

**Research Article****Pain, Pain Management and Pain Management Outcomes  
in Chest Trauma Patients: The Preliminary Study**Sahas Bilalee<sup>1\*</sup> Khomapak Maneewat<sup>2</sup> Wipa Sae-Sia<sup>2</sup><sup>1</sup>Master Student, Faculty of Nursing, Prince of Songkla University, Songkhla, Thailand.<sup>2</sup>Assistant Professor, Faculty of Nursing, Prince of Songkla University, Songkhla, Thailand.*\*Corresponding author: aya\_mza@hotmail.com***Abstract**

Chest trauma patients experience pain, particularly in the acute phase. Knowledge of the phenomena of pain, management strategies, and pain management outcomes are an integral part of the holistic approach to pain in chest trauma patients to provide a basis for adequate pain management. The objectives of this study were to describe pain, pain management, and pain management outcomes in patients with chest trauma. An observational study of 21 participants was conducted at the trauma ward of a university hospital in southern Thailand. A multidimensional pain assessment tool assessed the holistic aspects of pain in the first day of admission. The American Pain Society Patient Outcome Questionnaire evaluated the primary pain management outcomes and a spirometer measured lung vital capacity as the secondary pain outcome. Descriptive statistics were performed to determine frequency percentage, mean, and standard deviations of the data. The participants reported severe pain on admission; the mean (SD) numerical rating scale was 8.00 (1.34). Fentanyl intravenous injection was prescribed as needed for most of the participants (95.20%). More than half of the participants (61.90%) used cold compressions as a non-pharmacological strategy. The average pain intensity gradually decreased from 8.05 (day 1) to 4.43 (day 5), while lung vital capacity gradually increased from 1.05 L (day 1) to 1.71 L (day 5).

Severe pain continued to be experienced among chest trauma patients. The results regarding inappropriate pain management modality and inadequate pain management outcome raises the concern to develop an effective pain management program for chest trauma patients.

**Keywords:** chest trauma; pain management; pain management outcomes**Introduction**

In general, pain has been reported as a common and vital problem among trauma patients as well as chest trauma patients. More than 70% of trauma patients experienced moderate to severe pain,<sup>1</sup> particularly during the first three days of hospitalization.<sup>2</sup> The major causes of pain in chest trauma include tissue and nerve injury which result

in developing either nociceptive pain or neuropathic pain and mixed pain.<sup>3-5</sup> Moreover, pain in chest trauma patients can be caused by surgery and procedures.<sup>3,4</sup>

Pain results in profound effects in patients with both physical and psychological consequences. Pain increases the catabolic stress response and causes activation of the sympathetic nervous system

which result in disturbing the normal function of the respiratory, cardiovascular, and gastrointestinal systems,<sup>6,7</sup> immune response system, and sleep.<sup>7</sup> Pain also becomes one of the major barriers that impede a patient's participation in chest rehabilitation,<sup>7</sup> lung expansion, and gas exchange capacity.<sup>8</sup> In addition, pain causes negative moods such as fear and anxiety.<sup>9</sup> Inadequate management of acute pain leads to persistent pain that in turn results in developing depression and a decreased quality of life.<sup>10,11</sup>

Nurses have the vital role and responsibility of allocating adequate pain management. Currently, pain management outcomes have been used as one of the quality of care indicators. Quality pain management, according to the International Association for the Study of Pain (IASP), requires a pain intensity score not greater than 3/10.<sup>11</sup> From this, pain has been valued globally as the fifth vital sign.

To date, previous studies were conducted to examine pain, pain management, and pain management outcomes in trauma patients. However, there is still a lack of research that focuses on pain management in chest trauma patients as well as in the context of Thailand. Therefore, an observational study to describe pain, pain management, and pain management outcomes in patients with chest trauma was conducted in a tertiary care hospital in southern Thailand. The study results derived from this study will provide a basis to develop a pain management program to improve the quality of pain management in chest trauma patients.

## Objectives

The objectives of this study were to describe the phenomena of pain, pain management, and pain management outcomes in patients with chest trauma.

## Research Questions

What are the phenomena regarding pain, pain management, and pain management outcomes

in patients with chest trauma?

## Conceptual Framework

Multidimensional pain assessment, according to McCaffery and Beebe, consists of assessments of pain intensity, pain location, onset and duration of pain, the pattern of pain, factors alleviating and aggravating pain, quality, and impacts of pain.<sup>12</sup> In addition, knowledge regarding pain in chest trauma patients from previous studies were used to guide the scope and develop an instrument to assess the phenomenon of pain in chest trauma patients. The American Pain Society Patient Outcome Questionnaire (APS-POQ-R) proposed by the American Pain Society (APS) was used to evaluate the primary pain management outcomes. According to the APS, pain outcomes consist of primary pain outcomes and health outcome derived from adequate pain management.

Primary pain outcomes, according to the APS,<sup>13</sup> were developed to improve the quality of pain management in adult hospitalized patients. Primary pain outcomes are composed of 6 aspects: (1) pain intensity and relief; (2) impact of pain on activity, sleep, and negative emotions; (3) side effects of treatment; (4) helpfulness of information on pain treatment; (5) ability to participate in pain treatment decisions; and (6) use of non-pharmacological strategies. A secondary pain outcome is the health outcome derived from adequate pain management. With regard to chest trauma patients, chest rehabilitation reflected adequate pain management.<sup>8</sup> Therefore, lung vital capacity was used as a secondary pain outcome in this study.

## Methods

### Design and setting

An observational study using structured questionnaires was conducted at the trauma ward of a university hospital in southern Thailand.

### **Target population and sample of the study**

In this study, the participants were chest trauma patients admitted into the trauma ward between February and March 2017. Purposive sampling was performed to select the participants who met the inclusion criteria. The inclusion criteria were adults older than 18 years who were able to communicate and the severity of chest trauma based on the chest Abbreviated Injury Scale (AIS) score was in the range of 2 to 5. The exclusion criteria were underlying disease of lung cancer, asthma or chronic obstructive pulmonary disease, and transfer to other wards or discharge from the hospital before completion of the 5-day study. Since this study is a part of the study entitled “Effect of Evidence-Based Pain Management Program on Pain Outcomes in Patients with Chest Trauma”, the sample size presented in this article (n=21) was the sample size used for conducting the preliminary study. The sample size estimation was calculated using Comparison of two means of previous study which yielded 21 samples of each group for the complete study.

### **Instruments**

The data were collected using the multidimensional pain assessment tool, pain management outcomes evaluation form, and a spirometer. The multidimensional pain assessment tool for chest trauma patients consisted of 3 parts: (1) demographic data and health-related questionnaire; (2) clinical characteristics of the participants; and (3) multidimensional pain assessment. The pain management outcomes evaluation form was modified from the APS-POQ-R.<sup>13</sup> A psychometric evaluation was done and yielded a scale content validity index of 1.00 with test-retest reliability (correlation coefficient ranged from .90 to 1.0). A spirometer (Contec SP10) was used to measure the lung vital capacity. The calibration of volume accuracy of the spirometer before the study was  $\pm$  2.27% to 2.86%. The

inter-rater reliability precision was done with 5 healthy persons to compare the vital capacity measurements between the principal investigator and an expert spirometry nurse. The intra-class correlation coefficient yielded .99 and the intra-rater reliability testing (Spearman rank correlation coefficient [ $\rho$ ]) yielded 1.00.

### **Ethical considerations**

Ethical approval was obtained from the Ethics Committee in the Faculty of Medicine, Prince of Songkla University (EC number: 59-353-19-9). Written informed consent was obtained from all participants and family members prior to data collection.

### **Data collection/data analysis**

The name lists and details of the participants were identified by senior nurses in the trauma ward. The multidimensional pain assessment tool for chest trauma patients was used to assess pain on admission. Relevant medical and nursing records were also used to assess pain and pain management. Documentation of pain management and pain management outcomes of each participant were systematically recorded. Pain management outcomes and lung vital capacity were measured in each participant from admission throughout hospitalization of 5 days in the trauma ward. Descriptive statistics were used to analyze percentage, mean, and standard deviation of the data.

### **Results**

#### **Demographic and clinical characteristics of the participants**

In this study, the data were obtained from 21 chest trauma patients who met the inclusion criteria. The demographic and clinical characteristics of the participants are presented in Table 1. The majority of participants were male (76.20%) and

the mean (SD) age was 45.57 (18.85) years. The percentage of participants who were admitted due to traffic collision was 42.90% and the majority of the participants (81%) had blunt injuries. The chest AIS scores were moderate to severe (scores 2-4) and

the number of fractured ribs was 2-3 ribs. One-fourth of the participants had hemopneumothorax (23.80%) and 38.10% of the participants underwent chest tube insertion.

**Table 1** Demographic Data and Clinical Characteristics of the Participants (N= 21)

Demographic and clinical characteristics	n (%)
<b>Gender</b>	
Male	16 (76.20)
Female	5 (23.80)
<b>Age (range 22-75 years), M(SD)</b>	45.57 (18.85)
<b>Etiology of trauma</b>	
Traffic collision	9 (42.90)
Fall from height	8 (38.10)
Physical assault	4 (19.00)
<b>Type of chest injury</b>	
Blunt	17 (81.00)
Penetrating	4 (19.00)
<b>Medical diagnosis</b>	
Hemopneumothorax	5 (23.80)
Hemothorax	4 (19.00)
<b>Number of fractured ribs</b>	
2 fractured ribs	7 (33.30)
3 fractured ribs	4 (19.00)
Flail chest	1 (4.80)
<b>Chest AIS score</b>	
2	6 (28.60)
3	14 (66.70)
4	1 (4.80)
<b>Chest tube insertion</b>	8 (38.10)

Data are presented as number (%) unless indicated otherwise.

M= Mean; SD= Standard Deviation; AIS= Abbreviated Injury Scale.

## Pain and Pain Management in Chest Trauma Patients

In this study, the participants had severe pain on admission. The mean (SD) numerical rating scale was 8.00 (1.34). All participants (100%) reported constant pain. The majority of participants reported the characteristics of pain as throbbing (85.70%)

and throbbing/stabbing (23.80%). Pharmacological management was reported by all participants as a determinant of pain relief followed by support of the injured area (68.90%). Coughing, deep breathing, and changing position were reported by the majority of participants (95.20%) as determinants that worsened or increased pain intensity. All participants who

received intercostal drainage tube placement reported increased pain with chest tube movement. The daily living impacts of pain reported by the participants were sleep disturbance (95.20%) and altered daily activities (90.50%).

In this study, the usual pain management consisted of pain assessment every 4 hours during in the first 3 days of admission. Intravenous fentanyl

was prescribed as needed for most participants (95.20%). Procedural pain management as well as decision making to administer a pain killer injection varied which depended on the attending nurses. Cold compression was used most often by more than half of participants (61.90%) to manage pain (Table 2).

**Table 2** Pain and Pain Management of Participants (N= 21)

Pain and pain management	n (%)
<b>Initial pain intensity (NRS score), M(SD)</b>	8.00 (1.34)
<b>Pattern of pain</b>	
Constant	21 (100)
Periodic	0
<b>Quality of pain</b>	
Throbbing	18 (85.70)
Throbbing/stabbing	5 (23.80)
<b>Alleviating factors of pain</b>	
Painkiller injection	21 (100)
Support of injured parts	13 (61.90)
Cold compression	13 (61.90)
<b>Aggravating factors of pain</b>	
Movements of affected parts (cough, deep breathing, changing position)	20 (95.20)
Movements of chest tube	8 (100)
<b>Impacts of pain</b>	
Interfered patients from doing daily activities	20 (95.20)
Sleep disturbance	19 (90.50)
<b>Pharmacology management</b>	
Fentanyl	20 (95.20)
Non-opioids	15 (71.40)
Multimodal analgesia	10 (47.60)
Morphine	3 (14.30)
<b>Non-pharmacology management</b>	
Cold compression	13 (61.90)
Breathing relaxation	2 (9.50)
Listening to music	1 (4.80)

All data are reported as number (%) unless indicated otherwise,

NRS= numerical rating scale; M= Mean; SD= Standard Deviation

## Pain Management Outcomes in Chest Trauma Patients

The range of pain intensity score is 0-10. In this study, the average pain intensity of the participants after the usual pain management was still severe (8.05/10) (Table 3). The pain intensity gradually decreased from severe to moderate from day 3 to day 5. In day 1 of admission, the average pain relief of all participants was only 42.86/100. Almost all of the participants reported higher pain relief in day 5 (64.76/100). The high impact of pain on activity was reported by the participants in day 1 after admission (7.40/10) which gradually decreased until there was minimal impact in day 5 (2.50/10). Drowsiness was reported mostly by

the participants as the side effect of opioids in day 1 (3.30/10). More than half of the participants (57.1%) received information regarding pain management and treatment from the nurses in day 1 of admission which was perceived as helpful information (7.17/10). The participants reported low participation in pain treatment decisions (mean score in range 3.50-5.86/10). Overall, the participants reported moderate satisfaction on pain management in day 1 after admission (6.43/10) which gradually increased into high satisfaction (7.33/10) in day 5. The average lung vital capacity of the participants gradually increased from 1.05 L in day 1 to 1.71 L in day 5.

**Table 3** Pain Management Outcomes of the Participants (N=21)

Pain management outcomes in previous 8 hours	Day				
	1	2	3	4	5
<b>Pain intensity and relief [M(SD)]</b>					
Least pain	3.48 (1.54)	2.33 (1.32)	1.52 (1.08)	1.00 (.83)	0.57 (.98)
Worst pain	8.05 (1.24)	6.95 (.97)	5.67 (1.49)	5.10 (1.45)	4.43 (1.72)
Severe pain	49.52 (16.58)	34.29 (21.11)	19.05 (18.14)	10.95 (17.00)	8.10 (14.36)
Pain relief	42.86 (19.53)	54.76 (24.21)	56.19 (21.79)	64.76 (21.36)	64.76 (25.22)
<b>Impact of pain [M(SD)]</b>					
On activity	7.40 (1.09)	6.20 (1.76)	4.95 (1.93)	3.75 (2.17)	2.50 (2.32)
On snooze	2.62 (3.00)	1.29 (1.76)	0.81 (1.12)	0.57 (.81)	0.43 (.59)
On negative emotions	-	-	-	-	-
<b>Side effects of treatment [M(SD)]</b>					
Nausea	-	-	-	-	-
Itching	-	-	-	-	-
Drowsiness	3.30 (2.99)	2.15 (2.58)	1.05 (1.70)	0.50 (.83)	-
Dizziness	-	-	-	-	-
<b>Received information on your pain treatment options</b>					
Did not receive [n (%)]	9 (42.9)	17 (81)	18 (85.7)	19 (90.5)	20 (95.2)
Received [n (%)]	12 (57.1)	4 (19)	3 (14.3)	2 (9.5)	1 (4.5)
Helpfulness of information on pain treatment (Mean Rank)	7.17	6.75	2.33	2.00	1.00
<b>Ability to participate in pain treatment decisions[M(SD)]</b>					
Used [n (%)]	3.90 (1.48)	5.48 (0.93)	5.71 (0.90)	5.76 (0.89)	5.86 (0.96)
Not used [n (%)]	11 (52.4)	10 (47.60)	10 (47.60)	4 (19)	3 (14.30)
<b>Use of non-pharmacological strategies</b>					
Used [n (%)]	10 (47.60)	11 (52.4)	11 (52.4)	17 (81)	18 (85.70)
Not used [n (%)]	11 (52.4)	10 (47.60)	10 (47.60)	4 (19)	3 (14.30)
<b>Pain management satisfied [M(SD)]</b>					
Daily lung vital capacity[M(SD)]	6.43 (.98)	7.10 (1.09)	7.05 (1.12)	7.33 (1.07)	7.33 (1.24)

M= Mean; SD= Standard Deviation

## Discussion

Severe pain was evidenced in chest trauma patients in this study from the first day of admission which was consistent with previous studies. Accordingly, severe pain was evidenced during the first three days after chest injury.<sup>2</sup> Acute tissue injury as well as nerve injury caused severe pain in chest trauma patients.<sup>3-5</sup> Almost half of the participants in this study received chest tube insertion and reported higher pain intensity. Chest tube insertion resulted in increased pain due to further injury to tissue, muscles, and nerves inside the chest.<sup>14</sup> Pain around the chest tube was intense when the chest tube moved and induced pleural irritation.<sup>15</sup>

As mentioned previously, intravenous fentanyl was prescribed as needed for most of the participants in this study. However, this is not in accordance with the current best available evidence regarding pharmacological pain management.<sup>16</sup> Currently, morphine is recommended as the first line drug for acute pain management in injured patients.<sup>16</sup> However, the participants in this study were in the acute phase of injury that might lead to unstable hemodynamics. Since morphine can induce hypotension, this was possibly the reason the medical doctors decided to prescribe fentanyl to avoid developing this effect.<sup>17</sup>

In this study, more than half of the participants (61.90%) reported pain relief after cold compression application around the chest which was in congruence with previous studies.<sup>18,19</sup> Cold compression was selected most often for the majority of participants in this study possibly because it was easy to use and available in this setting. Only one participant (4.80%) used music in this study which was possibly due to the noisy and busy environment. Moreover, in the acute phase, a number of assessments, monitoring, and treatments were frequently performed for patients in this group which could interrupt listening to music.

The average worst pain of the participants

gradually decreased from 8.05 in day 1 to 4.43 in day 5. However, according to the IASP<sup>11</sup> as well as the Thai Association for the Study of Pain, acute pain should be managed to avoid going above 3/10.<sup>20</sup> Pain relief in this study possibly did not meet that standard. For the secondary pain outcome, the lung vital capacity of the participants gradually increased from 1.05 L in day 1 to 1.71 L in day 5.

Pain had a profound impact on chest rehabilitation after chest injury which was consistent with a previous study in which pain contributed to lung expansion, and vice versa, and lung expansion further contributed to gas exchange capacity.<sup>8</sup> In this study, less pain was evidenced to increase lung vital capacity.<sup>21,22</sup> Therefore, adequate pain management is essential for the enhancement of chest rehabilitation after chest injury.

## Conclusions

Chest trauma patients still experienced severe pain during hospitalization. Movement of injured areas that resulted from coughing, deep breathing, changing position, and chest tube movement were reported by the participants as aggravating factors that increased pain. Alleviating factors of pain among the participants included pain killer injection, support of injured parts, and cold compression. Fentanyl injection was prescribed as needed for the participants in this study, while cold compressions were usually used by the participants as a non-pharmacological strategy. Even though pain relief after pain management, this did not reach the optimal pain management of national and international standards. The study results revealed a gap in the development of an effective pain management program to enhance the quality of pain outcomes in chest trauma patients.

## Recommendations and Implications

1. Future research to develop a multi-disciplinary pain management program to enhance the quality of pain outcomes in chest trauma patients.

2. Establish a continuing nursing educational program to enhance nursing competency in managing pain for chest trauma as well as other trauma patients.

## References

1. Berben SA, Meijs TH, van Dongen RT, et al. Pain prevalence and pain relief in trauma patients in the Accident & Emergency department. *Injury*. 2008;39(5):578-85. doi: 10.1016/j.injury.2007.04.013
2. Solak O, Oz G, Kokulu S, et al. The effectiveness of transdermal opioid in the management multiple rib fractures: Randomized clinical trial. *Balkan Med J*. 2013; 30(3): 277-81. doi: 10.5152/balkanmedj.2013.8191
3. Bower TC, Reuter J P. Anagelsia, sedation, and nueromuscular blockcede in the trauma patient. In: Whalen E, Makic MBF, McQuillan KA, editor. *Trauma nursing: From resuscitation through rehabilitation*. 4th ed. St. Louis: Mosby; 2009..
4. Frawley PM. Thoracic trauma. In: Whalen E, Makic MBF, McQuillan KA, editor. *Trauma nursing: From resuscitation through rehabilitation*. 4th ed. St. Louis: Mosby; 2009.
5. Vadivelu N, Whitney CJ, Sinatra RS. Pain pathway and acute pain processing. In Sinatra RS, De Leon-Casasola OA, Ginsberg B, et al, editor. *Acute pain management*. Cambridge: Cambridge University Press; 2009.
6. Liu SS, Wu CL. Neural blockade: Impact on outcome. In: Cousins MJ, Bridenbaugh PO, Carr D, Horlocker T, editor. *Neural blockade in clinical anesthesia and pain medicine*. 4th ed. Philadelphia: Lippincott; 2008. doi: 10.1093/bja/aep382
7. Ghori MK, Zhang YR, Sinatra RS. Pathophysiology of acute pain. In: Sinatra RS, De Leon-Casasola OA, Ginsberg B, et al. editor. *Acute pain management*. Cambridge: Cambridge University Press; 2009.
8. Brown SD, Walters MR. Patients with rib fractures: Use of incentive spirometry volumes to guide care. *J Trauma Nurs*. 2012;19(2):89-91; quiz 2-3. doi: 10.1097/JTN.0b013e31825629ee
9. Keefe FJ. Acute pain: A psychosocial perspective. In: Sinatra RS, De Leon-Casasola OA, Ginsberg B, et al, editor. *Acute pain management*. Cambridge: Cambridge University Press; 2009.
10. Tecic T, Lefering R, Althaus A, et al. Pain and quality of life 1 year after admission to the emergency department: Factors associated with pain. *Eur J Trauma Emerg Surg*.2013; 39(4): 353-61. doi: 10.1007/s00068-013-0271-9
11. Wells N, Pasero C, McCaffery M. Improving the quality of care through pain assessment and management. In: Hughes RG, editor. *Patient safety and quality: An evidence-based handbook for nurses*. Rockville (MD): Agency for Healthcare Research and Quality (US); 2008.
12. McCaffery M, Beebe A. Pain: Clinical manual for nursing practice. St. Louis: Mosby;1989. doi: 10.1016/0885-3924(90)90052-L
13. Gordon DB, Polomano RC, Pellino TA, et al. Revised American pain society patient outcome questionnaire (APS-POQ-R) for quality improvement of pain management in hospitalized adults: Preliminary psychometric evaluation. *J Pain*. 2010; 11(11): 1172-86. doi: 10.1016/j.jpain.2010.02.012
14. Keene DD, Rea WE, Aldington D. Acute pain management in trauma. *Trauma*. 2011; 13(3): 167-79. doi: 10.1177/1460408611400813

15. Given J. Management of procedural pain in adult patients. *Nurs Stand.* 2010; 25(14): 35-40. doi: 10.7748/ns2010.12.25.14.35.c8153
16. Schug SA, Palmer GM, Scott DA, et al. Acute pain management: Scientific evidence, fourth edition. *Med J Aust.* 2016; 204(8): 315-7.
17. Barr J, Fraser GL, Puntillo K, et al. Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit. *Crit Care Med.* 2013; 41(1): 263-306. doi: 10.1097/CCM.0b013e3182783b72
18. Chailler M, Ellis J, Stolarik A, et al. Cold therapy for the management of pain associated with deep breathing and coughing post-cardiac surgery. *Can J Cardiovasc Nurs.* 2010; 20(2): 18-24.
19. Demir Y, Khorshid L. The effect of cold application in combination with standard analgesic administration on pain and anxiety during chest tube removal: A single-blinded, randomized, double-controlled study. *Pain Manag Nurs.* 2010; 11(3): 186-96. doi: 10.1016/j.pmn.2009.09.002
20. Thai association for the study of pain. Clinical guidance for acute pain management. [Internet]. 2009 [cited 2017 Nov 21]. Available from: <http://www.paintasp.com/download/cpg/CPG%20Acute%20Pain.pdf>.
21. Erdogan M, Erdogan A, Erbil N, et al. Prospective, randomized, placebo-controlled study of the effect of TENS on postthoracotomy pain and pulmonary function. *World J Surg.* 2005; 29(12): 1563-70. doi: 10.1007/s00268-005-7934-6
22. Truitt MS, Mooty RC, Amos J, et al. Out with the old, in with the new: A novel approach to treating pain associated with rib fractures. *World J Surg.* 2010; 34(10): 2359-62. doi: 10.1007/s00268-010-0651-9