

Original Article

Thoracostomy tube complications and pitfalls: an experience at a tertiary level military hospital

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ABSTRACT

Objective: To describe possible complications of thoracostomy tube insertion and common pitfalls regarding the management of the under water seal system.

Methods: This descriptive study was conducted at King Hussein Medical Center of the Royal Medical Services between December 2006 and January 2008. Two hundred twenty four patients were included in this study with 339 tube insertions.

Complications related to the thoracostomy tube insertion and mistakes practiced by the medical staff regarding the management of thoracostomy tube and its system were documented and analyzed.

Results: There were 131 males (58.5%) and 93 females (41.5%). Age ranged from 15 to 86 years (mean 41 ± 10.11). One hundred seventy one thoracostomy tubes (50.4%) were inserted in the operating theater post thoracotomy or thoracoscopic surgery, 99 (29.2%) were inserted in the intensive care unit and surgical wards, while 69 (20.4%) were inserted in the emergency department. The most common complications related to chest tube insertion were lung injury followed by intercostal vessels injury. The commonest mistakes related to the care of thoracostomy tube and its system were tube clamping during the transport of the patients, and improper handling of the negative suction system connected to the chest bottle.

Conclusion: All the complications related to chest tube insertion resulted from the trocar. Mistakes in dealing with the tube and its system were common. All physicians working in the surgical field, in particular general surgery residents and nurses should have special courses in chest tube management and care. (Rawal Med J 2008;33:141-144).

Key words: Thoracostomy tube, complications, pitfalls.

INTRODUCTION

Thoracostomy tube was first described by Hippocrates for the drainage of pleural cavity.¹ In 1876, Hewitt was the first to use a completely closed intercostal drainage system, but it was not until World War II that tube thoracostomy became common in the treatment of injured patients.² Physicians with almost all surgical specialties, intensivists, and emergency physicians are required to perform this life saving procedure.^{2,3} In this study, we documented all possible complications and mistakes related to chest tube insertion and care of its system at King Hussein Medical Center.

PATIENTS AND METHODS

This descriptive study was conducted at King Hussein Medical center in the period between December 2006 and January 2008. Two hundred twenty four patients were included in this study with 339 tube insertions. All of these patients underwent a drainage procedure of the pleural cavity using a thoracostomy chest tube.

Table 1. Indications of thoracostomy tube insertion.

Indication	Number	Percentage
Post surgery	171	50.4%
Pleural effusion	76	22.4%
Trauma	51	15.0%
Spontaneous pneumothorax	18	5.3%
Empyema	12	3.5%
Post central line injuries	5	1.5%
Post cardiac massage injuries	5	1.5%
Chylothorax	1	0.3%
Total	339	100%

The procedure was performed by different physicians with different specialties including thoracic surgeons, general surgeons, general surgery residents and emergency physicians. Chest tubes that were inserted at the cardiac center were excluded. Tubes were inserted either with or without trocars. The site of insertion was the lateral chest wall in the vast majority of the patients ranging from the third to the seventh intercostal space and from the posterior to anterior axillary line. The tubes were connected to a chest bottle with under water seal system or to negative suction system.

Table 2. Complications related to thoracostomy tube insertion.

Complication	Number	Percentage
Lung injury	16	4.7%
Intercostal vessel injury	5	1.5%
Diaphragmatic injury	1	0.3%

Liver injury	1	0.3%
Post expansion pulmonary edema	2	0.6%
Total	25	7.4%

Chest X-ray was performed post insertion, for daily follow up and post removal of the tube. Chest CT scan done, if needed. The chest tubes and its drainage system were followed up daily by the thoracic surgery team till the date of its removal. Any complication related to the insertion of the chest tube and any mistake during the care and management of the tube and its system were recorded. The continuous variables were expressed as the mean $\pm$ SD, and categorical variables were expressed as percentages.

RESULTS

There were 131 males (58.5%) and 93 females (41.5%). Age ranged from 15 to 86 years (mean 41 ± 10.11). One hundred seventy one thoracostomy tubes (50.4%) were inserted in the operating theater post thoracotomy or thoracoscopic surgery, 99 (29.2%) were inserted in the intensive care unit and surgical wards, while 69 (20.4%) were inserted in the emergency department. The most common indication of thoracostomy tube insertion was post thoracotomy or thoracoscopic surgery (Table 1). There were no complications due to tube insertion intra operatively post thoracotomy or thoracoscopic surgery. All of the complications occurred in patients who underwent chest tube insertion using a trocar, apart from one case of post expansion pulmonary edema that occurred post pleural drainage using a thoracostomy tube without a trocar.

Table 3. Mistakes during insertion and handling of chest tube drainage system.

Pitfall	Number	Percentage
Clamping	31	9.1%
Improper handling of suction system	23	6.8%
Intra thoracic mal-position*	19	5.6%
Loose fixation	15	4.4%
Vent covering	11	3.2%
Intra thoracic kinking*	9	2.7%
Improper insertion site*	7	2.1%
Subcutaneous position*	1	0.3%
Improper filling of the bottle	1	0.3%
Total	117	34.5%

*related to insertion.

All the complications occurred in the patients who under went the insertion at the emergency department, intensive care units and the wards. Out of 339 tubes insertions, 25 (7.4%) complications were related to insertion. Sixteen (4.7%) iatrogenic lung injuries occurred during the insertion process (Table 2). The commonest pitfall was clamping the chest tube during transport of the patients which was observed in 31 (9.1%) cases (Table 3). General surgery residents caused 17 out of 25 (5%) complications related to insertion, emergency physicians and general surgery specialists caused 5 (1.5%) complications, while thoracic surgery specialists caused 3 (0.9%) complications (Table 4).

DISCUSSION

Chest tube thoracostomy is an invasive procedure and complications resulting from inadequate tube thoracostomy drainage are common.⁴ Early complications include tube mal-position, kinking, clogging, dislodgement, and injury to an intercostal artery, vein or nerve, perforation of a lung, perforation of the right atrium or right or left ventricle, stenosis of the subclavian artery, injury to the inferior vena cava, Horner's

syndrome, and intra-abdominal mal-position.⁵ Others reported risks are injury to the heart, oesophagus, mediastinum, induction of a contra lateral pneumothorax, injury to the phrenic nerve, and an arterio-venous fistula.^{5,6-8}

Table 4. Pitfalls observed according to various staff title.

Pitfall	Job Title					
	Practical nurse	Staff Nurse	Resident	Specialist	Senior Specialist	Consultant
clamping	14	11	6	0	0	0
Improper handling of suction system	7	9	7	0	0	0
Intra thoracic mal-position	0	0	16	2	1	0
Loose fixation	0	0	15	0	0	0
Vent covering	6	3	2	0	0	0
Intra thoracic kinking	0	0	7	1	1	0
Improper insertion site	0	0	7	0	0	0
Subcutaneous position	0	0	1	0	0	0
Improper filling of the bottle	0	1	0	0	0	0
Total	27	24	61	3	2	0

In our study, intra-operative chest tube insertion in the theater post thoracotomy had no complication as all of these were inserted and positioned under vision. All of the complications related to chest tube insertion occurred when urgent intervention was needed in the emergency department or intensive care unit, which is comparable to the results of other authors.⁵⁻⁹ In our study, all of the complications were related to chest tube insertion using trocars, while no complications occurred when using the open technique for the insertion. This observation should trigger the alarm as this can occur at the hands of junior doctors when not well trained.^{2,10}

Emergency chest tube placement resulted in lung injury most frequently,⁵ as seen in our results. Some authors reported intercostal artery laceration as the most observed complication related to the insertion.² Although, others considered mal positioning of the tube ranking first in the complications rate.²⁻⁵ We preferred to classify mal-

positioning as part of the pitfalls. Our results showed clamping the chest tube during the transport of patients from one department to other was the commonest pitfall observed. Doing this maneuver may put the patients in danger of accumulating air in the pleural cavity and possible tension pneumothorax. This practice was done mostly by the nurses and the residents. Lehwaldt et al, in a study about nurse's knowledge of the chest drains care, warned about this common pitfall by the nurses.¹¹

Inadequate knowledge of the suction system that is connected to the chest bottle was being practiced by both residents and nurses. We noticed a dangerous pitfall of connecting the chest bottle to the thoracostomy tube without filling the bottle with saline, which resulted in a tension pneumothorax immediately and cardiac arrest, although the patient was resuscitated and survived and this has been highlighted earlier.¹² As many pitfalls are related to either residents or the nurses,^{2,11-13} simulation models to teach junior doctors how to insert chest drains have been used.¹⁰ In conclusion, almost all of the complications that resulted from tube thoracostomy insertion resulted from insertion of a chest tube with trocar. Thus, using chest tubes with trocars should be avoided by the in-experienced. Mistakes in dealing with the thoracostomy tube and its system are commonly being practiced, mainly by the residents and the nurses, due to inadequate knowledge and poor experience.

Therefore, training courses for both the residents and the nurses are mandatory in any hospital dealing with thoracic patients.

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