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Original Article

The Effectiveness of an Evidence-Based Pain Management Program on Pain Intensity and Chest Rehabilitation Improvement Among Chest Trauma Patients in a Thai Hospital

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ABSTRACT

Background: Pain after thoracic injury has further profound impacts on patients resulting in increased length of hospital stay and hospital care cost, and decreased quality of life. Utilization of the cutting-edge evidence on pain management that fits with the individual care context is therefore important.
Aim: To examine the effects of an evidenced-based pain management program on the worst pain intensity and lung vital capacity among acutely ill hospitalized chest trauma patients.
Design: A two-group repeated measures design.
Settings: trauma unit, a university hospital in southern Thailand.
Participants/Subjects: 42 chest trauma patients.
Methods: The study population included 42 chest trauma patients admitted to the trauma unit. Twenty-one eligible chest trauma patients were consecutively assigned into intervention and control groups. The impacts of the intervention on the level of the worst pain intensity and lung vital capacity were measured before implementation of the program and throughout the first 5 days of admission.
Results: The study found a significant reduction in the worst pain intensity and an increase in the lung vital capacity among chest trauma patients in the intervention group compared with the control group ($p < .05$).
Conclusions: Use of a pain management program can be an effective, inexpensive, and low-risk intervention for the improvement of pain management and chest rehabilitation among chest trauma patients.

Introduction

Pain is commonly experienced by patients after chest injury with severe pain reported during the first 3 days of admission (Solak et al., 2013). The types of pain include nociceptive pain and neuropathic pain, as well as mixed pain (Bower & Reuter, 2009; Frawley, 2009; Vadivelu, Whitney, & Sinatra, 2009). In addition, surgery and some treatment procedures were reported to be the major sources of pain for patients after chest injury (Bower & Reuter, 2009; Frawley, 2009).

Pain has profound impacts on chest trauma patients. The physical impacts from pain include impeding normal functions of the respiratory system (Ghori, Zhang, & Sinatra, 2009), cardiovascular system (Adam et al., 2013; Ghori et al., 2009), gastrointestinal tract, immune system, wound healing, and decreased quality of sleep (Ghori et al., 2009). Psychological impacts from pain after thoracic surgery include the development of negative moods (e.g., fear, anxiety), reduced social interaction, and decreased ability to establish or maintain relationships (Keefe, 2009). Persistent pain and chronic pain after chest injury also cause depression and decreased quality of life (Ghori et al., 2009; Malchow & Black, 2008; Tecic, Lefering, Althaus, Rangger, & Neugebauer, 2013).

Moreover, pain impedes rehabilitation after injury (Ghori et al., 2009). A previous study revealed the negative effects of pain after chest injury on pulmonary rehabilitation and lung vital capacity resulting from ineffective breathing (Brown & Walters, 2012). Consequently, adequate pain management can enhance effective breathing of chest trauma patients as a result of increasing lung vital capacity (Truitt et al., 2010). Effective pain management is therefore crucial for enhancing chest rehabilitation in chest trauma patients.

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Nurses play a vital role in, and are responsible and accountable for, adequate pain management of patients. The Joint Commission, an organization in the United States that accredits health care organizations, launched the pain management standards. According to the quality indicators, pain should be prevented and controlled to a degree that facilitates function and quality of life and meets "the objective of preventing moderate to severe pain" (e.g., pain intensity exceeding 3/10) (Wells, Pasero, & McCaffery, 2008). However, severe pain and inadequate pain management have been reported among trauma patients, including chest trauma patients (Bower & Reuter, 2009; Frawley, 2009). Pain management programs have been developed for trauma patients in the prehospital phase and in emergency departments (Australian and New Zealand College of Anesthetists and Faculty of Pain Medicine, 2015; National Clinical Guideline Center, 2015; Queensland Ambulance Service, 2016; Scholten et al., 2015). However, there is still a lack of published evidence on pain management programs for acute hospitalized chest trauma patients.

In the era of evidence-based practice, day-to-day nursing practices should be guided by the best available evidence to ensure the best nursing care for patients (Polit & Beck, 2014) to achieve positive health outcomes (Melnyk, Fineout-Overholt, Gallagher-Ford, & Kaplan, 2012), including pain management outcomes (Shahriari, Golshan, Alimohammadi, Abbasi, & Fazel, 2015; Zabari, Lubart, Ganz, & Leibovitz, 2012). Reports of pain, inadequate pain management, and the lack of pain management programs for acutely ill hospitalized chest trauma patients, in particular in Thai hospitals, all reflect the need to develop an improved program of pain management. To date, there is also a lack of studies of evidence-based pain management programs in Thailand.

This gap in the literature indicates a need for further development of an evidence-based pain management program to achieve positive pain management outcomes for chest trauma patients in Thai hospitals.

Research Objective

The objective of this study was to examine the effects of an evidence-based pain management program on pain intensity and chest rehabilitation improvement among chest trauma patients in a hospital in southern Thailand.

Hypotheses

The hypotheses for this study were as follows: (1) Chest trauma patients will have significantly lower worst pain intensity after receiving the pain management program than before receiving the program, and lower than those in patients in the conventional care group. (2) After receiving the pain management program, chest trauma patients will have a significantly greater lung vital capacity than before receiving the program and greater than patients in the conventional care group.

Methods

A quasi-experimental design using two-group repeated measures was employed in this study. The study was conducted at the trauma ward of a university hospital in southern Thailand.

Participants

The sample size was calculated using power analysis to reduce the risk of type II error (Polit & Beck, 2014). The α value was set at 0.05 and power was equal to 0.80. The effect size calculation was based on findings from a previous relevant study conducted by Ho et al. (2014) that indicated the need for 21 participants in each group. This study included 42 chest trauma patients hospitalized in the trauma ward between February and June 2017 who were older than 18 years, had not been intubated, were able to communicate, and had a chest Abbreviated Injury Scale score between 2 and 5 with no other co-injuries and no history of chronic pain or pulmonary diseases. Excluded from the study were patients whose condition became critical, were transferred to other wards, or were discharged before the completion of the 5-day program. To avoid developing design contamination, the first 21 patients were assigned to the control group and received the usual care and the next 21 patients were assigned to the experimental group and received the pain management program.

Data Collection

Research Instruments

The worst pain intensity experienced during the previous 8 hours was measured using a numerical rating scale (NRS) from 0 to 10. Higher numbers indicated greater pain intensity or higher worst pain. The content validity index of the NRS was 1.00 with a test-retest reliability correlation coefficient of 0.97. A spirometer (Contec SP10) was used to measure the lung vital capacity as a parameter of the improvement of chest rehabilitation (Brown & Walters, 2012). The calibration of volume accuracy of the spirometer before the study was $\pm$2.27% to 2.86%, which met the standard level according to the European Respiratory Society 2005 (Miller et al., 2005). Interrater reliability testing was also conducted between the researcher, three research assistants, and the clinical nurse specialist who was an expert in spirometer measurement. The intraclass correlation coefficient yielded a value of 0.996. The intrarater reliability testing of each assessor was done using Spearman rank correlation coefficient (ρ), which yielded a value of 1.00. The quality of the pain management program was appraised by three experts using the Appraisal of Guidelines for Research & Evaluation II (The AGREE Next Steps Consortium, 2013) and the quality of each domain ranged between 86.66% and 96.53%.

Procedures

Data collection was conducted after the proposal was approved by the Institutional Review Board, Faculty of Nursing, Prince of Songkla University, Thailand, and the Ethics Committee of the Hospital Research Board (EC number: 59-353-19-9). Ethical principles in conducting research were employed at every step of the study, especially in the stage of data collection, analysis, and interpretation. Fully informed consent was obtained from each patient and family member before collection of the data. In this study, informed consent was developed based on the standard informed consent procedure of the Ethics Committee of the Hospital Research Board and the principle of respect for autonomy, which the participants signed before they engaged in the research. Purposive sampling was performed to select the patients who met the inclusion criteria. The first 21 patients admitted from February to March 2017 were assigned into the control group, and the next 21 patients admitted from April to June 2017 were assigned into the experimental group. Age, site of chest injury, Abbreviated Injury Scale score, intercostal drainage insertion, and thoracic surgery received were considered to be the potential determinants of pain perception among chest trauma patients (Bower & Reuter, 2009; Ho et al., 2014). Matching those parameters between the control and experimental group was used to reduce confounding and bias as well as to increase the reliability of the program (Polit & Beck, 2014).

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After the patients consented to participate in the study, the researcher approached each patient individually. The steps in the implementations of patients included in the study were as follows.

Conventional Group (Control Group)

Unidimensional pain assessment was used in the dimension of pain intensity using the NRS every 4 hours during the first 3 days of hospitalization by either the registered nurse or the nurse assistant. There was still a lack of documentation of pain reassessment after receiving pain management, breakthrough pain assessment, and assessment of procedure-related pain. Pharmacologic pain management, including type, dose, and route of medication, was performed according to the medical doctor's prescription and the attending nurse's decision making. The consistency of procedural pain management as well as nonpharmacologic pain management interventions varied depending on the attending nurses and medical doctors.

The worst pain intensity and spirometer measurement were measured on the first day and at 8 hours after joining the study and continued from day 1 throughout day 5 at the same time of the day.

Pain Management Program Group (Experimental Group)

Chest trauma patients in the experimental group received focused pain management from the researcher from day 1 to day 5 of hospitalization. Multidimensional pain assessment was used to assess pain on arrival. After this, the worst pain intensity at rest and during activity was assessed using the NRS every 4 hours, 5-10 minutes after receiving intravenous analgesics, and 60 minutes after receiving oral pain medication or nonpharmacologic intervention, including the development of breakthrough pain and procedure-related pain (e.g., intercostal drainage insertion and removal, changing wound dressing, while receiving chest rehabilitation, and during mobilization). If the patient had an NRS score >3 out of 10 at rest or >4 out of 10 during activity, interventions were implemented within 30 minutes to alleviate the pain. The pain management program included both pharmacologic and non\pharmacologic interventions for general and procedure-related pain.

On the first day of hospitalization and as needed, verbal information and a patient information booklet on pain management for chest trauma patients was given to the patients (e.g., how and when to report pain, when to ask for pain medication). The pharmacologic intervention was based on the pain treatment plan derived from mutual collaboration between the researcher and attending physician. The researcher reassessed the pain after pharmacologic interventions and consulted the physician if inadequate pain relief was evident. Nonpharmacologic interventions that were available included breathing relaxation techniques or listening to music or cold application. The method used was according to the preference of the patient.

Procedural pain was managed during three phases of before, during, and after the procedure (Czarnecki et al., 2011). Before the procedure, the interventions included pain management planning and assessment as well as administration of prescribed preemptive analgesia at an interval that permitted the onset of action before the start of the procedure. The patient's preference for nonpharmacologic therapy was used (Czarnecki et al., 2011; Given, 2010). During the procedure, the interventions included distraction/coping techniques, assessment of pain intensity, and providing additional support depending on whether the intervention was pharmacologic or nonpharmacologic or both as needed. After the procedure, the interventions included assessment of pain intensity regarding need for further pain management, discussing/evaluating the procedure with the patient and family if applicable, and documentation (Czarnecki et al., 2011).

Data Analysis

Data analysis was conducted using SPSS Version 16 for Windows software. Demographic data, clinical characteristics, pain, and pain management information were analyzed using descriptive statistics, χ^2, and independent *t* test. One-way repeated measures analysis of variance (ANOVA), two-way repeated measures ANOVA with repeated measure on one factor, and independent *t* test were used to test the hypotheses of this study.

Results

Demographic and Clinical Characteristics of the Participants

The data were obtained from 42 chest trauma patients who met the inclusion criteria. The study participants consisted of 32 men (76.2%) and 10 women (23.8%). The age of the participants ranged from 19 to 80 years (mean [M] = 47.3, standard deviation [SD] = 18.01 years). The demographic and clinical characteristics were not significantly different between the two groups ($p > .05$). Table 1 shows the demographic and clinical characteristics of the participants.

Pain and Pain Management of the Participants

Conventional Pain Management Group

The worst pain intensity measured by the NRS of the chest trauma patients in the regular pain management group on arrival revealed high pain intensity (M = 8.00, SD = 1.34). The patients reported constant pain (100%), and the characteristic was a throbbing pain (85.7%). Intravenous fentanyl was the most common pharmacologic intervention (95.2%). Almost half of the prescriptions were for multimodal analgesia (47.6%); 61.9% of the patients in the regular care group used cold application and only 9.1% used breathing relaxation techniques (Table 2).

Pain Management Program Group

The worst pain intensity measurements for chest trauma patients in the pain management group on arrival revealed high pain intensity (M = 8.43, SD = 1.08). The patients reported constant pain (100%), and the characteristic was a throbbing pain (90.5%). Fentanyl intravenous injection was used as the major pharmacologic intervention (85.7%). Multimodal analgesia prescription was also the major prescription (81%). Every patient in the pain management group used cold application, and most of them also used breathing relaxation techniques (95.2%) (Table 2).

There was no statistically significant difference between the groups in the worst pain scores on arrival ($p > .05$), characteristic of pain ($p > .05$), or types of intravenous opioid ($p > .05$). In contrast, multimodal analgesia prescription, cold application, and breathing relaxation techniques were used by a significantly greater proportion of chest trauma patients in the pain management program group than in the conventional care group ($p = .024$, $p < .001$, $p < .001$, respectively) (Table 2).

Pain Management Outcomes of the Participants (Worst Pain Intensity and Lung Vital Capacity)

In both groups the average scores of the worst pain intensity gradually decreased (Fig. 1) and the average lung vital capacity volume gradually increased from day 1 through day 5 of hospitalization (Fig. 2). In the pain management group, the worst pain intensity was significantly lower ($p = .000$) and the lung vital capacity was significantly higher after implementing the pain management program than before implementation ($p = .000$). Two-way

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Table 1
Demographic and Clinical Characteristics of the Participants

Variable	Control (n = 21)	Experiment (n = 21)	*p*
	n (%)	n (%)	
Sex			1.00*
Male	16 (76.20)	16 (76.20)	
Female	5 (23.80)	5 (23.80)	
Age (years)	M = 45.57, SD = 18.85	M = 49.50, SD = 17.45	.54†
AIS chest score			.43‡
Moderate (2)	6 (28.60)	10 (47.60)	
Serious (3)	14 (66.70)	10 (47.60)	
Severe (4)	1 (4.80)	1 (4.80)	
Medical diagnosis			.80‡
Pneumohemothorax	5 (23.80)	4 (19)	
Hemothorax	4 (19)	3 (14.30)	
Pneumothorax	2 (9.50)	5 (23.80)	
Lung contusion	1 (4.80)	1 (4.80)	
Number of fractured ribs			.57‡
1 fractured rib	2 (9.50)	0	
2 fractured ribs	7 (33.30)	9 (42.90)	
3 fractured ribs	4 (19)	5 (23.80)	
>3 fractured ribs	1 (4.80)	2 (9.50)	
Chest tube insertion	8 (38.10)	8 (38.10)	1.00*

* χ^2 Test.
† Independent *t* test.
‡ Likelihood ratio test.

repeated measures ANOVA revealed the worst pain intensity and the lung vital capacity ($p = .007$, $p = .016$, respectively) were significantly different between the pain management group and the conventional group. Independent *t* test analysis revealed significantly lower worst pain intensity ($p < .05$) and significantly higher lung vital capacity ($p < .05$) in the experimental group compared with the control group from day 1 to day 5 of hospitalization.

Discussion

Similar to the findings of previous studies, evidence-based pain management programs used in a variety of target populations were shown to achieve adequate pain management and positive pain management outcomes (Jewnarye, 2013; Rathanapratumwong & Youjaiyen, 2014; Shahriari et al., 2015; Zabari et al., 2012). The results of the present study also provided evidence to support the benefit of evidence-based use to enhance positive health outcomes (Melnyk, Fineout-Overholt, Gallagher-Ford, & Kaplan, 2012). Evidence-based practice has long been accepted as one of the best strategies to enhance the quality of nurses' clinical decision making, which results in enhanced quality of nursing practice (Grol, 2001). Evidence-based nursing practices also decrease variability of practice with all patients receiving the same standard of care (Polit & Beck, 2014).

As shown in this study, the patients in the pain management program group received the best pain management from both pharmacologic and nonpharmacologic interventions (e.g., multimodal analgesia, cold application, breathing relaxation techniques) according to the current best available evidence (Chailler, Ellis, Stolarik, & Woodend, 2010; Keene, Rea, & Aldington, 2011; Lin, 2012; Pasero, Quinlan-Colwell, Rae, Broglio, & Drew, 2016). The

Table 2
Pain and Pain Management of the Participants

Pain and Pain Management	Control (n = 21)	Experiment (n = 21)	*p*
	n (%)	n (%)	
Initial worst pain intensity (NRS 0-10)	M = 8.00 SD = 1.34	M = 8.43 SD = 1.08	.26*
Pattern of pain (constant)	21 (100)	21 (100)	
Characteristic of pain			.29†
Throbbing	18 (85.70)	19 (90.50)	
Stabbing	0	1 (4.80)	
Heavy	3 (14.30)	1 (4.80)	
Pharmacologic management			
Fentanyl	20 (95.20)	18 (85.70)	.28†
Morphine	3 (14.30)	3 (14.30)	1.00†
Nonopioids	15 (71.40)	17 (81)	.47¶
Multimodal analgesia	10 (47.60)	17 (81)	.024¶,§
Nonpharmacologic management			
Cold compression	13 (61.90)	21 (100)	<.001†,‡
Breathing relaxation	2 (9.50)	20 (95.20)	<.001¶,‡
Listening to music	1 (4.80)	3 (14.30)	.028†

M = mean; NRS = Numeric Rating Scale; SD = standard deviation.
* Independent *t* test.
† Likelihood ratio test.
‡ Significant; $p < .001$.
§ Significant; $p < .05$.
¶ χ^2 Test.

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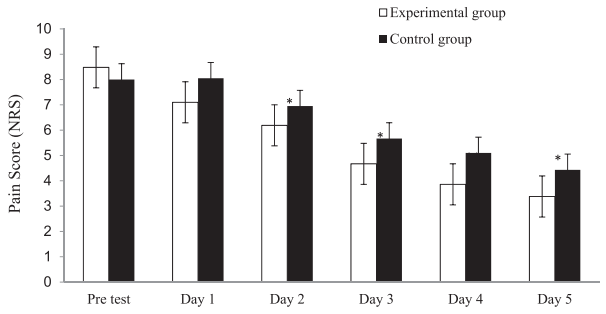

Figure 1. Comparison of the worst pain intensity between the experimental group and the control group. Vertical lines represent standard error of the mean.

study also revealed significant improvement in lowering pain intensity and increasing lung vital capacity. Noticeably, although listening to music was found to decrease pain, in particular in Western studies (Ozer, Ozlu, Arslan, & Gunes, 2013), it was not chosen by Thai patients in this study. This might reflect the influence of cultural differences of patient preferences in using nonpharmacologic intervention. Here, successful implementation of new interventions in one country needs to be modified for effective use in another country or be congruent with health care protocols in the context of Thailand.

Chest rehabilitation improvement that resulted from adequate pain management as evidenced in the present study was also congruent with previous studies (Ritkaew, 2009; Truitt et al., 2010). Pain around the chest that results from chest injury as well as from procedures has a profound impact on effective breathing and chest expansion (Ghori et al., 2009; Truitt et al., 2010). Pain around the chest area also decreases inspiration when performing chest rehabilitation exercises, such as a breathing exercise, or during mobilization (Ghori et al., 2009).

Limitations

The pain management program developed in this study focused on adult hospitalized communicable chest trauma patients in an acute phase in a hospital in Thailand. Results may not be generalized to all chest trauma patients (e.g., child, noncommunicable, different care context). The finding should be considered applicable to a specific group of patients and in a particular care context.

Conclusions

This study was a nurse-led pain management program with the aim at evaluating the effects of the intervention with the goal of reducing the level of the worst pain and increasing the lung vital capacity in chest trauma patients. The results indicated that the application of the pain management program reduced the worst pain intensity and increased the lung vital capacity of hospitalized trauma patients in the acute phase. Successful use of a pain management program lies in the integration of the best available evidence into nursing practice to achieve standardized nursing interventions and significantly improve the quality of pain management.

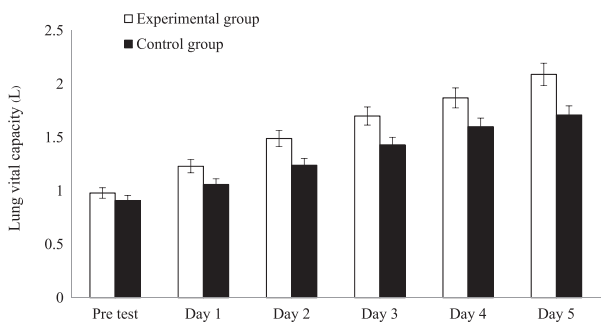

Figure 2. Comparison of lung vital capacity between the experimental group and the control group. Vertical lines represent standard error of the mean.

Clinical Implications

The findings of this study provided a practical and applicable intervention for pain relief and chest rehabilitation in chest trauma patients. Use of this pain management program in every hospital nationwide is recommended. Interdisciplinary pain management should also be established to enhance the quality of pain management.

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