TUBE THOROCOSTOMY: MANAGEMENT AND OUTCOME IN PATIENTS WITH PENETRATING CHEST TRAUMA

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Background: Penetrating chest trauma is common in this part of the world due to present situation in tribal areas. The first line of management after resuscitation in these patients is tube thoracostomy combined with analgesia and incentive spirometry. After tube thoracostomy following surgery or trauma there are two schools of thought one favours application of continuous low pressure suction to the chest tubes beyond the water seal while other are against it. We studied the application of continuous low pressure suction in patients with penetrating chest trauma. This Randomized clinical controlled trial was conducted in the department of thoracic surgery Post Graduate Medical Institute Lady Reading Hospital Peshawar from July 2007 to March 2008. The objectives of study were to evaluate the effectiveness of continuous low pressure suction in patients with penetrating chest trauma for evacuation of blood, expansion of lung and prevention of clotted Haemothorax. **Methods:** One hundred patients who underwent tube thoracostomy after penetrating chest trauma from fire arm injury or stab wounds were included in the study. Patients with multiple trauma, blunt chest trauma and those intubated for any pulmonary or pleural disease were excluded from the study. After resuscitation, detailed examination and necessary investigations patients were randomized to two groups. Group I included patients who had continuous low pressure suction applied to their chest drains. Group II included those patients whose chest drains were placed on water seal only. Lung expansion development of pneumothorax or clotted Haemothorax, time to removal of chest drain and hospital stay was noted in each group. **Results:** There were fifty patients in each group. The two groups were not significantly different from each other regarding age, sex, pre-intubation haemoglobin and pre intubation nutritional status. Full lung expansion was achieved in forty six (92%) patients in group I and thirty seven (74%) in group II. Partial lung expansion or pneumothorax was present in three (6%) in group I and 10 (20%) in group II. One patient in group I and three (6%) patients in group II had no response. The mean time to removal of chest drains were 8.2±3.14 days in group I and 12.6±4.20 days in group II. The length of hospital stay was 7.2±2.07 days and 12.4±3.63 days in group I and II respectively. Clotted Haemothorax requiring surgery developed in three (6%) patients in group I and 8 (16%) patients in group II. **Conclusion:** Placing chest tubes on continuous low pressure suction after penetrating chest trauma helps evacuation of blood, expansion of lung and prevents the development of clotted Haemothorax. It also reduces the time to removal of chest drains, the hospital stay and the chances of surgery for clotted Haemothorax or Empyema.

Keywords: Penetrating chest trauma, low pressure suction, clotted Haemothorax, lung expansion, pneumothorax, tube thoracostomy.

INTRODUCTION

Pleural effusion and pneumothoraces have been well described and managed by different authors in the past.[1,2] Chest tubes are routinely placed in the pleural cavity after thoracic surgery & in cases of haemo- or pneumo-thoraces in chest trauma. Penetrating chest trauma has become common in this part of the world due to present situation in tribal areas. The first line of management after resuscitation in these patients is tube thoracostomy combined with analgesia and incentive spirometry. Tube thoracostomy not only quantify the amount of drainage and the air leak but also characterizes the nature of fluid through the transparent tubing during management.[3] After tube thoracostomy following surgery or chest trauma, there are two schools of thought for their management. One favours application of low pressure suction to the chest tubes arguing that it hastens the evacuation of collection and expansion of lung by creating negative pressure in the pleural cavity leading to shorten the duration of air leak and the time to removal of chest drains.[4,5] The other argue that applying suction to the chest tubes might aggravate & prolong air leak as well as the time to removal of chest drain and thus can adversely effect the recovery process and increase the hospital stay and costs.[6–10]

Cerfolio *et al*[7] tested the hypothesis that suction was counter productive in patients with lung resection surgery in terms of duration of air leak and the time to removal of chest tubes. They found that duration of air leak was about half of that in water seal group as compared to suction group (1.5±0.32 days versus 3.27±0.8 days, *p*-value 0.05). Similarly the duration of chest tube in situ was also prolonging in suction group as compared to water seal group

(5.47±0.98 days versus 3.33±0.35 days, *p*-value 0.06). In Marshall *et al*[4] study it was found that suction was helpful in evacuation of bloody discharge from the pleural cavity. We studied the benefits of low pressure suction in evacuating blood from the pleural cavity, re expansion of the lung and the time to removal of the chest drain in patients with penetrating chest trauma.

The aim of our study was to evaluate whether continuous low pressure suction would help expansion of lung, evacuation of pleural collection and reduce the time to removal of chest drains in patients with penetrating chest trauma.

MATERIAL AND METHODS

This randomized clinical controlled trial was carried out in the department of thoracic surgery Post graduate medical institute Lady Reading Hospital Peshawar from July 2007 to march 2008. Informed written consent was taken from patients to be placed in either group. Approval was taken from institutional ethical committee. One hundred patients with penetrating chest trauma, either fire arm injuries or stab wounds who under went tube thoracostomy were included in the study. Patients with multiple trauma, blunt chest trauma and those intubated for pulmonary or pleural disease were excluded from the study. Detailed general physical and systemic examination, chest radiograph, full blood count and serum albumen were done for all patients. The patients were then randomized to two groups. Randomization was done by preparing hundred sealed envelopes, fifty each for low pressure suction and water seal. A randomly selected envelope by the patients was opened and allocation to either group done accordingly.

Group 1 included patients who had continuous low pressure suction applied to their chest drains. Group 2 included those patients whose chest drains were placed on water seal only. During the study period chest physiotherapy and incentive spirometry was administered to all the patients in both groups. Patients with suction protocol had their chest tubes attached to –20 cm of water wall suction (BOC company) run by central oxygen plant of the hospital 24 hrs a day. It was continuously applied to the chest drains and only interrupted at the time of bottle change or patient going to wash rooms (less then 10 minutes at one time). Chest tubes in both the groups were regularly assessed for drainage and air leak. Lung expansion was assessed clinically by listening to air entry in the morning and evening rounds and radiologically by chest X-rays daily. Chest tubes were removed when there was serous discharge of less then 100 ml per day and no air leak as well as clinical and radiological evidence of lung expansion. All the patients were discharged home after the removal of chest drains.

Full lung expansion was defined as clinical evidence of bilateral equal air entry and radiological presence of lung markings up to the periphery and acute costophrinic angles on chest X-ray.

Chest X-rays with visible lung border short of lateral chest wall and absent lung markings with or without blunted costophrenic angles were defined as pneumothorax or partial lung expansion. No lung expansion was defined as no response of lung to water seal or suction from the beginning.

Data was expressed as Means±SD and percentages according to the type of variables uses T test with the statistical significance as determined by $p \leq 0.05$. Data analysis was made using SPSS version 10.

RESULTS

The study included hundred patients comprising fifty patients in each group. Thirty eight were males and 12 females in group I while 36 males and 14 females in group II. Age ranged from 17–68 years (mean age 38.06±11.00) in group I and 13–63 years (mean age 40.22±11.07) in group-II. The two groups were also not significantly different regarding nutritional status, haemodynamics and pre intubation haemoglobin as shown in Table-1. After tube thoracostomy, 46 (92%) patients in group-I achieved full lung expansion while three patients had partial lung expansion or pneumothorax with air leak and one patient had no response to low pressure suction from the beginning. This patient had massive air leak during quite breathing and developed empyema and bronchopleural fistula. He underwent decortication and repair of bronchopleural fistula. The 3 patients with partial lung expansion and air leak were on continuous low pressure suction for 7–10 days but did not progress after the initial response. Two of them underwent thoracotomy with evacuation of clots and repair of lung perenchymal tear. One patient had persistent space but asymptomatic and was left alone. His air leak had stopped subsequently.

Table-1: Pre- Operative variables in suction and water seal groups in patients with penetrating chest trauma

Variable	Group-I (n=50)	Group-II (n=50)	*p*-Value
Age (Years)	38.06±11	40.21±11.07	>0.05
Sex (Males %)	38 (76%)	36 (72%)	>0.05
Pre Operative haemoglobin (g/dl)	12.05±1.28	11.93±1.36	>0.05
Pre Operative Serum Albumin (g/dl)	3.52±0.33	3.6±0.37	>0.05

In group-II who were on water seal only, 37 (74%) patients achieved full lung expansion while 10 (20%) patients had partial lung expansion or pneumothorax and 3 (6%) had no response. All the three patients had clotted haemothorax with perenchymal injuries. They underwent thoracotomy

with evacuation of clots and repair of lung injuries. Out of ten patients with partial lung expansion, 5 patients had obliteration of the pleural space secondary to intensive chest physiotherapy and incentive spirometry. The remaining 5 patients had developed clotted haemothorax and empyema. They underwent decortication with evacuation of clots and repair of perenchymal tear wherever found. The chest tube duration was 3–19 days (mean 8.2±3.14) in group I and 7–24 days (mean 12.6±4.20) in group-II. The total no of days in hospital in group-I was 3–14 days (mean 7.2±2.07) and 5–19 days (mean 12.4±3.63) in group-II. Three patients in group-I developed clotted haemothorax requiring elective surgery later on while 8 patients in group-II developed clotted haemothorax. These patients underwent elective surgery and evacuation of clots with repair of perenchymal injuries. Two patients in group-I and three patients in group-II developed main wound infections which responded well to conservative management. There was no mortality in the study.

Table-2: Post- tube Thoracostomy variables in suction and water seal groups in patients with penetrating chest trauma

Variable	Group I (n=50)	Group II (n= 50)	*p*-Value
Full lung expansion (%)	46 (92%)	37 (74 %)	<0.05
Pneumothorax or partial lung expansion (%)	3 (6%)	10 (20 %)	<0.05
No lung Expansion (%)	1 (2 %)	3 (6%)	>0.05
Chest tube duration (days)	8.2±3.14	12.6±4.20	<0.05
Length of hospital stay (days)	7.2±2.07	12.4±3.63	<0.05
Clotted Haemothorax (%)	3 (6%)	8 (16%)	>0.05

DISCUSSION

This randomized clinical controlled trial established that in patients with penetrating chest trauma treated with tube thoracostomy, continuous low pressure suction achieves full lung expansion in significantly large number of patients as compared to those on water seal only. The application of suction to the chest tubes also significantly reduced the duration of chest tube removal and thus the hospital stay of the patient.

Cerfolio *et al*[7] have found suction as counter productive in cases of lung resection surgery stating that applying suction to the chest drains prolonged the duration of air leak and the time to removal of chest drain. The reason might have been the long length of the resection margin and the diseased lung for which surgery had been undertaken. Suction might have aggravated the air leak through the resection margin and thus slowed down the healing process. However Marshall *et al* [4] has found suction to be helpful in evacuating blood from the pleural cavity and apposition of the two surfaces together. This goes in favour of our study where suction was helpful in evacuation of blood and expansion of lung. When suction is applied to the chest drain combined with chest physiotherapy in patient with penetrating chest trauma, the lung movement's helps to prevent blood from clotting while suction expedites its removal from the pleural cavity. Our study showed that the number of patients who developed clotted haemothorax requiring surgery was more in water seal group as compared to suction group (6% vs 16%).

Pneumothorax or partial lung expansion was more common in patients on water seal then those kept on continuous low pressure suction. This was because of continuing air leak and the retained blood which was not cleared properly and in time by the water seal. In a study by Marshall *et al*[4] there were more pneumothoraces of significant size in patients placed on water seal. The same findings are also stated by other studies.[7,11,12] In a study by Adel *et al*[13] on hundred post thoracoscopy patients, 16% developed pneumothorax in those who were on water seal only and none in patients on suction. These patients had to be put back on suction to treat their pneumothoraces.[10,12] In our study too, 20% of patients had pneumothorax or partially expanded lung in patients on water seal compared to only 6% in those on suction. The chest tube duration and the time to removal of chest drains was significantly shortened in patients on suction which resulted in their short hospital stay. It shows the importance of suction in patients with tube thoracostomy after penetrating chest trauma. It helps early evacuation of blood before it gets clotted, expansion of lung and thus early recovery from the injury.

We conclude that placing patients with tube thoracostomy after penetrating chest trauma on continuous low pressure suction helps evacuation of blood, expansion of lung and reduce the chances of clotted haemothorax. Thus it definitely helps in reducing the number of thoracotomies performed for clotted haemothorax and empyema.

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