



To evaluate the role of definite intervention in lung function improvement among paediatric Empyema Thoracis cases

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Abstract:

Introduction- Empyema thoracis is purulent collection in the pleural space. Pleural empyema is mostly caused by speeding infection from lung. This process has several steps, from pneumonia to parapneumonic effusion, uncomplicated empyema, and complicated septate empyema and at the end fibro thorax. Surgical treatments tube thoracostomy and thoracotomy with decortications ,physically remove the problem which are the causes of the lung function disorder, so after it, a better lung function is expected post operatively. With the above background the present study was conducted to assess the change in lung function of paediatric age group patients of empyema thoracis, after definite intervention. **Material and methods-** The present prospective study was conducted in department of general surgery, Pt. J.N.M. Medical College and Dr BRAM hospital, Raipur (C.G.), India. 40 patients according to above mentioned inclusion and exclusion criteria, getting admitted during the study period were taken under the study. Patients were subjected to undergo either tube thoracostomy (ICD insertion) or thoracotomy with decortication. In the Post operative period the lung function of the patients was be measured at 1 week, 15 days, 1 month, 3 month, 6 month interval. Preoperatively percentage predictive value of lung function is compared with six months postoperatively percentage predictive values of lung function using paired t test. **Results-** In our study of 40 cases, it was found that mean age of presentation of empyema for ICD insertion was 6.6 yrs and decortications was 6 yrs. Percentage predicted value of FEV1 and FVC was increased significantly before and after definitive procedure. **Conclusion-** Pleural pus removal by ICD insertion results in significant improvements in lung function, in early stage 1 empyema, improving with time, and good function found after 6 months. Thoracotomy with decortications done in cases which had thicker peel, in fibrinopurulent phase of empyema and even still later organized stage, significant lung function improvement at follow up after 6 months.

Key words: Empyema thoracis, Tube thoracostomy, Thoracotomy, Decortication, Chhattisgarh

Introduction:

Empyema thoracis is purulent collection in the pleural space, it requires a combination of thick pus or coagulum with thick cortex of fibrin over the lung. It is end stage of pleural infection. Pleural empyema is mostly caused by speeding infection from lung, (Moir Talunder RL) [1]. This process has several steps from pneumonia to parapneumonic effusion, uncomplicated empyema, and complicated septate empyema and at the end fibro thorax. It is an advanced parapneumonic effusion (Eartham KM et al) [2].

The American thoracic society has described the formation of empyema in a three stage continuum:

STAGE 1- Exudative phase: in this stage there is a protein rich effusion, it becomes infected with organism from lung thus setting the scene for empyema.

STAGE 2- Fibrinopurulent phase: the previously exudates fluid now thickens to what is known as Fibrinopurulent phase.

STAGE 3- Organising phase: above pathological process causes lung to be trapped by the thick peel or cortex.

Chronic Fibrinopurulent empyema according to ATS(American thoracic society),described by Andrews ,are in stage 2 and 3,are the conditions when purulent collection with fibrin exists in pleural cavity which reduces the respiratory function of lung (Patton WA et al) [3]. In the latter process

fibroblastic inoculation into fibrosis collection traps the lung and any attempt to remove the fibrosis envelope damage the lung with possibility of presence of prolonged leak. On the other side, visceral and parietal pleura are connected with fibrous bridges which were making the space like multiple loculated lacs with purulent collection. In this phase the application of thoracic drainage and evacuation of purulent collection of pleural cavity is impossible. In these cases it is necessary to evacuate the parietal and visceral pleura by cutting the fibrosis bridges carefully to prevent the damage to surface of lung (Rai SP et al) [4].

The pathological process in empyema causes the reduction in the ventilation function of lung on side where the pathological process is. Pressure on the lung by the purulent collection, atelectasis of the lung under it, inflammation and trapping of the lung are causes of reduced FVC. Pneumonia as a cause of all these changes is the reason for the appearance of spastic collection with reduction of FEV (Kondor G et al) [5].

Atelectasis of the lung under empyema results in collapse of alveolar parenchyma, the appearance of A-V shunt with disorders in changes of gases, which also result in decreased spirometry tests (volumes and capacities) with changes in gas and acid base status of blood.

Spirometry which means “the measuring of breath” is a routinely used pulmonary function test (PFT) that measures amount and speed of air that a person can inhale or exhale. Results from the tests can be used to estimate lung function and aid in the diagnosis of certain respiratory disorders. Participants perform the spirometry test using a spirometer, a device that measures the amount of air a subject exhales and the rate at which he or she exhales the air. The basic standard spirometric test require the subject to exhale as forcefully as possible after taking in a full deep breath, the subject effort is called the forced expiratory maneuver. (Ryzman W et al) [6].

Surgical treatment tube thoracostomy and thoracotomy with decortications, physically removes the problem which are the causes of the lung function disorder, so after it a better lung function is expected post operatively. Improvement of lung function is not immediate because of pain following thoracotomy. The percentage of increase in spirometric function is dependent on the reason for empyema (nonspecific and specific inflammation), the time after beginning of symptoms, extent of pathological process in lung and other reasons [5]. With the above background, the present study was conducted to assess the

changes in lung function among paediatric empyema thoracis patients after definite intervention in a tertiary care hospital of Raipur city (C.G.), India.

Materials and Methods:

The present prospective study was conducted in department of general surgery, Pt. J.N.M. Medical College and Dr BRAM hospital, Raipur (C.G.), India.

Criteria of selection

- Patients – Age between 5 to 14 yrs of age.
- Patients with other obstructive or restrictive lung diseases.
- Patients with significant lung destruction, not included

40 patients according to above mentioned inclusion and exclusion criteria getting admitted during the study period was be taken under the study. Written and informed consent was taken from each patient to participate in the study. Detailed history was recorded from each patient pertaining to the onset and duration of the present complaints. Physical examination was done on all the patients, including general and systemic examination. All the routine investigations including X- Ray chest and USG thorax was are done on the cases. Each patient was subjected for pre interventional Lung Function measurement using spirometry. Control of same age, sex, height without any known disease is taken and lung function is measured. Patients was be subjected to undergo either Tube thoracostomy (ICD insertion) or Thoracotomy with Decortication.

In the Post operative period the lung function of the patients was be measured at 1 week, 15 days, 1 month, 3 month, 6 month interval. Mean lung function is calculated preoperatively and post operatively at 1 week, 15 days, 1 month, and 3 month, 6 month interval for both ICD insertion and thoracotomy with decortications. Percentage of predictive value of lung function for ICD insertion and decortications preoperatively and postoperatively is calculated by

[Calculated mean lung function X 100]

Mean lung function of controls

Now the preoperatively percentage predictive value of lung function is compared with six months postoperatively percentage predictive value of lung function using paired t test.

Results

In our study of 40 cases, it was found that mean age of presentation of empyema for ICD insertion was 6.6 yrs and decortications was 6 yrs. In our study of 40 cases, it was found that 22 (55%)

patients were male & 18(45%) were female. The commonest symptom was fever which was present in all (100%) patients, followed by cough (87.5%), dyspnoea (85%), and chest pain (32.5%). Right chest was involved in 25 (62.5%) patients followed by left chest in 11(27.5%) and bilateral chest involvement in 4 (10%) patients. In our study 40% of the patients underwent decortication & ICD insertion was done in 60% of patients. [Table-1]

Mean percentage predicted value of FVC in ICD insertion and Decortication is 55.84% & 52.34% preoperatively. Mean percentage predicted value of FEV₁ in ICD insertion and decortications are 63.90% & 58.64% preoperatively. [Table-2]

Mean hospital stay was 14.37 days after ICD insertion and 10.37 days after decortication. [Table-3]

Percentage predicted value of FVC increased from 55.84% to 67.70% before ICD insertion and after six months of ICD insertion respectively. Percentage predicted value of FEV₁ increased from 63.90% to 74.31% before ICD insertion and after six months of ICD insertion respectively. Percentage predicted value of FVC increased from 52.44% to 61.12% before decortication and after six months of decortication respectively. Percentage predicted value of FEV₁ increased from 58.64% to 68.33% before decortication and after six months of decortication respectively. [Table-4, 5]

Table 1: Background variables of the study subjects

Variables	No. (%)
Mean Age During The Procedure	
ICD Insertion	6.6 Yr
Decortication	6 Yr
Sex	
Male	22(55%)
Female	18(45%)

Table 4: Post operative lung function in patients of empyema thoracis who underwent ICD insertion and decortication

Duration	1 Wks		15 Days		One Month		Three Month		Six Month	
	FVC	FEV ₁	FVC	FEV ₁	FVC	FEV ₁	FVC	FEV ₁	FVC	FEV ₁
Lung Function(% Of Predicted Value)										
ICD insertion	60.60	62.83	63.67	65.41	66.49	67.3	68.47	69.98	70	74.31
Decortication	52.18	59.05	54.40	59.67	56.02	61.61	58.31	63.96	61.12	68.33

Clinical Presentation	
Fever	40(100%)
Cough	35(87.5%)
Dyspnoea	34(85%)
Chest Pain	13(32.5%)
Side Of Chest Involvement	
Right	25 (62.5%)
Left	11 (27.5%)
Bilateral	4 (10%)
Procedure performed	
ICD Insertion	24 (60%)
Decortication	16 (40%)

Table 2: Preoperative lung function in patients of empyema thoracis patients

Procedure	Preoperative Mean FCV(% Of Predicted Value)	95% C.I.
ICD Insertion	55.84	54.94-56.72
Decortication	52.24	50.95-54.74
Preoperative Mean FEV₁(% Of Predicted Value)		
ICD Insertion	63.90	61.89-65.68
Decortication	58.64	56.93-61.54

Table 3: Mean hospital stay (in days) after the intervention

Procedure	Mean Hospital Stay (In Days)	95% C.I.
ICD Insertion	14.37	13.45 -15.29
Decortication	10.37	9.33 - 11.41

Table 5: Comparison of lung function before & after six months of the ICD insertion and Decortication

Patient group	Lung function(% of predicted value)		Paired t test p-value
	FVC	FEV1	
ICD insertion			
Before procedure	55.84%	63.90%	<0.05 Significant
After 6 months	67.70%	74.31%	
Decortication			
Before procedure	52.44%	58.64%	<0.05 Significant
After 6 months	61.12%	68.33%	

Discussion

In our study, the commonest symptom was fever which was present in all (100%) patients, followed by cough (87.5%), dyspnoea (85%), and chest pain (32.5%). **Satpati et al (2005)** [7] observed the most common symptom to be dyspnoea (88.6%), followed by fever (77.3%), cough (71.6%) and chest pain (24.5%). **Karannin I et al (2004)** [8] the most common symptom was fever. **Demirhan et al (2008)** commonest symptom was fever which was seen in 91 % cases followed by cough (81%), Dyspnoea (68%) [9].

In our study right chest was involved in 25 (62.5%) patients followed by left chest in 11(27.5%) and bilateral chest involvement in 4 (10%) patients. **Karannin I et al (2004)** observed right side involvement in 60% cases and left side chest involvement in 40% cases [8].

Baranwal et al (2008) observed right chest involvement in 68% cases, left side was involved in 27% cases and bilateral chest involvement in 5 % cases [10]. **Demirhan et al (2008)** Right side chest involvement was seen in 64% case and left side involvement was seen in 36% cases [9].

In our study 40% of the patients underwent decortication & ICD insertion was done in 60% of patients. Mean hospital stay was 14.37 days after ICD insertion and 10.37 days after decortication. **Satpaty et al (2005)** observed mean hospital stay in ICD insertion to be 13.3 days and 12.8 days in patients who had decortication [7]. **Baranwal et al (2008)** observed mean hospital stay in ICD insertion to be 23.2 days and 27.7 days in patients who had decortication [10]. **Gupta AK et al (2008)** observed in a series of 60 pediatric patients of empyema

thoracis, thoracotomy and decortications had a rapid recovery and decreased length of hospital stay [11].

In our study percentage predicted value of FVC & FEV1 were significantly increased before ICD insertion and decortications after six months of interval. **Rai S.P et al (2006)** in their study 25 patients of chronic empyema subjected to decortications pre operatively spirometry shows mean FVC 53% and mean FEV₁ 61.7% which improves to 68% and 72.8% after surgery [6]. **Hussian Niaz et al** studied 50 patients of empyema who were subjected to decortications pre operative spirometry shows FVC 51% of predictive value and FEV₁ 59%. Post operatively after 6 months spirometry gave satisfactory results of FVC 66% and FEV₁ 70% [12]. **Rauf Gaur et al (2007)** in their study spirometric parameters FEV₁ (68.1% Vs 71.01%) and FVC (67.6% vs 71.3%) significantly improved after operation [13]. **Metrol gokoe et al (2009)** studied 50 patients of chronic pleural empyema from 6 months to 58 months found mean improvements in FEV₁ was 61.40% to 78.92% and FVC from 60.85% to 77.48% [14]. **Sung Sil Choy et al (2004)** they have taken 60 patients divide them into two groups tuberculous and non tuberculous and decortications was done in both group. In tuberculous group pre and post operative mean in FEV₁ was 65.8%-80.75% in FVC was 61.9%-71.8%. In non tuberculous group pre and post operative mean in FEV₁ is 66.4%-73.8% and in FVC is 64.9%-71.8% [15]. **Richard W Light (2006)** observed in his study that pulmonary function of the patients who underwent decortications increases significantly [16]. **Arsalane et al** in their study of 25 cases of decortications observed that there is a significant improvement in pulmonary function after 3 months of surgery [17]. **Bhimiji Shabir** in his article states that ultimate return of lung function depends on preoperative lung diseases if lung parenchyma was normal prior to surgery then complete reexpansion of lung and obliteration of pleural space is certainly possible in most of the cases lung volumes improve significantly after decortications [18]. **Kryzstof Karawat et al** in their study found that pleural fluid removal cause significantly improvements in lung function [19].

Conclusion

Pleural pus removal by ICD insertion results in significantly improvements in lung function, in early stage 1 empyema, improving with time and good function found after 6 months. Thoracotomy with decortications done in cases which had thicker peel, in Fibrinopurulent phase of empyema and even

still later organized stage, significant lung function improvement at follow up after 6 months. The finding of the present study will be useful for surgeons for appropriate and effective management of paediatric empyema thoracis cases.

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References

- Moir CR, Talander RL. Complications of Lower Respiratory Tract Infections: Empyema Complicating pneumonia, Pneumatoceles And Respiratory Embarrassment, Chapter 24. Pediatric Thoracic Surgery, Fallis JC, Filler RM, Lemoine G. New York: Elsevier Science Publishing Co Inc 1991; p. 299.
- Eastham K M, Freeman R, Kearns AM, Eltringham G, Clark J, Leeming J, et al. clinical feature, aetiology and outcome of empyema in children in the north east of England. *Thorax*.2004;544-5.
- Patton WE, Watson TR, JR Gaensler A :Pulmonary function before and after surgical decortications of lung. *Surg Gynecol Obslet* 1952 Oct.
- Ryzman W, Skokowski J, Romanowicz, Lass P, Dziadziuszko R. Decortication in chronic pleural empyema-effect on lung function. *Eur J Cardiothorac Surg*. 2002; 21: 502–7.
- Kondov G, Colanceski R, Kondova Topuzovska I, Spirovski Z, Caeva Jovkovska B3, Kokareva A2, Popovska A2, Petrushevska Marinkovic S4, Kondov B1: Analysis of lung function test in patients of pleural empyema treated with thoracotomy and decortications.
- S P Rai, S K Kaul, R K Tripathi, D Bhattacharya, M Kashyap:Decortication in chronic pleural empyema.(2006)
- S K Satpathy, C K Behera and P Nanda; Outcome of parapneumonic empyema *Indian J Pediatr* 2005 :75(3) 197-199.
- Karannin I, Erdogan D, Karannin A, CAKMAK O. Comparison of closed thoracotomy and open thoracotomy procedures in the management of thoracic empyema in childhood *Eur J Pediatr Surg*.2004 14:250-254.
- R D Emirhan, A Kosa, I Sancakli, H Riral, A Orki (2005) Management of postpneumotic empyema in children *Acta Chir Beg*.2005,108.208,211.
- Baranwal A.K, Singh M, Kumar L (2003) Empyema thoracis a ten years comparative review of hospitalized children *South Asia Arch Dis child* 2003;1009-14(s)
- A.K Gupta, B Lahoti, S Singh, R Mathur, H Mishra and S Wadhwa (2008) A study of empyema thoracis in pediatric age group and their outcome. *The internet journal of surgery*, 14:1, 1525-8142.
- Niaz Hussain, Khurram Rais, Syed Waqar Ahmed, Tanveer Ahmed: Outcome of pulmonary decortications in empyema. *Pakistan Journal Of Surgery*, 2011, Vol 27, No 2.
- Rauf Gorur, Akin Yildizhan, Nurettin Yiyit, Ali Kutlu, Turgut Isitmangil: spirometric changes after pleural decortications in young adults. *ANZ Journal of surgery* 06/2007;77(5):344-6.
- Mertol G, Erdal O, Volkan B, Gokhan E, Gokcen S, Semih H. Lung decortication for chronic empyema: effects on pulmonary function and thoracic asymmetry in the late period. *Eur J Cardiothorac Surg*. 2009; 36: 754–758.
- Sung Si Choi, Dae Joon Kim, Kil Dong Kim, Kyung young chung: Change in pulmonary function following empyemectomy and decortications in tuberculous and non tuberculous chronic empyema; *Yonsu medical journal* 09/2004, 45(4):643-8.
- Richard W Light: Parapneumonic effusion and empyema, *Proceedings of the American Thoracic Society*, Vol 3, No 1, pp 75-80.
- A Arsalane, A Zidane. Pulmonary decortications, value of lung function recovery. *Revue de pneumologic Clinique* 10/2009;65(5) 279-86.
- Shabbir Bhimji MD, PHD: Lung function improvements after decortications.
- Krzysztof Karwat, Tadeus Prybylowski, Piotr Biclicki, Katarzyna Hildebrand, Magdalena Nowacha Mazurck : Estimation of volume of pleural fluid and its impact on spirometrical parameters. *Polski merkuriusz lekarski organ polskiego towarzystwa lekarskiego* 03/2014 36(213):186-90.