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Thoracotomies : Indications, Results And Implications

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Objective: Thoracotomy is a major surgical procedure requiring a thorough understanding of cardiorespiratory mechanics and maintenance of very vital organ function during the postoperative phase, which requires a high dependency environment with full monitoring capabilities. The aims of this prospective audit is to examine the indications for and outcomes of thoracotomies carried out at a secondary level hospital and to highlight the possible problems and challenges facing thoracic surgeons.

Design: Prospective study.

Setting: Cardiothoracic Surgical Unit, Department of Surgery, Assir Central Hospital , Abha, Saudi Arabia.

Method: Ninety-four consecutive adult patients (Aged 12 years and over) admitted or referred to the Cardiothoracic Surgical Service and who underwent thoracotomies between October 1999 and January 2004 (53 months). Information documented included patients' names, age, sex, type and date of operation, type of general anaesthesia, postoperative complications and post operative analgesia.

Result: There were 72 males and 22 females (M:F = 3.3:1). The mean age was 40.8 ± 17.1 years (Range = 13 to 80 years). The indications were fibrothorax/encysted hydrothorax (effusion/empyema) 21 cases (22.3%); lung bullae and cysts (with or without pneumothorax) 17 cases (18.1%); clotted traumatic haemothorax/fibrothorax 10 cases (10.6%). There was no mortality in these three categories. The overall mortality in our series was 5.3%. Mortality was higher in emergency thoracotomies (12.5%) and in patients needing mechanical ventilation (26.7%). Mortality in the elective cases was 3.9%.

Conclusion: Infection and the management of inadequate initial treatment of lung infections, traumatic haemothorax and lung cysts and bullae predominate amongst the indications for thoracotomy in our environment. Mortality is highest among those patients needing emergency thoracotomy and those needing postoperative mechanical ventilation.

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Thoracotomy is a major surgical procedure requiring a thorough understanding of cardiorespiratory mechanics and maintenance of very vital organ function such as the heart and lungs. Not only skilled anaesthetic management called for in the placement and management of the double-lumen endotracheal tubes, postoperative care requires a high dependency environment with full physiological monitoring capabilities and trained, well-experienced nursing staff.

The indications for thoracotomy include the management of mediastinal tumours, bronchogenic carcinoma, blunt chest trauma (including cardiac injury) transmediastinal gun shot injuries, stab wounds of the chest, encysted empyema and fibrothorax, recurrent pneumothorax with bullae, diaphragmatic hernia repair, and oesophageal pathology[1-11]. In trauma patients, specific indications for emergency room thoracotomy (carried out in the emergency room) and emergency thoracotomy (carried out in the main operating theatre) have become established especially for patients with blunt trauma[3, 4, 8]. In the last decade, the advent of video-thoracoscopic surgical techniques had restricted the indications for thoracotomy to chest trauma cases, management of spontaneous pneumothorax, and lung resection[11-13].

Chest re-exploration for complications after lung surgery occurs in about 3.7% of patients undergoing lung surgery[1]. The most common indications for rethoracotomy are: haemorrhage (52%), bronchopleural fistula (BPF) (17.8%), persistent parenchymal leak (10.9%)[1].

The aims of this prospective audit is to examine the indications for and outcomes of thoracotomies carried out at a secondary level hospital and to highlight the possible problems and challenges facing thoracic surgeons practising secondary level hospitals.

METHOD

All adult patients (aged 12 years and over) admitted or referred to the cardiothoracic surgical service and who underwent thoracotomies between October 1999 and January 2004 (53 months) were prospectively recruited into the study. Information documented included patients' names, type and date of operation, type of general anaesthesia, postoperative complications and post operative analgesia. We also identified various problems faced by thoracic surgeons practicing in a second level hospital far removed from the big national medical centres.

The data was analysed with a PC using the Statistical Package for the Social Sciences (SPSS V. 10). Statistical significance of differences between groups was calculated using Pearson correlation and *p* values.

RESULT

There were a total of 94 thoracotomies performed in the 53-month period. The mean age of the patients was 40.8 ± 17.1 years (range = 13 - 80 years). Age distribution showed two distinct peaks at 20 and 60 years respectively (Fig. 1).

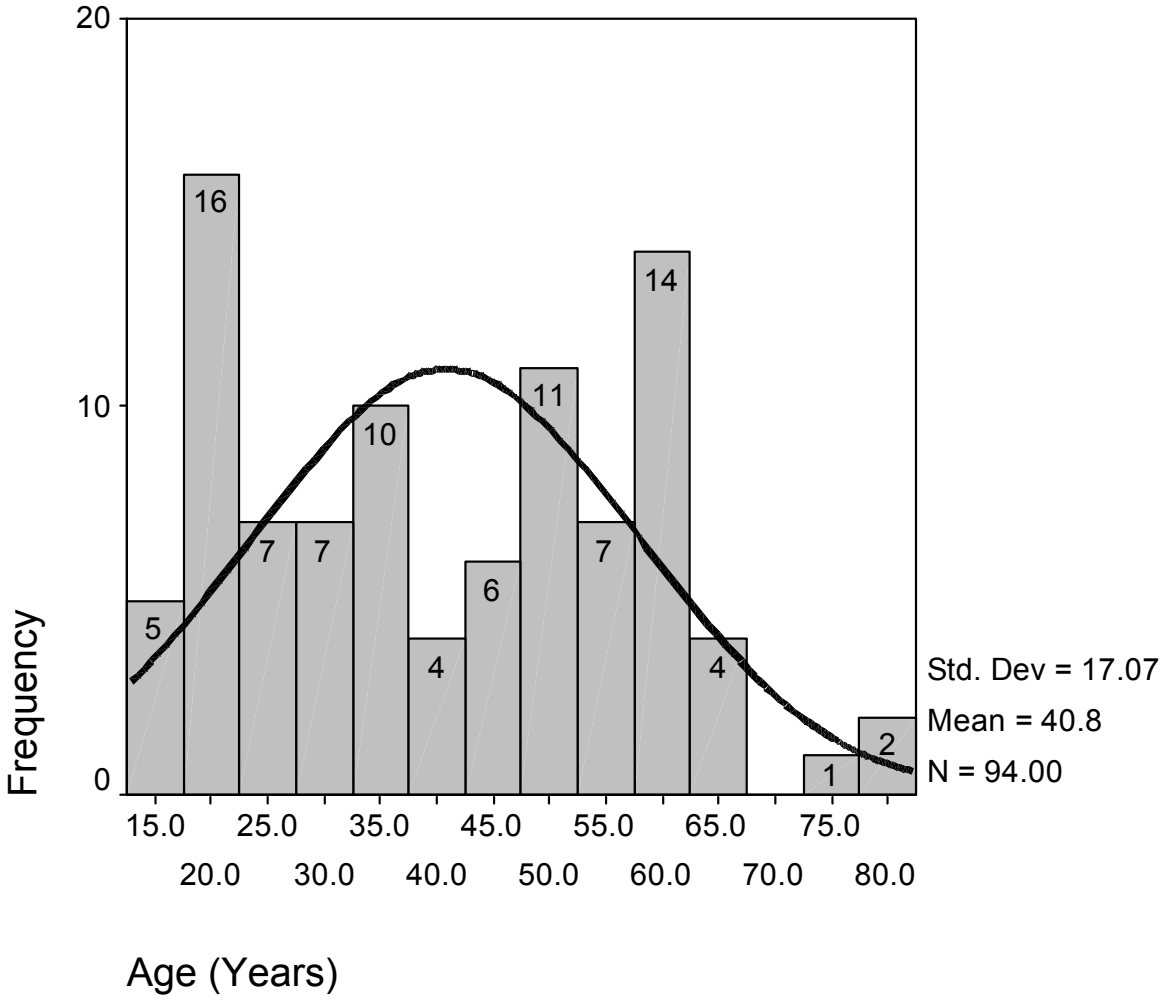

Figure 1. Histogram showing the frequency distribution of 94 patients who underwent thoracotomies.

There were 72 males and 22 females (M: F = 3.3:1).

A limited thoracotomy involving an anterior or anterolateral incision up to 12-15 cm in length was utilized in 86 patients (91.7%). Thoracotomies were performed on the left and right sides in 54 (57.5%) and 37 (39.4%) patients respectively (Table 1). One patient had bilateral thoracotomies through a median sternotomy incision for bilateral suppurative lung disease. Seventy-eight patients (83.0%) had elective thoracotomies (Table 2).

Table 1: Types of thoracotomies performed in 94 patients

TYPES OF THORACOTOMIES*	NUMBER OF PATIENTS	%
Limited lateral	86	91.5
Anterolateral	3	3.2
Median sternotomy	3	3.2
Left thoracotomy + laparotomy or left thoracolaparotomy	2	2.1
Total	**94**	**100**

***** Left thoracotomy54 (57.5%); Right thoracotomy37 (39.4%).

Table 2: Categories of thoracotomies and associated mortality in 94 patients.

CATEGORIES OF THORACOTOMIES	NUMBER OF PATIENTS (%)	NUMBER OF DEATHS (%)
Elective	78(83.0)	3(2.6)
Emergency	16(17.0)	2(12.5)
Rethoracotomy ▪ Clotted haemothorax ▪ Post-pneumonectomy encysted empyema	2(2.1) ▪ 1(1.05) ▪ 1(1.05)	0(0) ▪ 0(0) ▪ 0(0)

The indications for thoracotomy in our locality are shown in Table 3. The more frequently encountered indications were fibrothorax/encysted hydrothorax (effusion/empyema) 21 cases (22.3%); lung bullae and cysts (with or without pneumothorax) 17 cases (18.1%); clotted traumatic haemothorax/fibrothorax 10 cases (10.6%).

Table 3: Indications for thoracotomy in 94 patients

Indications	Number of Patients	%	Number of Deaths	%
Fibrothorax/Encysted empyema or effusion	21	22.3	0	0
Lung bullae and cysts (± pneumothorax)	17	18.1	0	0
Clotted traumatic haemothorax/fibrothorax	10	10.6	0	0
Interstitial lung disease (ILD)	7	7.5	1	14.3
Traumatic lung lacerations	6	6.4	0	0
Ruptured diaphragm	5	5.3	0	0
Bronchiectasis	3	3.2	0	0
Lung mass	3	3.2	0	0
Carcinoma of the lung	3	3.2	1	33.3
Oesophageal carcinoma	2	2.1	1	50
Pericarditis (Constrictive/Effusion)	2	2.1	0	0
Traumatic rupture of thoracic aorta	2	2.1	2	100
Thoraco-abdominal stab injury	2	2.1	0	0
Endobronchial mass	2	2.1	0	0
Lymphoma of lung and mediastinum	2	2.1	0	0
Post-thoracotomy clotted haemothorax	2	2.1	0	0
Biopsy of hilar mass	1	1.05	0	0
Lung biopsy for disseminated metastases	1	1.05	0	0
Post-pneumonectomy empyema	1	1.05	0	0
Bilateral cavitating lesions in the lungs	1	1.05	0	0
Medistinal mass (Schwannoma)	1	1.05	0	0
Haemoptysis/Cystic lungs	1	1.05	0	0
Thoraco-abdominal gun shot wound	1	1.05	0	0
Excision of aspergilloma	1	1.04	0	0
Penetrating lung injury	1	1.05	0	0
Diaphragmatic eventration	1	1.05	0	0
Thymoma	1	1.05	0	0
Gastro-Hepato-broncho-pleural fistulae	1	1.05	0	0
Bilateral lung abscesses	1	1.05	0	0
Rolling hiatus hernia	1	1.05	0	0
Oesophageal rupture	1	1.05	0	0

The complications of thoracotomies in the 94 patients are shown in Table 4. The observed postoperative complications included atelectasis due to retained tracheo-bronchial secretions (6 patients-6.4%), sepsis syndrome in four patients (4.4%), and clotted haemothorax in 2 patients (2.1%).

Table 4: Complications in 94 thoracotomies*

Complications	Number of Patients (%)	Deaths (%)	Comments
Atelectasis	6 (6.4)	0 (0)	Due to copious tracheobronchial mucus secretion
Deaths • Intraoperative • Postoperative	5 (5.3) 3 (3.2) 2 (2.1)	-------	Causes of death are detailed in Table 5
Sepsis syndrome	4 (4.4)	1 (25)	Mostly trauma patients managed in the ICU on mechanical ventilation pre-and post-operatively
Clotted haemothorax	2 (2.2)	0 (0)	One patient presented with shock and was re-operated immediately. The second patient presented with a clotted haemothorax one week after the original thoracotomy
Thoracotomy wound infection	2 (2.2)	0 (0)	The wound infections were superficial and resolved on daily cleaning with H_2O_2 and Betadine irrigation
Respiratory failure	2 (2.2)	2 (100)	Both patients had bilateral lung disease (ILD/Alveolar cell carcinoma)
ARDS	2 (2.2)	2 (100)	Developed postoperatively while on mechanical ventilation (MV) in the ICU
Post-pneumonectomy empyema	1 (1.05)	0 (0)	Patient had right pneumonectomy for squamous cell carcinoma

* Some patients had multiple complications.

The analysis of the causes of mortality is shown in Table 5. There were five deaths (5.3%), three deaths (3.2%) occurred intra-operatively and two deaths postoperatively (2.1%), two deaths occurred intraoperatively in the patients who were taken for emergency thoracotomy while waiting to be transferred to tertiary medical center due to ruptured traumatic thoracic aortic aneurysm. Two patients who were electively operated for open lung biopsy died postoperatively in the intensive care unit (ICU) from respiratory failure. One had disseminated bilateral alveolar cell carcinoma of the lung while the other had interstitial lung disease (ILD).

Table 5: Analysis of mortality in patients who underwent thoracotomies

CASES	INDICATIONS FOR THORACOTOMY	AGE (Years)	SEX	PROCEDURES PERFORMED	CAUSES OF DEATH	TIME ELAPSED AFTER SURGERY
1	Ruptured traumatic aortic aneurysm. Massive left haemothorax	50	M	Left thoracotomy and attempted repair	Traumatic transaction of the thoracic aorta. Rupture of false aortic aneurysm with massive tension haemothorax	Died IOP
2	RUL mass. ?Bronchial carcinoma	55	M	Left thoracotomy and wedge resection of LUL mass.	Intraoperative hypoxia. Obstructed LSVC and PAPVD. ? PE.	Died immediately post – thoracotomy in IOP
3	Ruptured traumatic aortic aneurysm. Massive left haemothorax	22	M	Left thoracotomy and attempted repair	Traumatic transaction of the thoracic aorta. Rupture of false aortic aneurysm with massive tension haemothorax	Died IOP
4	Bilateral disseminated lung infiltrates ?Carcinoma	52	F	Left thoracotomy and open lung biopsy	Respiratory failure. Cardiorespiratory arrest. Lung biopsy: Alveolar cell carcinoma	Died in ICU 24 hours after operation
5	Bilateral ILD. ?Aetiology	60	F	Left thoracotomy and open lung biopsy	ARDS. Respiratory failure. Cardiac arrest.	Died in ICU 21 days post-op.

Key: IOP = Intraoperatively; RUL = Right upper lobe; LUL =Left upper lobe; LSVC = Left superior vena cava; PAPVD = Partial anomalous pulmonary venous drainage; PE = Pulmonary embolism; ICU = Intensive care unit; ILD =Interstitial lung disease; ARDS = Acute respiratory distress syndrome.

The mortality among the elective thoracotomy cases was 2.6%. Sixteen patients (17.0%) had emergency thoracotomies out of which two (12.5%) died. There was statistically significant difference between the mortality from elective and emergency thoracotomies in this series. (Pearson correlation: $p = 0.01$). Re-thoracotomies were carried out in two patients (2.1%) with no deaths.

There was no mortality in the three categories of patients who presented with fibrothorax/encysted hydrothorax (effusion/empyema) 21 cases (22.3%); lung bullae and cysts (with or without pneumothorax) 17 cases (18.1%); clotted traumatic haemothorax/fibrothorax 10 cases (10.6%).

Fifteen patients (16.0%) required mechanical ventilation (MV) in the ICU postoperatively (Table 6). In eight of the 15 patients, mechanical ventilation was started preoperatively as indicated by the preoperative conditions such as RTA/Head injury in two cases (2.1%); RTA/Flail chest in two (2.1%); RTA/ARDS in two (2.1%). The overall mortality in mechanically ventilated patients was 4 out of 15 (26.6%). Pearson correlation in relation to mortality between those requiring mechanical ventilation and those not ventilated yielded (*p value* = 0.01).

Table 6: Indications for mechanical ventilation in 15 thoracotomy patients

INDICATIONS FOR MECHANICAL VENTILATION	NUMBER OF PATIENTS (%)	NUMBER OF DEATHS (%)
Respiratory failure	5(5.2)	3(75)
RTA/Head trauma*	2(2.1)	0(0)
RTA/Flail chest*	2(2.1)	0(0)
RTA/ARDS*	3(3.2)	1(33.3)
Post-excision of bronchogenic cyst(Elective)	1(1.05)	0(0)
Mediastinitis/ARDS/Post-oesophageal perforation*	1(1.05)	0(0)
TOTAL	15(16.0)	4(26.7)

*Patient placed on mechanical ventilation prior thoracotomy.

The problems encountered in relation to the performance of thoracotomies in our hospital included: (a) Difficulties with the insertion of DLET tubes by the anaesthesiologists. (b) Non-availability of high dependency (HD) beds for postoperative care. (c) Competing and conflicting interests with other specialties thus creating case load limitations. (d) Non-provision of specialty Scrub Nurses.

DISCUSSION

Recently, the indications for thoracotomy are becoming restricted with the advent of videothoracoscopic surgery, which offers the advantages of shorter hospital stay, less postoperative morbidity, less postoperative pain and minimal, more cosmetic incisions[11]. This however is available only at the tertiary centres. An overall mortality of 1.9% was reported from the Mayo Clinic although nearly half the patients had only wedge resection of the lung[14]. In our practice, the transition from thoracotomies to videothoracoscopic surgery has been a gradual one. It is envisaged that many of the cases reported in our series could eventually be done thoracoscopically[11]. The limitation of videothoracoscopic surgery in a secondary-level institution such as ours is cost-related and for now, thoracotomy appears to be the cheaper alternative which is within the budgetary reach of a secondary level institution.

Thoracotomies in our series were predominantly done electively 83.0%, while emergency thoracotomies were 17.0%. None of our patients required emergency room thoracotomies but one patient with a stab injury of the heart collapsed *en route* to the operating room and the chest was opened in the theatre corridor before being moved into the operating room, the patient survived. There are currently no facilities for emergency room thoracotomies in our hospital.

Sirbu et al., reported chest re-exploration for complications after lung surgery to be 3.7% mainly for bleeding 52%, bronchopleural fistula (BPF) 17.8% and persistent air leak 10.9%[1]. In our series re-thoracotomies were carried out in three patients 3.1%.

The overall mortality in our series was 5.3%. Mortality was higher in emergency thoracotomies 12.5% and in patients needing MV 26.6%. Mortality in the elective cases was 2.6%. Various indications for thoracotomy carry varying levels of mortality[15]. In the series of emergency thoracotomy cases reported by Hoth, et al., mortality for those with blunt chest trauma was 73% while those who had penetrating injuries had a mortality of 22%[15]. Utz, et al., have shown that patients with usual interstitial pneumonia of the idiopathic type, who present with atypical features, may be at higher risk of death following surgical lung biopsy than patients presenting with more typical features or patients with other interstitial illnesses[16]. Careful selection of patients for lung biopsy is thus called for in those patients referred for interstitial lung diseases (ILD). One patient with ILD in our series developed ARDS and respiratory failure following open lung biopsy and required prolonged period of MV before she died.

A high percentage 16% of our patients needed MV. However, MV was needed preoperatively because of severe head trauma 2.1%, flail chest 2.1%), ARDS 3.2% or a combination of any number of these factors in polytraumatised patients. MV was instituted preoperatively in 2 patients with respiratory failure due to oeasophageal perforation and mediastinitis in one and carcinomatosis in the other. Increased mortality 26.6% was observed in these patients needing MV either preoperatively or postoperatively. Baudouin showed that hypoxia developing intraoperatively when one-lung ventilation (OLV) is used may precipitate lung injury postoperatively[17]. The study by Guenoun, et al., failed to identify patients at risk of arterial hypoxemia when OLV is instituted because mainly intraoperative independent variables are involved in the decrease of PaO_2 in this situation[18].

Postoperative atelectasis was present in 6.4% of the patients who underwent thoracotomies in our series. The need for postoperative respiratory care in thoracotomy patients is well established[19]. In our hospital, the inadequate number of respiratory therapists (RT) (RT: Hospital Bed ratio = 1:287) who function only in the ICU meant that respiratory therapy for post-thoracotomy patients being managed outside the ICU was undertaken by the doctors, nurses, or occasionally, the physiotherapists. The cardiothoracic unit has thus adopted a policy of administering mucolytic agents (oral or nebulized), chest percussion and breathing exercises with an incentive spirometer in all non-ventilated patients postoperatively. The patients who develop atelectasis and who fail to respond to the above measures were all successfully subjected to flexible fibreoptic bronchoscopy for the removal of tracheo-bronchial secretions and mucus plugs.

The problems encounterd in this series were personnel and physical facilities dependent. We experienced a lot of difficulties with the insertion of double lumen endotracheal tubes (DLET) by the anaesthesiologists. This has arisen principally because no anaesthesiologist is assigned to the thoracic theatre on a permanent basis and the duty is rotated amongst about 6 anaesthesiologists. Problems due to malpositioning of the DLET during OLV are well recognized and some achieve OLV by placement of a wire-guided

endobronchial blocker[20]. Placement using a fibreoptic bronchoscope has also been reported[21]. Recently, our anaesthesiology department has acquired a flexible fibreoptic intubating bronchoscopic equipment to aid in the placement of DLET.

The problem of non-availability of high dependency (HD) beds for postoperative care arises from the fact that most of the HD beds are occupied long–term patients on MV, brain-injured patients and those with organ failure. It is thus difficult to get a bed on a regular basis for postoperative thoracic patients as our Intensive Care Unit (ICU) is general in nature and patients are admitted from all specialties. The Unit has no specific ward allocated and so thoracic surgical cases lie scattered all over the various hospital wards and are managed on their wards origin without a uniform level of nursing care.

In the Operating Room (OR), the Thoracic Surgical Unit does not have a Specialty Scrub Nurses attached on a permanent basis and during each operating session, any scrub nurse could be assigned. This creates a difficulty for both the surgeons and the nurses as the nurses are not able to acquire the necessary skill and experience that can only be gained through constant exposure.

CONCLUSION

The indications for thoracotomy in our environment differ from those reported from the more industrialized countries. The management of inadequate initial treatment of lung infections, traumatic haemothorax, lung cysts and bullae constitute the largest group of indications for thoracotomies in our region. The mortality in this series is within the level reported worldwide though some of the mortality could be reduced by adopting a more stringent patient selection policy. Various inadequacies in personnel and facilities exist which if addressed would make thoracotomy a safe procedure even at the secondary-level hospital.

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