

Original Article

# To Determine how the Severity of Pain Relates to the Quality of Sleep Following Tube Thoracostomy

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## ABSTRACT

**Background:** Tube thoracostomy (TT) is a prevalent procedure in the management of various thoracic conditions, including pneumothorax, pleural effusion, and chest trauma. Despite its widespread use, TT is associated with significant complications such as pain and impaired sleep quality, which can affect patient recovery and overall health outcomes.

**Objective:** This study aims to explore the relationship between pain severity and sleep quality following tube thoracostomy and to assess the impact of pain management on postoperative recovery.

**Methods:** A descriptive, prospective, cross-sectional study was conducted at Dr. Ruth K. M. Pfauf Civil Hospital Karachi and Dow University of Health Sciences from September 28, 2022, to March 27, 2023. The study included adults aged 18 to 70 who underwent TT for any indication. Patients were excluded if they withheld consent, had a history of substance use, psychological disorders, or were victims of poly-trauma. Pain severity was assessed using a visual analogue scale (VAS) and sleep quality was evaluated using the Richards-Campbell Sleep Questionnaire (RCSQ). Data were analyzed using SPSS version 25, employing descriptive statistics and Spearman correlation tests.

**Results:** The study involved 77 participants with a mean age of  $28.33 \pm 10.50$  years. The mean pain scores on postoperative days 1, 2, and 3 were  $8.08 \pm 0.66$ ,  $6.92 \pm 0.99$ , and  $4.92 \pm 1.37$ , respectively. Corresponding sleep quality scores were  $17.50 \pm 7.53$ ,  $36.67 \pm 9.84$ , and  $57.50 \pm 10.55$ . A significant negative correlation was found between pain scores and sleep quality scores on day 3 ( $r = -0.744$ ,  $p < 0.001$ ).

**Conclusion:** The findings suggest a significant association between lower pain scores and improved sleep quality among patients undergoing tube thoracostomy. Effective pain management may enhance sleep quality and facilitate recovery, highlighting the need for comprehensive postoperative care strategies in these patients.

**Keywords:** Tube Thoracostomy, Pain Management, Sleep Quality, Postoperative Care, Visual Analogue Scale, Richards-Campbell Sleep Questionnaire, Spearman Correlation, Thoracic Surgery.

## INTRODUCTION

Tube thoracostomy (TT) is a critical procedure frequently utilized across various medical settings, from emergency rooms to operating theaters, primarily for conditions that range from life-threatening emergencies to routine postoperative care. This procedure is crucial in managing chest trauma, which is a significant concern in Pakistan due to the increasing incidence of road traffic accidents attributed to rapid population growth and inadequate infrastructure. Although specific local data on chest trauma is limited, studies have documented mortality rates between 7% and 11.8%, underscoring the serious nature of such injuries (1-3). TT is indispensable in evacuating hemothorax, preventing tension pneumothorax, aiding lung re-expansion, controlling pulmonary bleeding, and improving respiratory function. Additionally, TT is essential in the postoperative setting and for patients with malignancies to manage pleural effusions, thus alleviating symptomatic distress (4, 5).

Despite its benefits, TT is associated with numerous complications such as infection, organ damage, hemothorax, and re-expansion pulmonary edema. Among these, pain is the most common, persisting typically between 72-96 hours post-procedure and often being more intense than pain from other surgical interventions (6). This pain, especially at night, can be exacerbated by movements like coughing or changing sleeping positions, which disrupts sleep by complicating the initiation, maintenance, and deepening of sleep cycles. The impact of pain is also known to interfere with the effectiveness of analgesic medications, further impairing sleep quality (6-9).

Sleep is fundamental to recovery in hospitalized patients, supporting physical, cognitive, and psychological restoration. Disrupted sleep can lead to cognitive and psychological impairments and worsen physical health outcomes. Therefore, understanding how pain impacts sleep quality after TT is crucial (10). The limited research available, including studies by Akutay et al. and Oren et al., suggests a relationship between postoperative pain severity and subsequent sleep quality. These studies found that while pain on the first day post-TT was positively correlated with sleep quality on the corresponding night, pain intensity on subsequent days negatively affected sleep quality on those nights (10-15).

Given the limited and somewhat inconclusive evidence currently available, our prospective study is designed to explore the relationship between pain severity and sleep quality following TT in greater depth. This investigation will not only add to the existing body of evidence but also set the stage for future research endeavors that could lead to improved patient outcomes in post-thoracostomy recovery. Through this study, we aim to clarify the extent to which pain influences sleep quality and identify potential interventions that could mitigate this effect, thereby enhancing overall recovery and patient care.

## MATERIAL AND METHODS

The study was designed as a descriptive, prospective, cross-sectional investigation, conducted over a six-month period from 28th September 2022 to 27th March 2023 at Dr. Ruth K. M. Pfau Civil Hospital Karachi & Dow University of Health Sciences. It aimed to assess the relationship between pain severity and sleep quality following tube thoracostomy in adult patients aged between 18 and 70 years. The study population included patients of any gender who required a chest tube insertion for any medical indication. Exclusion criteria were patients who declined to give consent, those with a history of substance use, psychological disorders, or those who had experienced poly-trauma.

Prior to the commencement of the study, ethical approval was granted by the Research Evaluation Unit of the College of Physicians & Surgeons Pakistan (CPSP/REU/SGR-2018-192-9936, REU no. 51328), and the study procedures conformed to the ethical standards of the Helsinki Declaration. A non-probability consecutive sampling method was employed to recruit participants, with the sample size calculated using PASS version 15 software. The necessary sample size was determined to be 77 based on a predicted correlation of 0.48414 between pain severity and sleep quality, assuming a baseline correlation of 0.2, with a power of 80% and a confidence level of 95% (12-14).

Data collection was initiated following approval from the CPSP and the Ethical Review Committee of Dow University of Health Sciences. Eligible patients were enrolled consecutively as they were admitted to the surgical department. Comprehensive study details, including potential risks and benefits, were explained to the patients, and written informed consent was obtained from each participant. Baseline data such as age, gender, height, weight, BMI, and medical history (diabetes, hypertension, and smoking habits) were gathered using standardized forms. The indication for chest tube placement and the details of the procedure, whether performed under general or local anesthesia, were also recorded.

Pain severity was measured at intervals of six hours (0, 6, 12, 18, and 24 hours) after the procedure using a visual analogue scale (0-10), and subsequently every 12 hours until tube removal. Sleep quality was assessed daily using the Richard-Campbell Sleep Questionnaire (RCSQ), where each item was scored from 0 to 100 mm, with higher scores indicating better sleep quality. Rescue analgesia was provided for patients experiencing moderate to severe pain (14).

For data analysis, SPSS version 25 was utilized. Descriptive statistics presented the data in terms of frequencies, percentages, means, and standard deviations. The Shapiro-Wilk test was used to check the normality of data distribution. The relationship between pain severity and sleep quality was analyzed using Spearman's correlation coefficient, taking into consideration confounding variables such as age, gender, BMI, comorbid conditions, smoking status, indications for chest tube placement, type of surgery, type of injury, and duration of drain placement. Confounding factors were controlled through stratification, and correlations were considered significant at a p-value less than 0.05.

## RESULTS

In the study, the distribution of etiological factors for tube thoracostomy was thoroughly examined. A notable 55.8% of the cases were due to chest trauma, indicating a significant prevalence of this condition as a contributing factor. Lung collapse and poly-trauma

were responsible for 10.4% and 33.8% of cases, respectively (Figure 1). These statistics underscore the critical need for tube thoracostomy in managing various forms of chest-related injuries and conditions.

Regarding the indications for the procedure, pneumothorax was the predominant reason, accounting for an overwhelming majority of the cases with a total of 52 incidents. This was followed by rib fractures, which were indicated in 10 cases, demonstrating the procedure's relevance in managing severe thoracic injuries. Other conditions necessitating tube thoracostomy included post-esophagectomy and empyema, with 8 and 5 cases respectively, reflecting a smaller but significant portion of clinical scenarios (Figure 2). Hemothorax was the least common indication, observed in only 2 cases.

Table 1: Descriptive Statistics and Shapiro-Wilk Test Results for Demographic and Clinical Details

Variable	Mean ± SD	P-value
Age Group	28.33 ± 10.50	0.002
Height	167.42 ± 6.78	0.249
Weight	61.17 ± 8.25	0.448
BMI	21.95 ± 2.90	0.937
Pain Score Day 1	8.08 ± 0.66	0.012
Pain Score Day 2	6.92 ± 0.99	0.011
Pain Score Day 3	4.92 ± 1.37	0.080
Sleep Quality Score Day 1	17.50 ± 7.53	0.080
Sleep Quality Score Day 2	36.67 ± 9.84	0.010
Sleep Quality Score Day 3	57.50 ± 10.55	0.032

Table 2: Details of Co-morbid Conditions

Variable	Yes	No
Diabetes Mellitus	12	65
Hypertension	21	56
Smoking	35	42
Elective Surgery	11	66
Emergency Surgery	66	11

Table 3: Relationship Between Pain Score and Sleep Quality Score

Timeline	Variable	Mean ± SD	Correlation (r)	P-value
Day 1	Pain Score (n=77)	7.97 ± 0.77	-0.640	0.0001
	Sleep Quality Score (n=77)	20.78 ± 8.54		
Day 2	Pain Score (n=77)	6.42 ± 1.15	-0.750	0.0001
	Sleep Quality Score (n=77)	41.95 ± 12.14		
Day 3	Pain Score (n=77)	4.52 ± 1.61	-0.744	0.0001
	Sleep Quality Score (n=77)	61.25 ± 13.90		

Table 4: Relationship Between Pain Score and Sleep Quality Score with Stratification

Variables	Relationship	Mean ± SD	Correlation (r)	P-value
Age Group < 40	Pain Score	4.34 ± 1.54	-0.744	0.0001
	Sleep Quality Score	61.87 ± 14.59		
Age Group > 40	Pain Score	5.27 ± 1.71	-0.765	0.001
	Sleep Quality Score	58.67 ± 10.60		
Gender Male	Pain Score	4.30 ± 1.42	-0.723	0.0001
	Sleep Quality Score	62.70 ± 13.40		
Gender Female	Pain Score	5.04 ± 1.91	-0.770	0.001
	Sleep Quality Score	57.83 ± 14.75		
BMI < 20	Pain Score	4.92 ± 1.69	-0.835	0.0001
	Sleep Quality Score	57.92 ± 16.97		

Variables	Relationship	Mean ± SD	Correlation (r)	P-value
BMI > 20	Pain Score	4.31 ± 1.54	-0.695	0.0001
	Sleep Quality Score	62.94 ± 11.88		

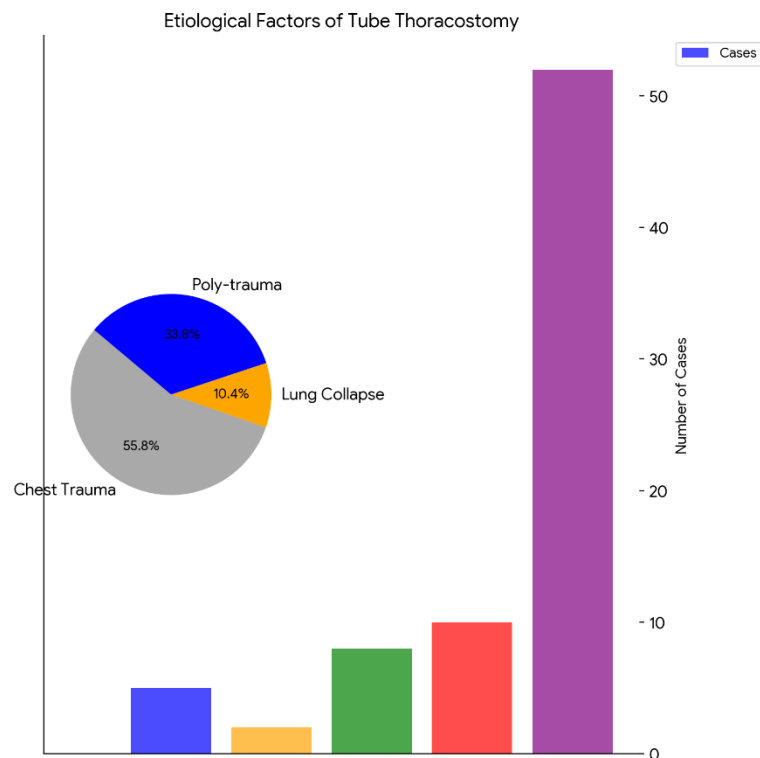


Figure 1 Etiological Factors of Tube Thoracostomy and underlying cause

The analysis of pain scores and sleep quality further illustrates the procedure's impact on patient outcomes. On the first day post-thoracostomy, the average pain score was notably high at 7.97 but decreased to 4.52 by the third day, indicating a gradual improvement in patient condition. Correspondingly, sleep quality scores improved from an average of 20.78 on the first day to 61.25 by the third day (Table 3). These trends suggest a direct correlation between decreasing pain and improving sleep quality post-procedure, highlighting the effectiveness of pain management and its significance in enhancing patient recovery.

Moreover, stratified analysis based on various demographic and clinical parameters revealed consistent patterns. For example, younger patients (under 40 years) and males tended to report lower pain scores and higher sleep quality, underscoring potential demographic differences in postoperative recovery (Table 4). Such detailed insights are crucial for tailoring postoperative care and enhancing overall treatment outcomes.

These findings collectively provide valuable insights into the etiology and indications for tube thoracostomy, alongside the effects of the procedure on postoperative pain and sleep quality. They emphasize the importance of effective pain management strategies to facilitate recovery and improve quality of life for patients undergoing this critical surgical intervention.

## DISCUSSION

In the management of patients following tube thoracostomy, addressing pain severity and optimizing sleep quality are pivotal to ensuring a successful recovery. The complexities of postoperative care involve not only treating the underlying medical condition but also enhancing patient comfort and overall well-being (16). This study has delved into the relationship between pain and sleep, crucial aspects that significantly influence patient outcomes. Pain, a common sequelae of surgical interventions like tube thoracostomy, can substantially hinder recovery if not effectively managed. Furthermore, sleep, integral to the body's healing processes, is often disrupted when pain is poorly controlled, thereby exacerbating stress levels and potentially delaying recovery (17).

The research highlighted how disruptions in sleep could amplify pain perception and impede the natural recuperative processes, reinforcing the need for an integrated approach to managing these aspects (13, 20). Our findings revealed a strong negative correlation between pain severity and sleep quality on the third day post-operation ( $r = -0.744$ ) ( $P = 0.0001$ ), emphasizing the intertwined nature of these factors. Similar studies, such as those by Akutay S. et al. and Oren B. et al., have also observed correlations between pain and sleep post-thoracotomy, though their findings suggested variations in the pattern of this relationship across different postoperative days (14, 15).

Tube thoracostomy is frequently indicated for conditions such as pneumothorax, traumatic injuries, and pleural effusions, among others (18). The procedure itself, involving potential damage to the parietal pleura and intercostal nerves, underscores the origins of postoperative pain, which if unmanaged, leads to significant discomfort and poor sleep quality (19). This study's demographic findings align with broader research, showing a predominance of male patients undergoing tube thoracostomy, which is consistent with the gender distribution reported in related literature (14, 15, 21).

While our study contributes valuable insights into the dynamics of pain and sleep post-tube thoracostomy, it is not without limitations. The sample size, though adequate for initial analysis, restricts the generalizability of the findings across broader, more diverse populations. Furthermore, the observational nature of the study limits the ability to infer causation definitively.

Future research should aim to expand on these findings with larger, more diverse populations to enhance the robustness and applicability of the data. Implementing randomized controlled trials could also help delineate causative relationships more clearly and evaluate the effectiveness of specific pain management and sleep enhancement interventions. There is also a pressing need for developing and testing targeted strategies that address both pain and sleep simultaneously, as this approach could significantly improve recovery outcomes.

## CONCLUSION

In conclusion, this study has demonstrated a significant correlation between pain severity and sleep quality among patients following tube thoracostomy, underlining the importance of effective pain management to enhance sleep quality and, by extension, recovery. Moving forward, it is imperative that healthcare providers implement comprehensive pain management protocols, not only to alleviate discomfort but also to facilitate better sleep patterns, thereby supporting the overall recuperation process of their patients.

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