DEAD SPACE REDUCTION CLOSED THORACOPLASTY IN CHRONIC EMPYEMA THORACIS PATIENTS OF EARLY YOUNG AGE GROUP

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ABSTRACT

BACKGROUND
The social stigma of chronic empyema thoracis treated with open window thoracostomy (OWT) has significant negative impact on psychosocial well-being, especially in early young age group patients. So, evaluation of better alternative of dead space reduction closed thoracoplasty method was done by the author.

Aims and Objectives- To evaluate standard easily reproducible surgical method to cure and control chronic empyema thoracis other than open window thoracostomy in early young age group patients in central India.

MATERIALS AND METHODS
Dead space reduction closed thoracoplasty was performed in 44 patients of chronic empyema thoracis between the age group of 13 and 25 years by conventional thoracoplasty (Alexander type), tailoring thoracoplasty and Schede thoracoplasty. Patients were evaluated in terms of weight gain, chest x-ray, air leak and column movement in ICD and pus culture sensitivity at regular intervals. Targeted dead space reduction is achieved excellently when column movement is less than 5 cm and acceptable when between 5 and 10 cm. Absence of air leak even on coughing excellent and only on coughing acceptable in patent intercostal drainage tube. Statistical Analysis- By student’s t-test, repeated measure ANOVA test for difference of mean, confidence interval with standard error estimation, 'p' value and percentage also.

Setting and Design- A hospital-based prospective longitudinal study as all the enrolled patients are followed up at designed time.

RESULTS
Chronic empyema thoracis of 40 patients was cured and controlled with dead space reduction thoracoplasty, whereas 4 patients with multi-drug resistance tuberculosis (MDR TB) did not cure, so they further required other modalities.

CONCLUSION
Patients with persistent infection and poor weight gain have high failure rate in dead space reduction closed thoracoplasty.

KEYWORDS
Chronic Empyema thoracis, Broncho-Pleural Fistula, Dead Space Reduction Closed Thoracoplasty, Open Window Thoracostomy.


BACKGROUND
Empyema thoracis is the collection of purulent material in the pleural space. The treatment of empyema thoracis is done mainly by closed tube drainage with underwater sealed system along with antibiotics and other supportive medicines. In spite of above management, many patients of empyema are not cured and converted into chronic empyema. Chronic empyema is associated with or without bronchopleural fistula. Chronic empyema is an extremely morbid pathology with a high mortality rate.1-2 Thoracotomy with decortication is indicated when underlying pulmonary parenchyma is normal. Lung resection is used to remove the destroyed lung tissue. But dead space is always a significant problem in these chronic empyema patients. The dead space becomes highly significant problem when associated with bronchopleural fistula. These communications between bronchus to pleural cavity are at high risk of bronchial aspiration, adult respiratory distress syndrome which lead to high mortality.3,4,5 The principle of management is to protect the contralateral lung from the spillage of pleural fluid, control of empyema with complete drainage and antibiotics, identification and closure of fistula and dead space obliteration along with nutritional rehabilitation.6,7 The management depends on the size of bronchopleural fistula and clinical condition of the patients.8,9,10 Open window thoracostomy is an old procedure, which is still considered as procedure of choice in these situations of chronic empyema with or without bronchopleural fistula associated with severe sepsis, acute septic shock, multi-organ dysfunction and other co-morbid condition like diabetes, hepatitis etc. Open window thoracostomy is associated with psychosocial stigma, especially in young age group patients due to a large opening
Present in thoracic wall which needs daily dressing. To address the negative psychosocial impact and poor quality of life in these chronic empyema thoracis patients treated with open window thoracostomy, extensive literature search was done by author to find evidence based alternative surgical method.

The study of Hopkins et al rejuvenated the idea of modern use of thoracoplasty. So, author used the principle of collapse therapy to treat chronic empyema in especially young age group patients, to eradicate the social stigma of open window thoracostomy. The basic principle followed in dead space reduction thoracoplasty is either lung expands enough to reach the chest wall or chest wall moves towards the partially expanded diseased lung.

Objective of this Study
To evaluate standard, easily reproducible surgical method to cure and control chronic empyema thoracis other than open window thoracostomy in early young age group patients in central India by exploring and examining the dead space reduction closed thoracoplasty on the basis of the selected parameters. The probable impact of this study (not direct access) may be considered in term of addressing the psychosocial stigma of Open Window Thoracostomy.

MATERIALS AND METHODS
This hospital-based prospective longitudinal study was conducted in the Department of Cardiothoracic and Vascular Surgery of a tertiary care centre, Gandhi Medical College and Hamidia Hospital, Bhopal, MP, from January 2013 to December 2016. This prospective longitudinal single centre study representing the patient population of central India. The inclusion criteria for the study were chronic empyema (of more than 8 weeks with intercostal drainage tube) patients with age group of 13 to 25 years. All 44 patients who fit into the criteria between specified duration were recruited for the study after obtaining the written informed consent. These enrolled patients were followed up time to time as per designed study protocol.

Statistical Analysis Method
All the quantitative variables were summarised by mean and standard deviation, while all the Categorical variables were shown by frequency distribution. For comparison of two groups we used student’s ‘t’ test and for more than two groups (repeated observation on weight gain by the participant) we used repeated measure ANOVA test. The acceptable limit of type-I error was set on 5% and any value beyond 95% confidence interval was deemed significant.

Patients suffering from tuberculosis were on anti-tubercular treatment (ATT) with completion of intensive phase of ATT. They had sputum negative for AFB too. Periodic evaluation of patients was done in terms of weight gain, chest x-ray, air leak and column movements in ICD at regular intervals. Pus culture and sensitivity was performed before and after 2 weeks of procedure.

When chest x-ray showed radiolucency with no bronchopulmonary markings considered as dead space, if radiolucency present in more than 50% it is large, 25% - 50% is moderate and less than 25% is mild of affected side of thoracic cavity volume.

RESULTS
Forty-four patients were enrolled for study, out of which 18 were males and 26 were females and mean age of 20.50 years was for males and 18.96 year was for females. There was statistically no significant difference in distribution of chronic empyema thoracis patients according to gender and age, (p=0.104).

Total 44 patients of chronic empyema thoracis in which 36 patients had tuberculosis (81.8%), 4 patients had infected hydatid cyst (9.1%), 2 patients with bronchiectasis (4.5%), one patient of mature teratoma (2.3%) and one patient with infected pleural cyst with empyema (2.3%).

Out of 44 patients, 24 had left-sided lung lesion (54.5%) and 20 patients had right-sided lung lesion (45.5%). The patient’s population was from low socio-economic status and few patients were associated with immune-compromised states like 3 patients were HBsAg positive and 2 were HIV positive.

Out of 44 patients, rib resection with decortication was done in 34 patients (77.27%) and rib resection with lobectomy and rib resection with decortication with excision...
biopsy was done in 4 patients each (9.1% + 9.1%) and 2 patients underwent rib resection only (4.5%) (Table 1).

In most of the patients, 3 and 4 ribs were resected. In 16 (36.4%) patients 3 ribs were resected and in 12 (27.3%) patients 4 ribs were resected. 6 ribs were resected in 4 (9.1%) patients.

Mean weight of both male and female patients significantly increased after thoracoplasty. It was 36.95 ± 4.7 kg at the time of enrolment. It increased with time and at 24 weeks increased to 42.83 ± 5.9 kg. There was highly significant difference in weight gain in both male and female patients (p= 0.001), (Table 2).

Repeated measures of ANOVA with a Greenhouse-Geisser correction determined that mean weight differed statistically significantly between time points (F (62.05, 180.33) = 652.89, p < 0.0001). Post hoc tests using the Bonferroni correction revealed that mean weight gain is significant at every time interval. Therefore, we can conclude the procedure elicits a statistically significant gain in mean weight at every time interval.

<table>
<thead>
<tr>
<th>Type of Operation</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rib resection</td>
<td>2</td>
<td>4.5%</td>
</tr>
<tr>
<td>Rib resection with decortication</td>
<td>34</td>
<td>77.27%</td>
</tr>
<tr>
<td>Rib resection with lobectomy</td>
<td>4</td>
<td>9.1%</td>
</tr>
<tr>
<td>Rib resection with decortication with excision biopsy</td>
<td>4</td>
<td>9.1%</td>
</tr>
<tr>
<td>Total</td>
<td>44</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 1. Type of Operation done among Chronic Pleural Empyema Patients

<table>
<thead>
<tr>
<th>Gender</th>
<th>Pre-Op</th>
<th>2 Weeks</th>
<th>6 Weeks</th>
<th>12 Weeks</th>
<th>24 Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>39.63 ± 3.7</td>
<td>40.57 ± 3.7</td>
<td>41.74 ± 3.9</td>
<td>42.30 ± 4.1</td>
<td>46.0 ± 4.6</td>
</tr>
<tr>
<td>Female</td>
<td>35.09 ± 4.5</td>
<td>35.79 ± 4.5</td>
<td>37.09 ± 5.1</td>
<td>38.20 ± 4.9</td>
<td>40.6 ± 5.7</td>
</tr>
<tr>
<td>Total</td>
<td>36.95 ± 4.7</td>
<td>37.74 ± 4.8</td>
<td>38.99 ± 5.1</td>
<td>40.29 ± 5.2</td>
<td>42.83 ± 5.9</td>
</tr>
</tbody>
</table>

Table 2. Weight of Chronic Pleural Empyema Patients after Thoracoplasty at different Time Intervals

<table>
<thead>
<tr>
<th>Chest X-Ray Findings</th>
<th>Nos.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild collapse with hydro-pneumothorax</td>
<td>4</td>
<td>9.1%</td>
</tr>
<tr>
<td>Moderate collapse with hydro-pneumothorax</td>
<td>25</td>
<td>56.8%</td>
</tr>
<tr>
<td>Near complete collapse with hydro-pneumothorax</td>
<td>15</td>
<td>34.1%</td>
</tr>
<tr>
<td>Total</td>
<td>44</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 3. Pre-operatively Chest X-Ray Findings among Chronic Pleural Empyema Patients

There was significant improvement in expansion of lung (less than 5 cm). Column movement from straight apical intercostal drainage tube (ICD) at 6 weeks post-operatively in 35 patients (79.9%), whereas 5 patients had 5 - 10 cm column movement considered acceptable. Near similar results were found in basal angle ICD tubes (Table 5a, 5b).

Air leak from straight apical ICD was absent even on coughing in 39 (88.6%) patients and in 1 (2.3%) patient was present on coughing only, while only 4 (9.1%) had air leak with deep expiration. In basal angle ICD, 39 (88.6%) patients had no air leak and 5 patients had air leak on coughing only at 4 weeks (Table 6a, 6b).

On the basis of Table 5a, 5b, 6a, 6b represent targeted dead space reduction is achieved excellently in 36 patients, whereas acceptable in 6 patients which show column movement less than 10 cm in basal angled ICD. Similarly, targeted dead space reduction and cure and control of lung parenchymal disease is achieved excellently in 39 and acceptable in 1 patient, which show absent air leak even on coughing in 39 and in one only on coughing.

40 patients were cured and controlled with dead space reduction thoracoplasty, whereas 4 patients with MDR TB were not recovered, so they further required other modalities like open window thoracostomy etc. afterward on follow-up.
In the year 1924, Reich and colleagues first described the use of Pneumoperitoneum for patient with emphysema. Pneumoperitoneum is safe and effective procedure performed with the aid of imaging exams to guide the introduction of air.22,23,24

Open window thoracostomy is an ideal method for draining the septic pleural cavity in patients with empyema after pulmonary resection, especially in patients with post-pneumonectomy bronchopleural fistula.11,12,13,25

Phrenic nerve block is used as temporary reduction of pleural cavity by raising the dome of diaphragm, which is contraindicated in patients with limited lung function.26

Clagett procedure is a two-stage procedure, which begins with open pleural damage and re-suturing of bronchial stump followed by packing of space with one or twice a day dressing with quarter strength Dakin’s solution or povidone-iodine solution 20%. Second stage involve the filling of pleural space with an antiseptic solution (DAB’s solution) followed by water tight wound shutting.27

For identification and closure of bronchopleural fistula, 3 modalities like Endoscopic management, Video-Assisted Thoracoscopic Surgery (VATS) and Open Surgical procedure are in use. Endoscopic management is primarily diagnostic, but now therapeutic as well is a bridge to definitive
surgery.28-30 The main benefit of VATS are better visualisation, which allow secure fixation of vascularised graft and decreased retraction of thoracic cage so postoperative pain is less and morbidity is reduced.

Early bronchopleural fistula requires urgent intervention with principle of surgical bronchopleural fistula repair, that is maintenance of vascularity as well as keep the short bronchial stump once the pleural cavity is clean.12,25,26,31,32 Late bronchopleural fistula requires either Clagett procedure or trans-sternal transcardiacal approach. As Clagett procedure is multistep, prolonged and associated with high morbidity, the trans-sternal transcardiacal approach which was initially described by Abruzzi is an option to avoid entering in a previously manipulated and diseased inflammatory cavity.33,34,35

So, the author found dead space closed reduction thoracoplasty has operative equivalence with minimal untoward consequences and improved psychosocial health when compared with open window thoracostomy. Its implication in early young age group of chronic empyema thoracis patients is highly demanding.

CONCLUSION
So, the author found that dead space closed reduction thoracoplasty has operative equivalence with minimal untoward consequences and improved psychosocial health when compared with open window thoracostomy. This study was done at a single centre with limited resource setting. So, author propose large multi-centric study to address the above issue more precisely.

REFERENCES
[22] Reich L. Der Einfluss des Pneumoperitoneums auf das Lungen-emphysym. Wien Arch Finn Med 1924;8:245-60.


