

## ORIGINAL ARTICLE

ROLE OF CLAMPING TUBE THORACOSTOMY PRIOR TO REMOVAL  
IN NON-CARDIAC THORACIC TRAUMA

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**Background:** The frequently encountered thoracic trauma in surgical emergencies is a major cause of mortality and morbidity. Eighty percent of thoracic trauma can be managed by simple insertion of tube thoracostomy. Though guidelines for insertion are comprehensively explained in literature, an ideal algorithm for discontinuation is not available. A standard and safe defined protocol would eliminate hesitancy in confident removal among general surgeons. The objective of this study was to determine role of clamping trial prior to removal in terms of frequency of recurrent pneumothorax. **Methods:** This study was conducted in department of Surgery Combined military hospital/Military Hospital Rawalpindi from April 2013 to March 2014. Total 180 patients with blunt or penetrating thoracic trauma were included in the study. Chest tube (28–36 Fr) was inserted in Trauma centre under strict asepsis. Tubes were then connected to under water seal for minimum six hours. Patients were randomly divided in two equal groups (90 in each). In Group A, Clamping trial was given before attempting removal while in Group B, tube was removed immediately without clamping trial. Patients of both groups were observed two hourly for development of recurrent pneumothorax. Data was analysed using SPSS-18. **Results:** The comparison of frequency of recurrent pneumothorax in Group A (9 patients, 10%) and in Group B (4 patients, 4.5%) was not found to be statistically significant. (*p*-value 2.073). **Conclusion:** Clamping trial is unnecessary prior to removal of tube thoracostomy in blunt and penetrating non-cardiac thoracic trauma in terms of recurrent pneumothorax.

**Keywords:** Clamping; Chest tubes; Thoracostomy.

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## INTRODUCTION

Injury is a significant public health problem that is often overlooked in the developing world.<sup>1-3</sup> Of all traumas, thoracic trauma comprises 10–15%.<sup>4,5</sup> Almost 25% of trauma related mortality is directly attributable to thoracic trauma and it is a contributing factor in another 25%.<sup>6</sup> The effects of lethal thoracic trauma can be ameliorated by timely and expert intervention. Fortunately 80% of injuries can be managed simply by insertion of a tube thoracostomy, analgesia, incentive spirometry and does not require any heroic major surgical intervention. The procedure is not without risks and has a complication rate of 6–36%.<sup>7,8</sup> Though indications and methods for insertion are comprehensively explained in guidelines by American College of Surgeons committee on trauma,<sup>9</sup> consensus on subsequent management once inserted is little. Practices in clinics and wards vary from centre to centre depending upon the personal experiences or custom practices. An ideal algorithm for discontinuation is not available because of paucity of available studies.<sup>10</sup> An early removal may necessitate re-insertion of tube thoracostomy. On the other hand a prolonged duration increases the risks of well documented positional and infective complications.

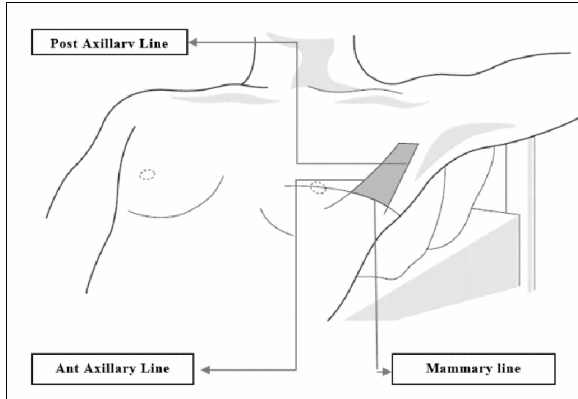
The most significant complication after tube thoracostomy removal is recurrent pneumothorax.<sup>11</sup> The incidence reported in literature for recurrent

pneumothorax after removal of tube thoracostomy ranges from 2–24%.<sup>12</sup> A trial of clamping for 6 hours followed by radiographs more often as a ritual is followed as a routine practice in General Surgical Units. Considering the most significant complication of removal, recurrent pneumothorax was the outcome variable observed in this research.

The rationale was to determine whether a clamping trial before removal was necessary to detect recurrent pneumothorax. The study was conducted with an aim to define a standard and safe protocol for removal of tube thoracostomy and eliminate the hesitancy in confident removal of tube thoracostomy.

## MATERIAL AND METHODS

This prospective Randomized Control Trial was conducted at surgical department, Combined Military Hospital (CMH) and Military hospital (MH) Rawalpindi over a period of one year (April 2013 to March 2014). Permission from hospital ethical committee was secured and written informed consent was taken from every patient in the study. A total of 180 patients with blunt or penetrating thoracic trauma were included in the study. Patients with associated head injury, requiring mechanical ventilator support or with previous history of thoracotomy were excluded. After appropriate diagnosis, a Chest tube (28–36 Fr) was inserted under strict asepsis by blunt dissection technique in the safety triangle.



**Figure-1: Diagram to illustrate the safety triangle**

In all tubes a retaining suture was left with an intent to close the wound while removal of tube. The practice in wards was to apply suction run centrally by hospital complex (-20 cm of water). Initial fluid output was noted. Chest tubes were then connected to underwater seal for a minimum of six hours in all patients. Patients were advised deep breathing exercises to facilitate good lung expansion and closure of air leak. Adequate analgesia in the form of intravenous ketorolac 30 mg 8 hourly was ensured. Patients were considered fit for the removal/clamping of tube only if they met a fixed criterion. The criteria included a lack of air leak for 6 hours, (objectively assessed by absence of air bubbles on inspiration) and/or a fluid output of less than 30 millilitres in 6 hours or 200 millilitres in 24 hrs. Patients were randomized by lottery method in one of the two groups. In group A, a trial of clamping was done before attempting removal of tube thoracostomy. In group B, no trial was given rather tubes were simply removed after the criteria were ensured to be met. All tubes were removed swiftly by the surgeon himself at end-inspiration. Patients were practiced to inspire and hold breath several times to maintain a positive intrathoracic pressure. Dressing was held near the tube insertion site with the non-dominant hand and tube was removed quickly with the dominant hand while simultaneously tying the retaining suture. Air tight anti septic dressings were applied after removal of tube. The patients were monitored 2 hourly for development of symptoms and signs suggesting recurrent pneumothorax. In the end, a chest radiograph was obtained after 24 hrs to confirm that the lung is fully expanded.

Data so obtained was entered and analysed using computer software, SPSS-18. Mean and standard deviation for quantitative variables (age) and frequency and percentage for qualitative variables (gender, mechanism of thoracic injury, recurrent pneumothorax) were calculated. Chi square test was applied to compare recurrent pneumothorax between clamping and non-clamping groups. The *p*-value of less than <0.05 was taken as significant.

## RESULTS

The study population comprised of one hundred and eighty patients (90 in each group). No subjects were dropped out or lost at any point in the study.

The mean age and standard deviation for the total patient sample was 33.3±9.429. The minimum age was 21 years and maximum age of test subject was 65 years. Male patients were 163 (90.6%) while 17 patients (9.4%) were females with male to female ratio of 9.59:1. Blunt trauma as mechanism of thoracic injury was observed in 82 patients (45.6%) and penetrating trauma in 98 patients (54.4%). The two groups were equal in size and comparable in terms of clinical characteristics of the patients. (Table-1)

Recurrent pneumothorax after discontinuation of tube thoracostomy was observed in a total of 13 cases (7.2%). Nine out of ninety patients (10%) in group A developed recurrent pneumothorax requiring unclamping of tube thoracostomy whereas in group B, four out of ninety patients (4.5%) required a second tube placement due to development of recurrent pneumothorax. The comparison of frequency of recurrent pneumothorax after tube thoracostomy discontinuation in both groups was not found to be statistically significant. (Table-2) Chi square tests were applied and *p* value was 2.073.

**Table-1: Summary-Clinical characteristics of patients in clamping and non-clamping group**

Characteristic	Total (180)	Group A Clamping Trial (90)	Group B Non-clamping Trial (90)
Age±SD	33.3±9.429	32.9±9.228	32.3±9.667
Male	163 (90.6%)	81	82
Female	17 (9.4%)	9	8
M:F	9.59:1	9 : 1	10.25 : 1
Blunt trauma	82 (45.6%)	40	42
Penetrating trauma	98 (54.4%)	50	48
Pneumothorax	151 (83.9%)	74	77
Hemopneumo-thorax	29 (16.1%)	16	13

**Table-2: Comparison of recurrent pneumothorax between clamping and non-clamping groups**

Recurrent Pnumothorax	Group-A (Clamping Trial) n (%)	Group-B (Non-Clamping Trial) n (%)	<i>p</i> -Value
Yes	9 (10.0%)	4 (4.5%)	2.073
No	81(90.0%)	86 (95.5%)	(>0.05)

## DISCUSSION

Though tube thoracostomy today is the standard of care for most of the cases of thoracic trauma, there are very few studies which clarify queries and determine the best method of insertion<sup>13,14</sup> or discontinuation of tube thoracostomy.<sup>15,17</sup>

In our study, mean age of 33.3 years and minimum age of 21 years proved the impact of

thoracic trauma in young productive years of life as explained in literature.<sup>16-18</sup> The predominant mechanism of thoracic trauma as reported in literature is blunt thoracic trauma.<sup>19,20</sup> The incidence of penetrating trauma is at obvious rise in past few years especially in this part of world due to engagement of military services in war and increase in civilian violence.<sup>21</sup> Penetrating trauma as the predominant mechanism was also seen in a study showing experience of thoracic trauma in military hospitals of Peshawar and Quetta.<sup>22</sup> The probable explanation to this difference is due to the fact that our patients are usually military soldiers and are serving mostly in hostile environment where they are exposed to gunshots, improvised explosive devices and bomb blasts.

The overall incidence of recurrent pneumothorax found in our study was 7.2% (13 out of 180) which is comparable to the incidence available in literature.<sup>8,10,11,15,23</sup> Bell RL *et al* observed recurrent pneumothorax in 7% cases of thoracic trauma after discontinuation of tube thoracostomy.<sup>24</sup> A study from Baylor university medical centre showed an overall incidence of 11.1% recurrent pneumothorax (27 out of 243).<sup>25</sup> The comparison of recurrent pneumothorax in clamping and non-clamping group was not found statistically significant in our study (*p*-value 2.073) This is comparable to a study conducted in USA in which a retrospective analysis of 243 patients of thoracic trauma showed no statistical significance in terms of recurrent pneumothorax with or without clamping.<sup>25</sup> In American College of Chest Physicians consensus, it was noticed that 59% consider a clamping trial as well as a radiograph prior to removal while 41% had the opinion of not clamping chest tube under any circumstances.<sup>26</sup>

A lower incidence of recurrent pneumothorax in our study further validates the criteria set for removal which we followed. The cut off limit of 200 ml of fluid output per 24 hours instead of 100 ml explained by Younes *et al*<sup>27</sup> seems acceptable as there were no reaccumulation of fluids in pleural cavities after removal. However a strong consideration should be given to other factors which might play a role in preventing recurrent pneumothorax after removal. These might include a swift removal, immediate occlusion of the tube insertion site, suturing of wound with pre-placed retaining suture and role of an experienced hand for removal. Future studies with tight algorithm might be conducted to determine the risk factors associated with development of recurrent pneumothorax. Inter-observer variation in objective assessment of positive air leak should also be examined in future studies.

## CONCLUSION

This study revealed that removal of tube thoracostomy with or without clamping is equally safe in experienced hands, in terms of recurrent pneumothorax provided that the criteria for removal are strictly met with. The unnecessary ritual of clamping trial prior to removal should be avoided while removing a tube thoracostomy in patients of blunt and penetrating non-cardiac thoracic trauma.

## CONFLICT OF INTEREST

The author declares no conflict of interests in preparing this research.

## AUTHORS' CONTRIBUTION

MAR: contribution towards conception, design and development of study, collection of data, interpretation of data, literature review, draft and review of manuscript for final approval; FAM: conception of design, analysis and interpretation of data and revision of manuscript for intellectual content.; SZAS: statistical analysis and review of manuscript; AN: drafting of manuscript, contribution towards final approval of article.

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