/kg/d)	6.77 (3.28-12.20)	6.66 (3.38-9.94)	1.000	0.00 (0)	0.00 (0-0)	
Midazolam (mg/kg/d)	0.05 (0.02-0.55)	0.24 (0.03-0.44)	.889	0.00 (0-0)	0.00 (0-0.12)	0.168

p values for Mann-Whitney U test (continuous variables).
Data are presented as median (interquartile range).

Please cite this article as: Thikom, N et al., Incidence of Inadequate Pain Treatment among Ventilated, Critically Ill Surgical Patients in a Thai Population, Pain Management Nursing, https://doi.org/10.1016/j.pmn.2020.09.010

Table 4
Comparison of Patient Outcomes for Adequate and Inadequate Pain Control Groups

Outcomes	Inadequate (n = 40)	Adequate (n = 76)	*p*-Value
ICU mortality	5 (12.5%)	3 (3.9%)	0.122
ICU length of stay (days)	5 (3-9)	7 (4-11)	0.068
Duration of mechanical ventilation (days)	4 (2-10)	6 (3-10)	0.237
Ventilator-associated pneumonia	2 (5.0%)	8 (10.5%)	0.490
Gastrointestinal hemorrhage	2 (5.0%)	8 (10.5%)	0.490
Venous thromboembolism	3 (7.5%)	8 (10.5%)	0.746
Delirium	15 (37.5%)	24 (31.6%)	0.541
Restraint	15 (37.5%)	19 (25.0%)	0.199

p values for χ square test (categorical variables) and Mann-Whitney U test (continuous variables).
Data are presented as n (%) or median (IQR).

Our study revealed no significant difference in the incidence of inadequate pain control in patients admitted directly to the ICU after surgery compared to that for patients admitted from a ward after the first postoperative day. Moreover, on postadmission Day 2, there were no significant differences in pain scores or analgesics needed for the different types of surgery or choices of anesthesia. However, there was a slight difference in the incidence of pain as it related to nurse shifts. During the day shift, 28 patients were reported as having inadequate pain control, compared with 15 and 17 patients during the evening and night shifts, respectively ($p = .052$). These higher pain levels might have arisen because of environmental factors (such as patient care activities), diagnostic procedures, or the presence of an intermediary. Previous painful procedures during the daytime (e.g., bed bathing, venipunctures, or therapeutic interventions) might increase the focus on bodily sensations and aggravate pain sensitivity at rest (Laarhoven et al., 2010). Finally, there were no statistically significant differences in the ICU lengths of stay, the durations of mechanical ventilation, or the complications after 30 days for the patients admitted directly to the ICU compared with those admitted from a ward after the first postoperative day.

This study has several limitations. First, the studied population included only surgical patients who had undergone general surgery and been admitted to the SICU; the results, therefore, cannot be generalized to all critically ill surgical patients (such as critically ill cardiac and neurosurgical patients). In addition, the incidence of pain in our study was lower than previously reported; our sample size might have been insufficient to demonstrate differences between the characteristics and the rates of complications of the adequate and inadequate pain treatment groups. Lastly, while the median ICU stay is 6 days, this study documented the pain experienced only during the second day of the patients' ICU stays. This might have led to an underreporting of the incidence of pain in the ICU.

Our study has shown that incidence of pain varies from place to place. Many factors may contribute to that variation. We suggest that pain assessment tools in critically ill patients should be developed or validated in the patient's own language. In this way, the incidence of inappropriate pain treatment can be learned about. We believe that doing so could establish the significance of inadequate pain control's impact on patients, thus providing a framework for future efforts toward the management of the short- and long-term adverse consequences of pain and the development of preventive strategies.

Conclusions

The incidence of inadequate pain treatment in SICUs varies among studies. The incidence of pain experienced by surgical ICU patients in Thailand was 34% at rest and 29% during bed bathing. No statistically significant difference was found between the length of ICU stay, duration of mechanical ventilation, ICU mortality rates, and other complications of the adequate versus inadequate pain treatment groups.

Table 5
Characteristics of Main Studies Reporting Pain in Critically Ill Patients

	Study Design	Study Population	Pain-Assessment Method	Incidence of Pain
Puntillo, 1990	Prospective, descriptive study	24 critically ill patients (cardiac and noncardiac surgical)	Patient interview after ICU discharge	63% of the patients rated their pain as being moderate to severe in intensity.
Desbiens, 1996	Prospective cohort study	5,176 severely ill medical hospitalized patients*	Patient and family member interviews on days 2-6 and days 8-12 after study entry	Pain was reported by 49.9%; 14.9% reported extremely severe pain
Carroll, 1999	Descriptive correlational study	213 critically ill patients (cardiac, noncardiac surgical, & trauma)	Patient interview before ICU discharge or 72 hours postoperatively	64% were often in moderate to severe pain
Puntillo, 2001	Comparative descriptive study	5,957 critically ill patients (medical, cardiac, noncardiac surgical, neurological, & trauma patients)	NRS before, during, and 10 minutes after procedure	Procedural pain intensity 2.65-4.93 on a 0-to-10 NRS; turning was the most painful procedure
Chanques, 2007	Prospective observational Study	230 critically ill patients (medical & postoperative abdominal patients)	NRS/BPS twice a day at rest and 30 min after procedure every day during ICU stay	Pain at rest Medical ICU 52% Surgical ICU 50%
Gelinas, 2007	Prospective, descriptive study	93 cardiac surgical patients	Patient interview after ICU discharge	77.4% recalled having pain during ICU stay
Payen, 2007	Prospective, observational study	1,381 mechanically ventilated ICU patients (medical, surgical & trauma patients)	NRS/BPS on day 2, day 4, and day 6 (2-4 assessments during a 24-h period)	Pain at rest: 33% During procedure: 56%

* Severely ill medical hospitalized patients defined as one or more of nine common, high-mortality diseases: acute respiratory failure, chronic obstructive pulmonary disease, congestive heart failure, chronic liver failure, nontraumatic coma, metastatic colon cancer, advanced non-small cell lung cancer, multiple organ system failure with malignancy, and sepsis.

Please cite this article as: Thikom, N et al., Incidence of Inadequate Pain Treatment among Ventilated, Critically Ill Surgical Patients in a Thai Population, Pain Management Nursing, https://doi.org/10.1016/j.pmn.2020.09.010

Authors' Conflicts of Interests

NT, RT, PW, PK and KW report no disclosures.

Acknowledgments

We are grateful to Dr. Onuma Chaiwat and Dr. Arunotai Siriussawakul for sharing advice and knowledge on medical education. We also thank Assistant Professor Dr. Chulaluk Komoltri, M.P.H. and Dr. Orawan Supapueng for statistical assistance. Finally, the authors thank Arporn Pimtong, a research assistant, for her invaluable help with paperwork.

Funding: This research project was supported by Siriraj Research Development Fund (managed by Routine to Research [R2R]), the Faculty of Medicine, Siriraj Hospital, Mahidol University, Thailand (grant number R2R416/17).

References

Aïssaoui, Y., Zeggwagh, A. A., Zekraoui, A., Abidi, K., & Abouqal, R. (2005). Validation of a behavioral pain scale in critically ill, sedated, and mechanically ventilated patients. *Anesthesia & Analgesia, 101*(5), 1470–1476.

Barr, J., & Donner, A. (1995). Optimal intravenous dosing strategies for sedatives and analgesics in the intensive care unit. *Critical Care Clinics, 11*(4), 827–847.

Barr, J., Fraser, G. L., Puntillo, K., Ely, E. W., Gélinas, C., Dasta, J. F., Devlin, J. W., Kress, J. P., Joffe, A. M., Coursin, D. B., Herr, D. L., Tung, A., Robinson, B. R., Fontaine, D. K., Ramsay, M. A., Riker, R. R., Sessler, C. N., Pun, B., Skrobik, Y., & Jaeschke, R. (2013). Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit: Executive summary. *American Journal of Health-System Pharmacy, 70*(1), 53–58.

Brun-Buisson, C., Abrouk, F., Legrand, P., Huet, Y., Larabi, S., & Rapin, M. (1987). Diagnosis of central venous catheter-related sepsis. Critical level of quantitative tip cultures. *Archives of Internal Medicine, 147*(5), 873–877.

Carroll, K. C., Atkins, P. J., Herold, G. R., Mlcek, C. A., Shively, M., Clopton, P., & Glaser, D. N. (1999). Pain assessment and management in critically ill postoperative and trauma patients: a multisite study. *American Journal of Critical Care, 8*(2), 105–117.

Chanques, G., Sebbane, M., Barbotte, E., Viel, E., Eledjam, J. J., & Jaber, S. (2007). A prospective study of pain at rest: Incidence and characteristics of an unrecognized symptom in surgical and trauma versus medical intensive care unit patients. *Anesthesiology, 107*(5), 858–860.

Chanques, G., Viel, E., Constantin, J. M., Jung, B., de Lattre, S., Carr, J., Cissé, M., Lefrant, J. Y., & Jaber, S. (2010). The measurement of pain in intensive care unit: Comparison of 5 self-report intensity scales. *Pain, 151*(3), 711–721.

Chatchumni, M., Namvongprom, A., Eriksson, H., & Mazaheri, M. (2016). Treating without seeing: pain management practice in a thai context. *Pain Research & Management, 2016*, 9580626.

Cook, D. J., Walter, S. D., Cook, R. J., Griffith, L. E., Guyatt, G. H., Leasa, D., Jaeschke, R. Z., & Brun-Buisson, C. (1998). Incidence of and risk factors for ventilator-associated pneumonia in critically ill patients. *Annals of Internal Medicine, 129*(6), 433–440.

Desbiens, N. A., Wu, A. W., Broste, S. K., Wenger, N. S., Connors, A. F., Lynn, J., Yasui, Y., Phillips, R. S., & Fulkerson, W. (1996). Pain and satisfaction with pain control in seriously ill hospitalized adults: Findings from the SUPPORT research investigations. *Critical Care Medicine, 24*(12), 1953–1961.

Devlin, J. W. (2008). The pharmacology of oversedation in mechanically ventilated adults. *Current Opinion in Critical Care, 14*(4), 403–407.

Devlin, J. W., Skrobik, Y., Gélinas, C., Needham, D. M., Slooter, A. J. C., Pandharipande, P. P., Watson, P. L., Weinhouse, G. L., Nunnally, M. E., Rochwerg, B., Balas, M. C., van den Boogaard, M., Bosma, K. J., Brummel, N. E., Chanques, G., Denehy, L., Drouot, X., Fraser, G. L., Harris, J. E., Joffe, A. M., Kho, M. E., Kress, J. P., Lanphere, J. A., McKinley, S., Neufeld, K. J., Pisani, M. A., Payen, J. F., Pun, B. T., Puntillo, K. A., Riker, R. R., Robinson, B. R. H., Shehabi, Y., Szumita, P. M., Winkelman, C., Centofanti, J. E., Price, C., Nikayin, S., Misak, C. J., Flood, P. D., Kiedrowski, K., … Alhazzani, W. (2018). Clinical practice guidelines for the prevention and management of pain, agitation/sedation, delirium, immobility, and sleep disruption in adult patients in the ICU. *Critical Care Medicine, 46*(9), e825–e873.

Follin, S. L., & Charland, S. L. (1997). Acute pain management: Operative or medical procedures and trauma. *Annals of Pharmacotherapy, 31*(9), 1068–1076.

Gélinas, C., Fillion, L., Puntillo, K. A., Viens, C., & Fortier, M. (2006). Validation of the Critical-Care Pain Observation Tool in adult patients. *American Journal of Critical Care, 15*(4), 420–427.

Gélinas, C., & Johnston, C. (2007). Pain assessment in the critically ill ventilated adult: Validation of the critical-care pain observation tool and physiologic indicators. *The Clinical Journal of Pain, 23*(6), 497–505.

Gélinas, C. (2007). Management of pain in cardiac surgery ICU patients: Have we improved over time? *Intensive & Critical Care Nursing, 23*(5), 298–303.

Gélinas, C., Joffe, A. M., Szumita, P. M., Payen, J. F., Bérubé, M., Shahiri T, S., Boitor, M., Chanques, G., & Puntillo, K. A. (2019). A Psychometric analysis update of behavioral pain assessment tools for noncommunicative, critically ill adults. *AACN Advanced Critical Care, 30*(4), 365–387.

Girard, T. D., Kress, J. P., Fuchs, B. D., Thomason, J. W., Schweickert, W. D., Pun, B. T., Taichman, D. B., Dunn, J. G., Pohlman, A. S., Kinniry, P. A., Jackson, J. C., Canonico, A. E., Light, R. W., Shintani, A. K., Thompson, J. L., Gordon, S. M., Hall, J. B., Dittus, R. S., Bernard, G. R., & Ely, E. W. (2008). Efficacy and safety of a paired sedation and ventilator weaning protocol for mechanically ventilated patients in intensive care (Awakening and Breathing Controlled trial): A randomised controlled trial. *Lancet, 371*(9607), 126–134.

Haythornthwaite, J. A. (2013). Assessment of Pain Beliefs, Coping, and Function. In S. B. McMahon, et al. (Eds.), *Wall & Melzack's Textbook of Pain* (6th ed., pp. 328–338). Saunders.

Jacobi, J., Fraser, G. L., Coursin, D. B., Riker, R. R., Fontaine, D., Wittbrodt, E. T., Chalfin, D. B., Masica, M. F., Bjerke, H. S., Coplin, W. M., Crippen, D. W., Fuchs, B. D., Kelleher, R. M., Marik, P. E., Nasraway, S. A., Jr., Murray, M. J., Peruzzi, W. T., & Lumb, P. D. (2002). Clinical practice guidelines for the sustained use of sedatives and analgesics in the critically ill adult. *Critical Care Medicine, 30*(1), 119–141.

Kumar, A. B., & Brennan, T. J. (2009). Pain assessment, sedation, and analgesic administration in the intensive care unit. *Anesthesiology, 111*(6), 1187–1188.

Merskey H, A. F. D., Bonica, J. J., Carmon, A., Dubner, R., Kerr, F. W. L., Lindblom, U., Mumford, J. M., Nathan, P. W., Noordenbos, W., Pagni, C. A., Renaer, M. J., Sternbach, R. A., & Sunderland, S. (1979). Pain terms: A list with definitions and notes on usage. *Pain, 6*(3), 249–252.

Nimmaanrat, S., Chittawatanarat, K., Kongsayreepong, S., & Morakul, S. (2016). Pain management in surgical intensive care units: a multi-center prospective observational study (THAI-SICU study). *Journal of the Medical Association of Thailand, 99*(Suppl 6), S242–S246.

Payen, J. F., Bru, O., Bosson, J. L., Lagrasta, A., Novel, E., Deschaux, I., Lavagne, P., & Jacquot, C. (2001). Assessing pain in critically ill sedated patients by using a behavioral pain scale. *Critical Care Medicine, 29*(12), 2258–2263.

Payen, J. F., Chanques, G., Mantz, J., Hercule, C., Auriant, I., Leguillou, J. L., Binhas, M., Genty, C., Rolland, C., & Bosson, J. L. (2007). Current practices in sedation and analgesia for mechanically ventilated critically ill patients: A prospective multicenter patient-based study. *Anesthesiology, 106*(4), 687–695.

Puntillo, K. A. (1990). Pain experiences of intensive care unit patients. *Heart and Lung, 19*(5 Pt 1), 526–533.

Puntillo, K. A., White, C., Morris, A. B., Perdue, S. T., Stanik-Hutt, J., Thompson, C. L., & Wild, L. R. (2001). Patients' perceptions and responses to procedural pain: results from Thunder Project II. *American Journal of Critical Care, 10*(4), 238–251.

Puntillo, K. A., Max, A., Timsit, J. F., Vignoud, L., Chanques, G., Robleda, G., Roche-Campo, F., Mancebo, J., Divatia, J. V., Soares, M., Ionescu, D. C., Grintescu, I. M., Vasiliu, I. L., Maggiore, S. M., Rusinova, K., Owczuk, R., Egerod, I., Papathanassoglou, E. D., Kyranou, M., Joynt, G. M., Burghi, G., Freebairn, R. C., Ho, K. M., Kaarlola, A., Gerritsen, R. T., Kesecioglu, J., Sulaj, M. M., Norrenberg, M., Benoit, D. D., Seha, M. S., Hennein, A., Periera, F. J., Benbenishty, J. S., Abroug, F., Aquilina, A., Monte, J. R., An, Y., & Azoulay, E. (2014). Determinants of procedural pain intensity in the intensive care unit: The Europain study. *American Journal of Respiratory and Critical Care Medicine, 189*(1), 39–47.

Puntillo, K. A., Max, A., Chaize, M., Chanques, G., & Azoulay, E. (2016). Patient recollection of ICU procedural pain and post-ICU burden: The memory study. *Critical Care Medicine, 44*(11), 1988–1995.

Severgnini, P., Pelosi, P., Contino, E., Serafinelli, E., Novario, R., & Chiaranda, M. (2016). Accuracy of Critical Care Pain Observation Tool and Behavioral Pain Scale to assess pain in critically ill conscious and unconscious patients: Prospective, observational study. *Journal of Intensive Care, 4*, 68.

Siffleet, J., Young, J., Nikoletti, S., & Shaw, T. (2007). Patients' self-report of procedural pain in the intensive care unit. *Journal of Clinical Nursing, 16*(11), 2142–2148.

Stevens, D. S., & Edwards, W. T. (1994). Management of pain in mechanically ventilated patients. *Critical Care Clinics, 10*(4), 767–778.

Stites, M. (2013). Observational pain scales in critically ill adults. *Critical Care Nurse, 33*(3), 68–78.

Stonington, S. D. (2015). On the (f)utility of pain. *Lancet, 385*(9976), 1388–1389.

Timmers, T. K., Verhofstad, M. H., Moons, K. G., van Beeck, E. F., & Leenen, L. P. (2011). Long-term quality of life after surgical intensive care admission. *Archives of Surgery, 146*(4), 412–418.

Van Laarhoven, A. I., Kraaimaat, F. W., Wilder-Smith, O. H., & Evers, A. W. (2010). Role of attentional focus on bodily sensations in sensitivity to itch and pain. *Acta Dermato-Venereologica, 90*(1), 46–51.

Whipple, J. K., Lewis, K. S., Quebbeman, E. J., Wolff, M., Gottlieb, M. S., Medicus-Bringa, M., Hartnett, K. R., Graf, M., & Ausman, R. K. (1995). Analysis of pain management in critically ill patients. *Pharmacotherapy, 15*(5), 592–599.

Wongtangman, K., Chaiwat, O., Suraseranivongse, S., Thikom, N., Sanansilp, V., & Wangnamthip, S. (2017). Validation of the Thai-Version Critical Care Pain Observation Tool and Behavioral Pain Scale in postoperative mechanically ventilated ICU patients. *Journal of the Medical Association of Thailand, 100*(9), S9–S19.

Young, J., Siffleet, J., Nikoletti, S., & Shaw, T. (2006). Use of a Behavioural Pain Scale to assess pain in ventilated, unconscious and/or sedated patients. *Intensive & Critical Care Nursing, 22*(1), 32–39.

Please cite this article as: Thikom, N et al., Incidence of Inadequate Pain Treatment among Ventilated, Critically Ill Surgical Patients in a Thai Population, Pain Management Nursing, https://doi.org/10.1016/j.pmn.2020.09.010