



FREQUENCY OF CHEST TUBE ERRORS AT SURGICAL FLOOR OF A TERTIARY CARE HOSPITAL

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Abstract

This study was conducted to access the incidence of chest tube errors in surgery patients. Those patients who had undergone chest tube thoracostomy in surgical emergency floor or in Thoracic surgery department at Nishtar Hospital, Multan from April 2022 to September 2023 after meeting inclusion and exclusion criteria were included in this study. Detailed history, physical examination and clinical notes were carried out in each patient. Chest X-ray (PA view) post intubation and if required CT scan chest was performed by radiology department of Nishtar Hospital Multan. Upon evaluation of the post intubation CXR, positional error was noted in 44 (27.0%) patients and Insertional error was observed in 31 (19.0%) patients. It can be concluded that chest tube errors are more of positional type as compared to insertional type and frequency of errors does depend upon the experience of the operator performing the chest tube insertion.

Keywords: Chest tube, Error, Surgical, Drain, intubation, X-ray, CT-scan, Obesity

Introduction

Tube thoracostomy is the insertion of a tube (chest tube) into the pleural cavity to drain pathology in chest cavity such as air, blood, bile, pus, or other fluids. Tube thoracostomy is often indicated for pneumothorax, hemothorax, or pleural effusion following a traumatic injury or infectious problem. Thoracic injury accounts for 25% of all trauma deaths.² Chest tube is usually inserted under local anesthesia in awake patients so it is important to place proper chest tube and in proper position to decrease pain and discomfort in patients. Proper placement of chest tube leads to reduce tube thoracostomy removal complications, decrease average length of hospital stay and hospital costs, reduce the radiation dose for patients who are exposed for chest X-rays, and reduce the likelihood of medical staff errors^{3,4}.

In insertional errors in which during insertion of chest tube there may be damage to intercostal vessels, Lung parenchyma, pericardium and heart, diaphragm, and sometime stomach.^{5,6} Other one is positional error in which chest tube is placed extra-thoracic usually in subcutaneous plane or not draining the desired pathology (Blood, Air, and Pus). A study conducted by Platnick et al. from Canada reported 12 % insertional, and 53 % positional.⁶ Another study conducted by Roebkar et al shows subcutaneous chest tube 1.4%, kinked tubes 7.2% and eyelet out of pleural space 3.6%⁷. There are some factors that can lead to chest tube error such as competency level of operator (senior registrar / postgraduate trainee / House officer), time at which tube is placed (day / night) and setup (emergency / elective). This proposed study will document chest tube errors among patients with tube thoracostomy which will help us to measure current magnitude of the problem; hence preventive measure could be adopted if such errors are reported to be high. This will help us to decrease our disease related morbidities, reduce hospital expenditures and improve quality of life our patients.

Methodology

A Descriptive cross-sectional study was conducted in the Department of Thoracic Surgery and Emergency department of Nishtar Hospital Multan from 15th April 2022 to 15th September 2023. Patients of both genders, 20-60 years of age with tube thoracostomy as advised by consultant (due to hemothorax, pneumothorax or pyothorax) were selected by non-probability consecutive sampling. A sample size of 163 was calculated by using Epi-Info software of CDC keeping $p = 12\%$ where $p =$ frequency of insertional chest tube errors, $q = 100 - p$, $d = 5\%$. Patients with ASA III or IV, more than 1.5 INR, history of repeat surgeries in the same region and those with hemoglobin less than 10 gram / deciliter on complete blood counts at admission.

The study was conducted after approval from Institutional Ethical Review Board (IERB). A total number of 163 patients with tube thoracostomy, meeting inclusion criteria and admitted in the Department of Thoracic Surgery and Emergency Department of Nishtar Hospital Multan were enrolled. Informed consent was taken from each patient before being enrolled in the study after describing them objectives of this study and ensuring them confidentiality of their information provided. Demographic data like age (in years), height, weight, residential status, obesity, type of operator (Senior Registrar / Postgraduate registrar/ House Officer) and situation (Elective / Emergency) was noted. Post Intubation Chest X-ray (PA view) was performed by radiology department of Nishtar Hospital Multan. Chest tube errors were determined by the consultant radiologist and consultant surgeon with ≥ 3 years post-fellowship experience. All the information was collected on a specifically designed Performa.

All collected data was entered in SPSS version 20 and analyzed. The quantitative data like age was presented as Mean and Standard Deviation. Qualitative data like gender, residential status, insertional error, positional errors, obesity, type of operator (Senior Registrar / Postgraduate registrar/ House Officer) and situation (Elective / Emergency) was presented as frequency and percentages. Confounding variables were controlled by stratification of data with regard to age, gender, residential status, obesity, type of operator and situation. Post stratification chi square was applied taking $p \leq 0.05$ as significant.

Results

Mean age of all the patients was 39.23 ± 11.16 years. Study population included 87 (53.4%) males and 76 (46.6%) females. Patients living in rural areas were 108 (66.7%) and from urban areas were 55 (33.3%). Of all the patients, 54 (33.1%) were obese (Table-I).

Table-I: Demographic data

Variable	Value
Age, years (mean± S.D)	39.23±11.16
Gender	
Male	87 (53.4%)
Female	76 (46.6%)
Residential status	
Rural	108 (66.7%)
Urban	55 (33.3%)
Obesity	
Yes	54 (33.1%)
No	109 (66.9%)

Tube thoracostomy was done by senior registrar in 48 (29.4%) patients, by postgraduate trainee in 64 (39.3%) patients, and by house officer in 51 (31.3%) patients. Tube thoracostomy was performed in 88 (54%) patients in emergency situation and 75 (46%) patients were elective cases (Table-II).

Table-II: Baseline data regarding Tube thoracostomy

Variable	Number (percentage)
Type of operator	
Senior registrar	48 (29.4%)
Postgraduate trainee	64 (39.3%)
House officer	51 (31.3%)
Situation	
Emergency	88 (54%)
Elective	75 (46%)

Upon evaluation of the post intubation CXR, positional error was noted in 44 (27.0%) patients and Insertional error was observed in 31 (19.0%) patients (Table-III).

Table-III: Outcome data of tube thoracostomy

Type of error	Number (percentage)
Positional error	44 (27.0%)
Insertional error	31 (19.0%)

Upon comparison of chest tube errors between age groups, positional error was observed in 18(24.0%) patients of ≤ 40 years of age and in 26 (29.5%) patients of 41-60 years of age ($p=0.427$). Insertional error was observed in 13 (17.3%) patients of ≤ 40 years of age and in 18 (20.5%) patients of 41-60 years of age ($p=0.613$). Upon comparison of chest tube errors between genders, positional error was observed in 27 (31.0%) male patients and in 17 (22.4%) female patients ($p=0.214$). Insertional error was observed in 19 (21.8%) male patients and in 12 (15.8%) female patients ($p=0.326$).

Upon comparison of chest tube errors between rural and urban population groups, positional error was observed in 27 (25.0%) patients from rural areas and in 17 (30.9%) patients from urban areas ($p=0.422$). Insertional error was observed in 23 (21.3%) patients from rural areas and in 8 (14.5%) patients from urban areas ($p=0.299$). Upon comparison of chest tube errors between non-obese and obese patients, positional error was observed in 12 (11.0%) non-obese patients and in 32 (59.3%) obese patients from urban areas ($p<0.001$). Insertional error was observed in 15 (13.8%) non-obese patients and in 16 (29.6%) obese patients from urban areas ($p<0.001$).

Upon comparison of chest tube errors among patients operated upon by different operators, positional error was observed in 8 (16.7%) of cases performed by senior registrar, in 15 (23.4%) of

cases performed by post graduate trainee, and in 21 (41.2%) of cases performed by house officer ($p=0.016$). Insertional error was observed in 10(20.8%) of cases performed by senior registrar, in 6 (9.4%) of cases performed by post graduate trainee, and in 15 (29.4%) of cases performed by house officer ($p=0.016$).

Upon comparison of chest tube errors between emergency and elective cases, positional error was observed in 31 (35.2%) of emergency cases and in 13 (17.3%) of elective cases ($p=0.010$). Insertional error was observed in 14 (15.9%) of emergency cases and in 17 (22.7%) of elective cases ($p=0.273$).

Table-IV: Errors in patients with respect to characteristics

Characteristics	Positional error	Insertional error
Age		
≤40 years	18 (24.0%)	13 (17.3%)
41-60	26 (29.5%)	18 (20.5%)
P value	0.427	0.613
Gender		
Male	27 (31.0%)	19 (21.8%)
Female	17 (22.4%)	12 (15.8%)
P value	0.214	0.326
Residence		
Rural	27 (25.0%)	23 (21.3%)
Urban	17 (30.9%)	8 (14.5%)
P value	0.422	0.299
Obesity		
Obese	32 (59.3%)	16 (29.6%)
Non-obese	12 (11.0%)	15 (13.8%)
P value	<0.001	0.015
Type of operator		
Senior registrar	8 (16.7%)	10 (20.8%)
Postgraduate trainee	15 (23.4%)	6 (9.4%)
House officer	21 (41.2%)	15 (29.4%)
P value	0.016	0.023
Type of intervention		
Emergency	31 (35.2%)	14 (15.9%)
Elective	13 (17.3%)	17 (22.7%)
P value	0.010	0.273

Discussion

Insertion of an intercostal tube drainage is (as well as needle thoracentesis) an appropriate, effective and definitive procedure for the treatment of thoracic injuries in trauma patients. The failure rate due to malposition is reported to be 11.2% (5.4—21%). There are also reports of malposition rates of 25—30%.⁸ Complication rates of tube thoracostomy have been found to be higher in the critically ill patients with about 21% of tubes placed intrafissurally and 9% intraparenchymally¹⁰.

In a previous study by Neekiet al.⁹ they showed that the frequency of chest tube errors in their study was 21.8% which as compared to our study is lower. The difference of these findings can be attributed to the fact that we studied the frequency of chest tube errors among patients undergoing emergency as well as elective chest tube insertion as compared to their study in which only elective surgeries were evaluated for chest tube errors.

In another study malposition was detected in 30% of percutaneously inserted chest tubes¹⁰. In a study where they evaluated the angle of insertion of chest tube among patients with trauma, they found that using univariate ANOVA analysis, BMI ≥ 30 was associated with increased complications or increasing angle of insertion $p = 0.04$ ¹¹. These findings are in accord to the results of our study as in current study obesity was associated with greater positional as well as insertional errors of chest tube insertion.

A survey of junior residents on the anatomical landmarks when inserting an intercostals drain revealed that 45% were placed outside the safe area of chest drain insertion with the most common error (20%) being a choice of insertion too low¹². These findings again support our conclusion as junior residents while performing chest intubation gave more chest tube errors as compared to senior registrars and postgraduate trainees.

Similarly, in another study they found that level of experience, seniority and specialty all had an effect on knowledge of the correct site of chest intubation. Unsupervised insertion by 48% junior doctors led to chest tube error as compared to 75% of those who did under supervision¹³.

Conclusion

It can be concluded that chest tube errors are more of positional type as compared to insertional type and frequency of errors does depend upon the experience of the operator performing the chest tube insertion. So, chest tube should be intubated under supervision of senior doctor and proper knowledge regarding anatomy of intubation site should be known by operator to avoid error of insertion.

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