THORACOPLASTY (TAILORED) REVISITED FOR HIGH RISK PATIENTS WITH NONRESOLVING TUBERCULOUS APICAL LUNG CAVITIES

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ABSTRACT

Objective: To evaluate the efficacy of thoracoplasty using thoracic epidural anaesthesia for relief of fever, sputum production and haemoptysis in pulmonary high risk patients with non-resolving apical lung cavities due to tuberculosis.

Study Design: Observational descriptive study.

Place and Duration of Study: PNS Shifa and Combined Military Hospital Peshawar and Rawalpindi, from Jul 2012 to Apr 2018.

Methodology: Patients of all ages of either sex with non-resolving apical lung cavities who had documented medical treatment failure along with functional vital capacity (FVC) and forced expiratory volume in one second (FEV1) less than 40% of predicted for their age, sex, and height were selected. Sample size was 30. It was non-probability convenient sampling. We performed tailored thoracoplasty using epidural anaesthesia only. A maximum of four complete ribs were removed while preserving 1st rib in all cases along with plication of upper lobe. Patients were assessed 4 weeks after surgery as outpatients for quantitative decrease in productive cough and relief of fever and haemoptysis.

Results: The mean age was 47.3 years and SD of 16.6 years. Number of male and female patients were equal. Most of the patients were discharged within first post op week. Overall, 30 (83.3%) showed improvement with thoracoplasty, 83.3% patients had relief of cough, 82.6% had decreased frequency of sputum and 92.6% had relief of haemoptysis. Most common complications associated with epidural analgesia was postoperative hypotension 6 (23.07%) and atelectasis 3 (11.5%). There was no death related to the procedure.

Conclusion: Thoracoplasty is a safe procedure associated with significant improvement in symptoms related to non-resolvingapical cavities.

Keywords: Epidural analgesia, Thoracoplasty, Tuberculosis.

INTRODUCTION

There are 5.7 million people worldwide who are suffering from tuberculosis, with 260000 new cases occurring every year[1]. In Pakistan the detection rate of new TB cases is 231 per 100000 populations. The emergence of Multidrug-resistant strains is especially significant health problem[2] in our setup.

The rise in incidence of MDR TB from 2.0 percent in 2003 to 3.2 percent in 2007 is real matter of concern nowadays. Pakistan accounts for 57 percent of the MDR-TB burden within WHO's Eastern Mediterranean Region[3]. This was supported by all local studies like Armed Forces Institute of Pathology, Rawalpindi in 2000[4], Agha Khan University Hospital at Karachi[5] and Sialkot Pakistan (WHO supervised study), which revealed poor compliance for treatment of TB because of social stigmas, lack of monetary support and lack of awareness on patient side and failure to adhere with WHO guidelines. The end result in most of these cases is MDR TB with non-resolving thick walled cavities.

Ideal treatment for these patients is resectional surgery but mostly these patients are high risk for general anaesthesia or unfit for resectional surgery due to poor pulmonary and nutritional reserves. We targeted this set of population and performed tailored thoracoplasties using thoracic epidural anaesthesia with aim to collapse

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the underlying infected lung cavities. By removal of three or four overlying ribs, the remaining intercostal soft tissues collapse as they loose strut support of ribs. Eventually the collapsed cavity walls develop adhesions and patient starts to improve symptomatically. TP Horrigan and NJ Snow[6] reported in 1990 a series of 13 patients who had thoracoplasty for apical cavities with or without empyema. 92% success rate was noted.

The main objective of this study is to evaluate the efficacy of thoracoplasty in high risk pulmonary tuberculosis patients with non-resolving apical lung cavities.

METHODOLOGY

This study was designed as an observational descriptive study and conducted between July 2012 to April 2018 at PNS Shifa and Combined Military Hospital Peshawar and Rawalpindi which are tertiary care referral hospitals with dedicated thoracic surgical, thoracic anaesthesiology departments and intensive care services. Hospital ethics committee approved the study vide letter number 15/10/19 dated 30/10/19. Sampling was done by the non-probability convenient technique. Sample size was calculated with the help of WHO sample size calculator with following calculations:

Sample size of 30 was estimated by using 95% confidence level, 10% margin of error with expected success rate of thoracoplasty 6 (92%). Male to female ratio was equal. Patients falling in this criteria were prospectively included in the study; their preoperative, postoperative and follow up data were collected. Written informed consent was taken from patients regarding the procedure.There was no gender or age limit. Patients with non-resolving apical lung cavities who had documented medical treatment failure along with FVC and FEV1 less than 40% of predicted for their age, sex and height were in the inclusion criteria. Positive Sputum for AFB, diabetes mellitus, hypertension, ischemic heart disease, COPD and acute lower respiratory tract infection were not considered as an adverse factor for the procedure however they were optimized before the procedure. Patients with cavity wall thickness greater than 10mm, cavitation in more than one lobe of lung and who didn't consent for awake surgery (epidural analgesia only) were excluded from the study. Patients were evaluated for quantitative decrease in sputum, relief of fever and haemoptysis at 4 weeks after surgery for three consecutive days.

We performed tailored thoracoplasty using epidural analgesia only. 3D reconstruction of CT image of chest wall coupled with abscess cavity images on computer were utilized to decide about the number of the ribs to be resected. All cases were operated using thoracic epidural block with catheter insertion using a combination of 0.25% Bupivacaine, 01% Xylocaine and 100 mg of preservative free Tramadol. Initial volume of 15 to 20 ml of this combination was used later on topped up with 5-7 ml per dose. To undertake thoracoplasty a higher level of vertebral space (T4) was used for epidural injection. No general anaesthesia was administered during the procedure. However conscious sedation using 2 to 3 mg boluses of midazolam or 20 mg Propofol with 20 mg Ketamine were administered intravenously in most of the patients. Patients were monitored for dysrhythmias, hypotension and hypoxia by using NIBP, pulse oximetry and cardiac monitoring during surgery. A standard posterolateral subscapular incision approach was made with vertical paravertebral extension of incision depending upon the location of the cavities. Extra periosteal resection of the ribs was performed. Pleural cavity was not entered in any case. A maximum of four complete ribs were removed while preserving 1st rib in all cases. Apicolysis was done by mobilizing the apex and identification of subclavian/innominate artery and brachiocephalic vein. Plication of the apex than done using Prolene 1 suture to prevent re expansion of cavities. Space was drained by a chest tube connected to underwater seal. Epidural catheter was retained for 4 days for postoperative analgesia. Chest drains were removed when drainage was less than 100ml/ day.

Patients were assessed 4 weeks after surgery as outpatients for quantitative decrease in sputum and relief of fever. Temperature was recorded daily per orum on a record sheet by patient. Temperature 99°F or less for 3 consecutive days was labelled as negative for fever and temp greater than 99°F for more than consecutive 3 days was labelled as positive for fever. Patients were provided with marked cups and record sheet for daily measurement of sputum production. Sputum production Less than 110 ml (1/2 of standard 220ml glass of water) in 24 hrs for consecutive 3 days was considered as positive relief of sputum production and more than 110 ml (1/2 of standard glass of water) in 24 hrs for consecutive 3 days was considered as negative for relief of sputum production. It is to be noted that patients continued on with the preoperative antibiotics if required by pulmonologist and no new medication was added.

Table-I: Demographic characteristics of patients.

	Number	Percentage (%)
Gender		
Males	15	50
Females	15	50
Age (years)		
<45	15	50
≥45	15	50
No. of Ribs Removed		
3	5	16.6
4	25	83.4
Transfusion		
0	18	60
1	9	30
>1	3	10
Post Op Stay (Days)		
3-5	5	16.6
6-9	17	56.6
10-16	8	26.6
Symptoms		
Cough	30	100
Hemoptysis	15	50
fever	23	76.7

Data Analysis

Data was collected and analysed using SPSS 20. Mean, standard deviation, minimum and maximum values were calculated for age. Frequencies and percentages were calculated for categorical datalike, gender, age group, symptoms, improvement status and post-operative complications. Binomial tests were applied to note the significance of improvement in fever, hemoptysis and cough. A *p*-value of ≤0.05 was taken as significant.

RESULTS

There were 30 patients who fall in the criteria underwent apical thoracoplasty. Demographics details were given in the table-I. Age range was 22-74 years. Mean age was 47.3 ± 16.66. Average post op stay was 7.8 days. Major Comorbids were malnutrition, IHD, DM and COPD but they all were optimized before surgery. Overall 25 (83.3%) showed improvement with thoracoplasty with significant *p*-value of <0.001 and it is in accordance with the similar study held in 1990 in which all patients included in the study were improved post operatively[11]. There is only 1 patientwho had recurrence of haemoptysis after initial improvement and settled with conservative management. Details of improvement of symptoms were given in table-II. Complications

Table-III: Operation related complications.

Complication	Frequency	Percentage (%)
Hypotension	6	23.07
Atelectasis	3	11.5
Intercostal neuralgia	5	19.2
Wound infection	2	7.6
pneumonia	1	3.8
Total	17	65.3

Table-II: Improvement of Symptoms.

Symptoms	Total	Improved	Not Improved	*p*-value (binomial test)
Hemoptysis	15	14 (93.3%)	1 (6.7%)	0.001
Fever	30	25 (83.3%)	5 (16.7%)	<0.001
Cough	23	19 (82.6%)	4 (17.4%)	0.003

Binomial test has the hypothesis that More than 50% improved on each symptom

were less and manageable as described in table-III Postoperative hypotension 6 (23.07%) due to high epidural injection was the most common complication and managed with ephedrine bolus doses during the procedure. Only two patients required ionotropic support for 24 hrs post-operatively. There was no death related to the procedure. Chest wall cosmetic deformity was less obvious as majority of the resections were high and were masked by scapula. There was no paradoxical chest wall movement in any of the operated cases.

Figure-1: Pre op CXR showing destroyed lt upper lobe with cavitation.

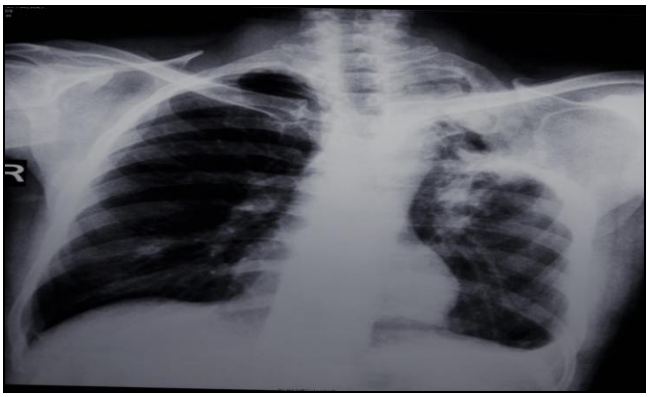

Figure-2: After apical thoracoplasty there is collapse of upper lobe.

DISCUSSION

The 'explosion of thoracic surgery' occurred between the two World Wars and the most frequent operation was thoracoplasty under local anaesthesia[7]: the term was first used by Estlander in 1879 for the description of the costal resections performed for eliminating pleural infection and the procedure was first used by De Cerenville (1845-1915) for collapsing the lung to cure lung tuberculosis, which was the main indication until the early 1950s. Semb popularized the procedure of apical thoracoplasty in1935[8].

This indication disappeared due to the advent of anti-tuberculosis drug and pulmonary resection became the predominant operation.

Figure-3: Apical thoracoplasty through high posterior incision.

Figure-4: Resected specimen of ribs.

Dewann and colleagues[9] and more recently by Jessica and Pomerantz[10] and Shiraishi[11], stressed that it can be an operation of continued relevance with the persisting problem of tuberculosis in the developing countries.

Suppurative lung infections like thick walled post tuberculous apical cavities still plague the developing Asian countries like Pakistan. Non-compliance to treatment, old age, weight loss due to persistent low grade sepsis, poor nutritional status and baseline lung disease like COPD are the factors which lead to weak respiratory effort and poor spirometricvalues. Now with increase

in the reported resistance against standard ATT especially Asian countries we think that this old procedure should be revisited in a modified form to accommodate the cosmetic appearance and reduce the complications of general anaesthesia and resectional surgery for unfit patients. Thick walled cavities (wall thickness greater than 3 mm on CT scanning) do not resolve with conservative medical treatment.

The decision and indication for surgery on a sick thoracic surgical patient should be very well defined. Indication for thoracoplasty in the modern age implies a failure of medical therapy due to

- A cavity with bronchial communication
- Unilateral cavity with resistant organism
- Bilateral cavitary disease.
- Bilateral disease so extensive that resection is not feasible

The procedure of thoracoplasty involves extra periosteal resection of ribs keeping the pleura intact. The technique of standard thoracoplastyas practiced by us entails retaining the first rib, thereby ensuring that the deformity is minimized by preventing shoulder drop. The apicolysis, however, allows release of the apex of the pleura and collapse of the lung toward the hilum and the mediastinum. The number of ribs excised is dictated by the need of the individual patient and the size and location of the space obliteration required. Scoliosis is minimized by retaining the transverse processes. Plication with Prolene prevent re expansion of lobe.

Like Gregoire and co-workers[12], we believe that preservation of the first rib has to be combined with apicolysis to achieve obliteration of the apical space. Omission of apicolysis may have accounted for some of the failures encountered by Hopkins and colleagues[13] and Horrigan and Snow[6].

After extensive literature search for treatment of apical lung cavities by tailored thoracoplasty we focused on three studies. An article by Bull[14] in 1922, Price[15] in 1942, and a new study by Bilal[16]. All revealed satisfactory results of thoracoplasty for pulmonary tuberculous cavities. All these procedures were performed under general anaesthesia whereas our study is unique in the sense that we selected patients who were high risk for GA and so were operated using epidural analgesia only thus further minimizing the anticipated complications. Preston and Tenholder[17] in 1996 concluded that patients with preoperative FEV 1 and FVC is less than 40% of predicted, the incidence of complications related to general anaesthesia and resectional surgery is high. This was the case in all of our patients where the mean FEV 1 and FVC was less than 40% of that predicted for their age and sex. To perform a resectional surgery under general anaesthesia with one lung ventilation (OLV) is associated with cardiopulmonary complications in postoperative period as was evidenced by Pomerantz, Madsen[18] in 1991 who performed resectional surgery upon two groups of pulmonary TB patients (n1=44 and n2=38). They had 2 mortalities and significant number of major complications. Such patients benefit with minimum morbid surgery such as thoracoplasty performed using epidural analgesia without the ill effects of GA and OLV. We selected a specific subgroup of patients in which repeated courses of ATT and broad spectrum antibiotics were ineffective as they had persistent thick-walled cavities. The wall thickness of a cavity is an important determinant of the nature of disease and its response to treatment. Woodring and freid[19] in 1980 evaluatedsixty-five solitary cavities of the lung for wall thickness. They found that all lesions in which the thickest part of the cavity wall was 1 mm were benign. Those with thickest measurement 4 mm or less, 92% were benign. Of cavities that were 5-15 mm in their thickest part, 51% were benign and 49% malignant. Those over 15 mm thick, 95% were found to be malignant. We selected those patients in which malignancy was already ruled out and maximum wall thickness was not greater than 10 mm. The procedure was performed on patients with localized disease only and maximum of 4 ribs were removed to avoid

hypoxia related to paradoxical chest wall movement and atelectasis of healthy lung segments.

Resectional surgery in sputum positive cases carries significant complications. Ravindra and Himanshu[8] at Institute of Tuberculosis and Respiratory Diseases New Delhi between the years 1999 to 2003, operated upon 74 cases of multi-drug-resistant tuberculosis that were sputum positive at the time of surgery. Majority of patients were treated with pulmonary resections (Pneumonectomy (n=37), Bilobectomy (n=09) and Lobectomy (n=21) while Primary Thoracoplasty with Apicolysis was planned in only 7 patients. There were 03 early and 02 late deaths. Post-operative complications were seen in 74 (24) cases. Eight patients developed Broncho pleural fistula with empyema. Although they achieved good results but they concluded that Morbidity remained as problem area.

Bilal[16] and associates performed 21 thoracoplasties in cases of destroyed post infectious lungs and for residual post resectionalspaces. Of these 12 were partial and 9 were complete thoracoplasties. Three patients had destroyed lungs and presented with haemoptysis. There was no mortality and only 3 patients had residual spaces. All the patients had fever which was relieved in all after the procedure. Haemoptysis was relieved in 5/21 cases and cough was relieved in 21/21 cases. They concluded that this procedure still has a place of benefit in selected cases.

Our results are comparable to this study however this study does not mention the pre-operative pulmonary functional status and all patients were operated under general anaesthesia. The advantages of epidural over general anaesthesia are no adverse effects and complications of general anaesthetics, retained pulmonary secretions during and after surgery, adverse effects of parenteral analgesics which were not required with epidural even postoperatively. Another benefit was cost effectiveness using epidural analgesia. The disadvantages were longer time for anaesthesia to be effective as compared to general anaesthetic, patient anxiety related to awake surgery and preoperative hypotension related to high thoracic epidural analgesia. Limited thoracoplasty underepidural analgesia translated into minimum morbidity of our study.

CONCLUSION

Apical lung cavities are a complex problem and a unique surgical challenge. Apical thoracoplasty obliterates the infected pleural space while preserving valuable ipsilateral lung function. Our study concludes that thoracoplasty is a safe procedure associated with significant improvement in symptoms related to tuberculous non-resolving apical cavities.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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