

COMPLICATIONS OF TUBE THORACOSTOMY IN ISOLATED CHEST INJURIES

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ABSTRACT

Objective To assess the complications and its related factors associated with tube thoracostomy.

Study design Descriptive case series.

Place & Duration of study Surgical Unit VI, Dow University of Health Sciences and Civil Hospital Karachi, from November 2008 to October 2009.

Methodology Sixty patients with isolated chest injury were included, who were managed with tube thoracostomy. Main outcome measures were chest tube related complications (insertional, positional, infective and others) and length of hospital stay (in days). The SPSS version 11 was used for statistical analysis.

Results The overall complication rate was 36.7% including 23.3% positional, 10% infective and 3.4% others. Mean (\pm SD) duration of hospital stay was 13.12 (\pm 6.28) days. Tube thoracostomies carried out by the postgraduate residents had a significantly higher complication rate (33.4%) as compared to senior registrars (3.3% - p 0.043).

Conclusions Tube thoracostomy is an effective measure of treating chest trauma but associated with significant morbidity. Furthermore, a remarkable difference in the complication rates among experience of operator suggests the need for further training.

Key words Tube thoracostomy, Trauma, Complications.

INTRODUCTION:

With the increasing frequency of traumatic chest injuries a large number of patients are dealt with by doctors in emergency department. Tube thoracostomy is an essential life saving measure for the management of pneumothorax, hemothorax and hemopneumothorax developed as a consequence of chest trauma.¹ In chest trauma, the primary aim is to maintain ventilation of lungs for proper oxygenation of body tissues and this cannot be achieved without chest decompression to decrease

intra-pleural pressure and allow lungs to expand fully. Various therapeutic options have been reported in literature for management of chest injuries like clinical observation, thoracocentesis, tube thoracostomy and open thoracotomy.²⁻⁴ Among these chest tube decompression remains the most efficacious with the complication rate up to 30%.⁵

Despite the enormity of its clinical utility, this procedure carries considerably significant preventable morbidity. In general, they are categorized as insertional, positional or infectious.⁵ Although several risk factors contribute to this tube-related complications like size of tube,⁶ technique and approach of insertion,⁷ experience of operator⁸ and prehospital tube placement,⁹ level of experience is one of the important factors in the development of these complications.

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The purpose of this study was to assess the complications associated with tube thoracostomy and analyze factors related to these.

METHODOLOGY:

This prospective descriptive study was conducted at Surgical Unit VI, Dow University of Health Sciences and Civil Hospital Karachi, from November 2008 to October 2009.

All adult patients of either gender, at least 15 years of age, were included if they had acute thoracic injuries (blunt or penetrating) with clinically suspected tension pneumothorax and/or proven pneumothorax on physical examination or chest x-ray. Exclusion criteria were patients with other thoracic visceral (like cardiac and esophageal) injuries and those who needed emergency thoracotomies, and patients with head and neck or thoracoabdominal or limb trauma requiring surgical intervention.

Chest tubes were inserted between anterior and posterior axillary lines with blunt dissection technique according to ATLS guidelines. Once inserted, the tube was connected to an underwater-seal drainage system and its working was affirmed by movement of water column in chest tube. Later, supine anteroposterior chest x-ray was performed to confirm its position. Patients were then subsequently managed and followed in surgical ward and/or ICU. Eventually, tubes were removed as indicated by the rate of drainage (i.e. <50 ml/day), clinical status of the patient i.e. bilaterally equal intensity of breath sounds and chest radiograph with evidence of lung expansion. Patients were then kept under observation for at least 24 hours to rule out post-extubation pneumothorax.

A predesigned proforma was used for all data entry. Outcomes of interest included duration of hospital stay (in days) and chest tube related complications. Complications were defined as insertional (for example, lung or other organ laceration or perforation, hemorrhage), positional (for example, improper positioning either within chest cavity leading to tube failure or outside the chest cavity i.e. extrapleural location of chest tube holes causing subcutaneous emphysema and post-extubation pneumothorax), infectious (for example, wound infection or empyema thoracis) or other complications (for example, tube blockage by blood clot or accidental dislodgement).

The software program SPSS for Windows (Version 11, 2002, SPSS Inc., Chicago, IL, USA) was utilized for all statistical analyses. Mean \pm SD (standard deviation) was used to compute quantitative

variables, whereas qualitative variables were expressed as percentages and frequencies. The Fischer's exact test was employed to assess differences in proportions and associations among categorical data. A p-value of less than 0.05 was considered statistically significance.

RESULTS:

A total of sixty patients, fulfilling the inclusion and exclusion criteria, were enrolled in this study with mean age of 33.5 ± 12.01 years (range 16-69 years). Of these, forty nine (81.7%) were males whereas eleven (18.3%) were females. The causative injury were grouped as penetrating (61.7%) and blunt (38.3%) thoracic injuries. All tube thoracostomies were placed in the operating room. The commonest indication was hemothorax (n 27, 45%) followed by hemopneumothorax (n 21, 35%) and pneumothorax (n 12, 20%).

The overall complication rate related to chest tube intubation was 36.7% (Table I). Malpositioned chest tubes constituted the major bulk of these complications; they were replaced on the basis of clinical and radiological grounds. Infectious complications were noted in six (10%) patients; two (3.3%) of them developed empyema thoracis. No insertional complications were noted in this series. Also post-extubation pneumothorax was not observed.

Significant associations were, however, observed when comparing complications of tube thoracostomy and seniority of operator (Table II). Considerably less complications were encountered when tube thoracostomy was performed by senior registrars in contrast to postgraduate residents ($p=0.043$). There was also a propensity towards postgraduate residents having more positional complications (21.7%) especially by junior residents (postgraduate trainee 1-2 years) (Table III). Overall, their complication rate was 23.4%, compared with 10% among senior residents and 3.3% among senior registrars.

With the exception of two patients who were referred to Thoracic Surgery Unit, all were discharged the next day after removal of their chest tubes. The mean duration of hospital stay of remaining fifty eight patients was 13.12 ± 6.28 days (range 6-24 days).

DISCUSSION:

In this series, majority of the patients (45%) presented to emergency room with hemothorax and only 20% with pneumothorax, which is not comparable to other studies.^{2,8-10} This discrepancy

Table I: Complications of Tube Thoracostomy		
Complications	No.	Percentage
Insertional	0	0
Positional (Improper position)		
Outside chest cavity	4	6.7
Within chest cavity	10	16.6
Post-extubation pneumothorax	0	0
Infectious		
Wound infection	4	6.7
Empyema thoracis	2	3.3
Other complications		
Tube blockage	1	1.7
Accidental dislodgement	1	1.7
Total	22	36.7

Table II: Risk Factor Analysis of Chest Tube Complications			
Seniority of operator	Complications		p-value
	Present	Absent	
Postgraduate Residents	20 (33.4)	26 (43.3)	0.043
Junior Resident (1-2 years)	14 (23.4)	15 (25)	
Senior Resident(3-4 years)	6 (10)	11 (18.3)	
Senior Registrars	2 (3.3)	12 (20)	
Data is shown as number followed by percentage in parentheses			

Table III: Positional Complications In Relation to Level of Experience		
Seniority of operator	Positional Complications	
	Present	Absent
Postgraduate Residents	13 (21.7)	33 (55)
Junior Resident (1-2 years)	9 (15)	20 (33.3)
Senior Resident(3-4 years)	4 (6.7)	13 (21.7)
Senior Registrars	1 (1.7)	13 (21.7)
Data is shown as number followed by percentage in parentheses		

is probably due to difference in proportion of mechanism of trauma. In this series, penetrating injuries were more common causing hemothorax in contrast to blunt trauma observed in international series.

There was no insertional complication noted in this

study, which is comparable to retrospective study conducted by Bailey.⁵ Chan et al¹¹ noticed 64 complications in 352 tube thoracostomies (18.2% complication rate), but no insertional complication. On the other hand, published complications in literature include lacerations of lung, intercostal artery, esophagus, diaphragm, stomach, right atrium,

subclavian vein as well as pulmonary artery.^{8,12-13} Most of these complications were the consequence of trocar insertion technique rather than blunt method, as we employed in this series. Hence, it is now a worldwide acceptance that trocar insertional technique is not safe and preference is being given to the blunt methods.¹⁴

The positional complications resulted in greater (23.3%) morbidity in this series, as also reported by others.¹⁵ Ball and associates⁸ observed 17 complications in 76 tube thoracostomies (22.4%); most of these were positional (53%). Critical review of malpositioned chest tubes in this series revealed four (6.7%) cases had extrathoracic location of tube leading to subcutaneous emphysema and ten (16.6%) had intrathoracic malposition resulting in tube failure. All were successfully replaced without further complications.

There is a high prevalence of chest tube malposition in emergency thoracostomies, as previously mentioned by Baldt et al in their retrospective series.¹⁶ None of the patients in this study developed post-extubation pneumothorax. This is in contrast to study conducted by Bailey who noticed three cases of recurrent pneumothoraces after removal of the drain.⁵ The best possible method for discontinuation of chest tubes has not been concluded yet and various protocols have been adopted for prevention of this adverse outcome so far but none of them had significantly decreased post-extubation pneumothorax.^{17,18} However, we employed sustained Valsalva maneuver to forcibly inflate the lung against the chest wall with suspended breathing during chest tube removal, as recommended by Gomela et al.¹⁹

In this series, out of the six (10%) infective complications four (6.7%) were drain site infections that responded well to a course of antibiotics and repeated dressings. Gonzalez and Holevar evaluated the efficacy of antibiotics in reducing the infective complication rate after tube thoracostomy for isolated chest trauma.²⁰ The remaining two (3.3%) infective complications in this series were empyema thoracis. Its rate is nearly consistent with study conducted by Bailey.⁵ Contamination of blood in pleural space during tube thoracostomy insertion is the key factor in developing post-traumatic empyema, as mentioned by Hoth and associates.²¹ Apart from aseptic techniques, prophylactic administration of antibiotics significantly lowers the incidence of this complication, as suggested by LoCurto and colleagues in their prospective randomized study.²²

The other complications in this series were one

(1.7%) case of accidental dislodgment and one (1.7%) with non-functioning tube as a result of clotted blood. Among these, dislodgment of drain was a cause of spontaneous pneumothorax, which was immediately replaced by another chest tube. Non-functioning tube due to clotted blood was also replaced. This was the consequence of using smaller tubes. We used #24-32 Fr sizes of drains in our patients. Horsley et al described the blockage of tube related to small bore drains usage.²³ Therefore, to overcome this complication large bore (#36Fr or greater) chest drains should be employed.

Although residents at our institution are taught to follow blunt dissection technique of performing tube thoracostomy, they still resulted in considerable complication rates as compared to senior registrars, and most of these complications were positional. Hence postgraduate training level is an important predictor of having these adverse outcomes in tube thoracostomy procedure.

CONCLUSIONS:

Tube thoracostomy is an effective measure in managing patients with chest trauma but associated with significant morbidity. Furthermore, placement of chest tube by postgraduate resident medical officers (especially by junior residents) is predictor of complications.

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