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A Study On Treatment Of Empyema Thoracis In Children

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Abstract:
Introduction: *Empyema thoracis is an accumulation of pus in the pleural space. The management of empyema involves three core principles, prompt initiation of appropriate antibiotics, complete evacuation of suppurative pleural fluid and preservation or restoration of lung expansion. Children with uncomplicated empyema are managed with intercostal drainage procedure and appropriate antibiotics. Empyema that is organized with fibrinous deposits requires a surgical approach based on decortication. Pleural decortication can be done by either intrapleural or extrapleural approach. Empyema complicated with lung abscess, bronchopleural fistula may require lobectomy or pneumonectomy.*
The study evaluated and compared various parameters of symptoms , complications, recovery, and residual morbity with Pleural decortication done by either intrapleural or extrapleural approach.
Materials And Methods: Results: *Extrapleural decortication was possible in 31 cases out of 74 cases. The cases in which extrapleural decortication was not possible were mostly associated with either prolonged duration of symptoms or underlying disease of lung parenchyma. Postoperative morbidity was less when decortication was performed by extrapleural approach*
Summary And Conclusions:*Management of empyema thoracis has to be individually tailored taking into consideration the age of the patient, duration and extent of empyema, presence or absence of systemic symptoms and signs, and general condition of the patient. Decortication is the treatment of the choice in cases not responding to conservative treatment. Post operative recovery is better with early decortication. . Morbid deformity of chest can be reduced by extra pleural decortication. Extrapleural decortication was ideal when performed during early stages of empyema. Extrapleural approach on contrary to intrapleural approach is associated with less contamination of hemithorax and less post operative morbidity& hospital slay.*
Keywords: *Empyema thoracis, intercostal drainage ,thoracotomy ,decortications, children.*

I. Introduction

Pleural empyema or empyema thoracis is an accumulation of pus in the pleural space. An empyema follows infection of the the pleural space and the structures surrounding the pleura, most commonly secondary to post-infectious pneumonia. The management of empyema involves three core principles, Prompt initiation of appropriate antibiotics, complete evacuation of suppurative pleural fluid and Preservation or restoration of lung expansion. An empyema severity score based on pleural fluid pH, glucose, radiographic findings and anaerobic infection can determine the approach to the management . In Children with uncomplicated empyema an intercostals drainage procedure and conservative management is pursued. Early drainage is desirable to avoid poor outcome .[1] Proper assessment of the response to conservative treatment is required in deciding the type of further surgical intervention. Empyema that is organized with fibrinous deposits prevent complete drainage of fluid as well as penetration of antibiotics .The organization phase of empyema requires a surgical approach based on decortication by direct removal of restrictive coagulum. Open thoracotomy for decortication utilizes a posterolateral thoracotomy incision for access into the pleural space. If the entire pleural sac is to be excised, the extra pleural plane can be sought immediately and the parietal wall of the sac separated from it. [2] The purpose of the decortication is to free the encased, trapped lung and as a result re-expansion of the lung, to obliterate the pleural space . There is less operative mortality with decortication. Decortication performed earlier in the clinical course has been demonstrated to reduce morbidity and hospital stay. However decortication is characterized by prolonged air leaks which are common. Pleural decortication can be done by either intrapleural or extrapleural approach. Empyema complicated with lung abscess, broncho pleural fistula require lobectomy and pneumonectomies .This study evaluated and compared the postoperative morbidity, duration of symptoms, and the restoration of lung expansion after decortication in children with empyema thoracis.

II. Review Of Literature

Anatomy of the Pleura : Each lung is invested by and enclosed within the pleura. The closed, mesothelium lined pleural space contains the two parts of the pleura : the outer parietal pleura. which retains its onginal relationship to the thoracic wall, and the visceral pleura which intimately invests the lung . The visceral pleura adheres to the lung and covers its entire surface including the fissures and indentations of the lobes. The mesothelial lining of the opposed surfaces of the two pleural layers secretes a small amount of ,lubricating serous fluid that minimizes friction between them during respiration.
The parietal pleura lines the thoracic cavity and is divided into four areas : the costal pleura , the diaphragmatic pleura, the mediastinal pleura and the cervical pleura . These terms designate regional parts of the contiguous pleural sac that extends beyond the lung and provides potential space for maximal expansion of the lung during forced ventilation. Anteriorly the mediastinal pleura follows the curvature of the pericardium to the root of the lung. Posteriorly, it overlies the bodies of the thoracic vertebrae, the thoracic aorta, and the esophagus. The mediastinal pleura reflects over the root of the lung and onto the lung surface to become the visceral pleura. The arterial blood supply to the parietal pleura is from branches of the posterior intercostal, internal mammary, superior phrenic. and anterior mediastinal arteties. The veins of the parietal pleura correspond to these arteries. The visceral pleura is supplied by radicles of the bronchial and pulmonary arteries, the veins of which are tributaries of the pulmonary veins. The costal and peripheral parts of the diaphragmatic pleurae are innervated by the intercostal nerves. The central portion of the diaphragmatic pleura and probably the mediastinal pleura are innervated by the phrenic nerves. Vagal and sympathetic twigs also reach the visceral pleura through branches from the pulmonary plexus . Unlike the parietal pleura. Which is extremely sensitive to contact and inflammatory changes, visceral pleura is insensitive because it receives no nerves of general ,sensation. L.ymphatics from the subpleural plexus and remaining lung drain into the mediastinal lymph nodes. The lymphatic's from the parietal pleura drain regionally; those from the costal pleural drain into intercostal and substernal nodes, those from the diaphragmatic pleura drain into phrenic nodes, and those from the mediasastinal pleura drain into anterior and posterior mediastinal nodes, from the cervical to the costal pleurae reach the axillary nodes. Eventually, the lymphatic drainage from the parietal and visceral pleurae is returned to the vascular system by the right lymphatic duct or the left thoracic duct.

The pleural space and pleura are susceptible to diseases that affects not only their own function but also that of organs invested by them. Diseases that affect the pleural space are essentially mechanical in pathophysiology and consist of pneumothorax, hemothorax, chylothorax, pleural effusions, empyema. bronchopleural fistula, and fibrothorax.

Pleural effusion : A pleural effusion is an accumulation of fluid in the pleural space from excessive transudation or exudation of interstitial fluid from the pleural surfaces.
Symptoms include pleuritic chest pain and dyspnea . The abnomial presence of pleural fluid can alter pulmonary function by mechanically inhibiting expansion of the lung, causing dyspnea. When chronic it may cause atelectasis, intercurrent pulmonary infections, and lung trapping. Patients with significant underlying pulmonary disease may becomes Symptomatic with only small to moderate pleural effusions. and improve dramatically with drainage.

The mechanisms of abnormal accumulation of pleural fluid are (I) Increased hydrostatic pressure, such as in congestive heart failure (2) Increased capillary permeability, as in pneumonia or inflammatory pleuritis (3) Decreased plasma colloid oncotic pressure, as in hypoalburninemia. (4) inreased intrapleural negative pressure, as in atelectasis, and (5) impaired lymmphatic drainage of the pleural space, usually owing to obstruction of the lymphatics by tumor, radiation, or fungal disease.

PleuraI effusions are divided into transudates and exudates. A transudate occurs with the alteration of systemic factors that influence the formation or absoption of pleural fluid. Examples are decreased plasma colloid osmotic pressure in hypolbuminemia or Increased hydrostatic pressure in congestive heart failure. The pleural surfaces are not involved in the primary pathologic process. An exudate results from disease of the pleural surface or lymphatic's. Pleural disease leads to the accumulation of pleural fluid because the capillary permeability increases through inflammation caused by bacteriaI pneumonia, tuberculosis, or tumor. Lymphatic obstruction secondary to lymphoma or metastatic tumor also causes an exudative effusion.

If the effusion is a trandudate no further diagnostic procedures are necessary and the underlying systemic cause is treated. If the effusion is an exudate, further evluation is needed to elucidate the etiology of the pleural or lymphatic disease. A pleural effusion has been considered an exudate when the protein level exceeded 3 g/I00 ml or the specific gravity is more than 1.016, But these values alone can lead to an error in diagnosis in I0% of cases because the protein concentration of long-standing transudates increases as fluid is absorbed in excess of protein, hence making them seem like exudates.

Simultaneous determination of protein and lactic acid dchydrogenase (LDH) levels in pleural fluid and serum correctly differentiates transudative from exudative effusions 99% of the time. A pleural effusion with one or more the following characteristics is an exudate. (Light et aL, l972)

1. Pleural fluid protein/serum protein > 0.5
2. Pleural fluid Ll)H/serum LDH >0.6
3. Pleural fluid LDH > two thirds of the upper limit of normal for serum LDH.

III. Pleural Fluid Charecteristics And Analysis-

Appearance of Pleural Fluid: The gross appearance of the pleural fluid should always be described and its odour noted. If the pleural fluid smells putrid, the patient has a bacterial infection- probably anaerobic. If the pleural fluid is bloody, a pleural fluid hematocrit should be obtained, and if this is greater than 50% that of the peripheral blood, the patient has a hemothorax. and one should consider inserting chest tubes. If the pleural fluid is turbid, milky or bloody, the superrnatant should be examined after centrifugation. If the supernatant is clear. then the turbidity is due to cells or debris in the pleural fluid. If the turbidity persists, then the patient probably has a chylothorax or a pseudochylothorax.

Pleural Fluid Glucose : The gross appearance of a reduced pleural fluid glucose level - <60 mg/dl - narrows diagnostic possibilities to six- parapneumonic effusion, malignant effusion. tuberculous effusion, rheumatoid effusion, hemothorax. or a pleural effusion ,,hat is due to paragonimiasis. If a patient with a parapneumonic effusion has a pleural fluid glucose level <40 mg/dl. Tube thoracostomy should be performed.

Pleural Fluid Amylase : An elevated pleural fluid amylase indicates that the patient has esophageal perforation, pancreatic disease, or malignant disease. The best screening test for a ruptured esophagus is probably the pleural fluid amylase. The ongin of the amylase in this instance is the salivary glands. Approximately 10% of patients with acute Pancreatitis have an accompanying pleural effusion, and in an occasional patient, the chest symptoms will dominate the clinical picture and the elevated pleural fluid amylase will be the first clue that the primary problem is pancreatic rather than pulmonary. Patients with chronic panreatic disease may develop a sinus tract between the pancreas and the pleural space, which leads to a chronic illness dominated by a large pleural effusion. The pleural fluid amylase level is elevated in approximately 10% all malignant pleural effusions.

Pleural Fluid Lactic Acid Dehydrogenase: The pleural fluid LDH level is not useful in the differential diagnosis of exudative pleural effusion. Nevertheless, it is recommended that a pleural fluid LDH level be measured every time a diagnostic thoracentesis is performed because the level of LDH in the pleural fluid is a good indicator o f the degree of inflammation in the pleural space. If the pleural fluid LDH level increases with serial thoracentesis the degree of inflammation is worsening, and one should be more aggressive in pursuing the diagnosis.

Pleural Fluid White Cell Count and Differential Count: The absolute pleural fluid white blood cell count is of limited utility. Counts >I0,000/ml are most common with parapneumonic effusions but are % seen with Pancreatitis, pulmonary embolism, collagen vascular disease. malignancy, and tuberculosis. The differential cell Count on the pleural fluid s of more utility than is the absolute cell count, If the pleural fluid contains predominantly olymorphonuclear leukocytes, then it is due to an acute disease process such as pneumonia, pulmonary embolization, pancreatitis, intra-abdominal abscess, or early tuberculosis, If the pleural fluid Contains predominantly mononuclear cells, then malignancy, tuberculosis, or a resolving acute process is probably responsible for the effusion. The demonstrration that more than 50%, of the white blood cells in an exudative pleural effusion are small lymphocytes indicates that the patient probably has a malignant or a Tuberculous pleural effusion and thus serves as a strong indicaion for needle biopsy of the pleura if the cytology of the pleural fluid

Pleural fluid Cytolog: Pleural fluid cytology is quite useful in establishing the diagnosis of malignant pleural effusion because the diagnosis can be established in 40 to 90 % depending on the tumor type, the amount of fluid submitted, and the skill of the cytologist. Rijken and associates(199l)[4] reported that the demonsration of anucuploidy in cells from pleural fluid is strongly of the diagnosis of malignant pleural effusion but that approximately one third of patients with malignant pleural disease do not have aneuploidy of their pleural fluid cells.

Bacteriology and Culture: Pleural fluid from patients with undiagnosed exudative pleural effusions should be cultured for bacteria for both aerobic and anaerobic bacteria, mycobacteria, and fungi. A Gram stain of the fluid should also be obtained. Countercurrent immunoelectrophoresis — CIE — is used to identify bacterial antigens in pleural fluid and to establish a presumptive bacteriologic diagnosis in patients with parapneumonic effusions. CLE has proved to be quite valuable in children with parapneumonic efflusions. It is less useful in adult population because anaerobic organisms are responsible for many .parapneumonic effusions in this population

and no antigens from these organisms are available for routine use. Pleural Fluid pH and PCO2 .The pleural fluid pH is most useful in determining whether chest tubes should be inserted in patients with parapneumonic effusions. If the pleural pH is <7.00, the patient invariably has a complicated parapneumonic effusion. and tube thoracostomy should be instituted. If the pleural fluid pH >7.20 the patient will probably not require tube thoracostomy. The - pleural fluid pH can be, reduced to <7.20 with several other conditions: I) systemic acidosis, 2) Esophageal rupture, 3) Rheumatoid pleuritis. 4) Tuberculous pleuritis. 5) Malignant pleural disease and 6)Haemothorax. When the pleural fluid pH is used as a diagnostic test, it must be measured with the same care as arterial pH. The fluid should be collected anaerobically in a heparinized syringe and placed in ice for transfer to the laboratoy to avoid spontaneous acid generation by the fluid.

Pleural fluid adenosine deaminase (ADA): pleural fluid adenosine deaminase (ADA) level of >70 U/L — is virtually agnostic of tuberculous pleuritis while level <40 U/L virtually rules out this diagnosis.
Cholesterol and triglycerides: If the supernatant of the pleural fluid is cloudy, levels of cholesterol and triglycerides in the pleural fluid should be obtained to differentiate chylothorax from pseudochylothorax . With chylothorax the pleural fluid triglyceride levels are usually elevated >110 mg/dl.

IV. Results

Table-1-Number of children treated by decortication

Extrapleural	31
Intrapleural	43

Table-2-Age of chidren treated by decortication

5 years	45
6-10 years	25
10 years	4

Table-3-pathology

Non- specific	66
Tuberculous	8

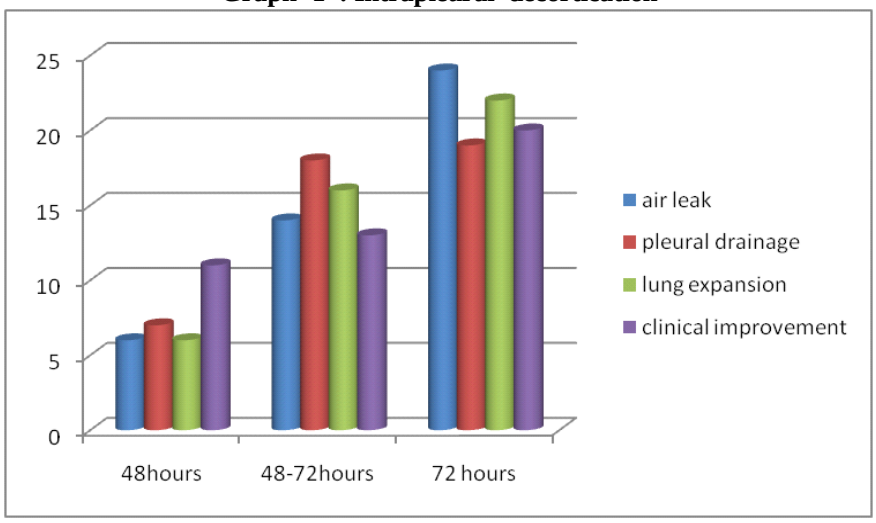
Table-4-complications

Redo thorocotomy	2
Lobectomy	8
B.P.F	11

Table-5, Intrapleural decortication

	48hours	48-72hours	72 hours
air leak	6	14	24
pleural drainage	7	18	19
lung expansion	6	16	22
clinical improvement	11	13	20

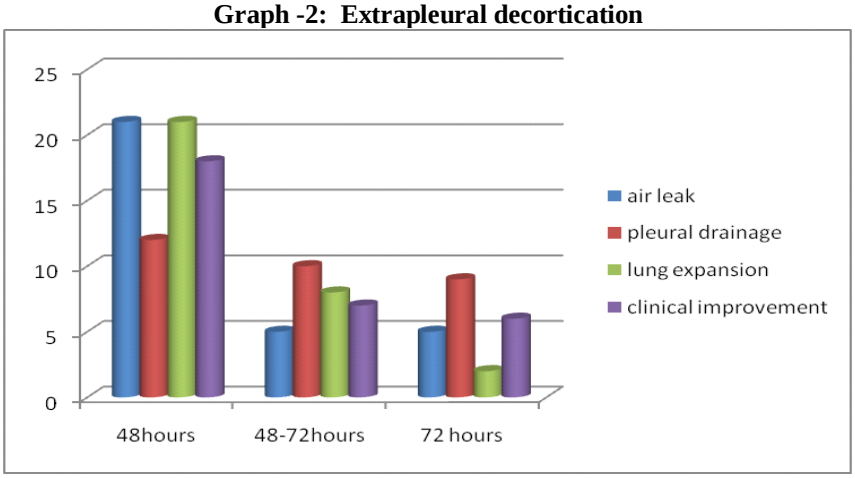
Graph -1 : Intrapleural decortication



Ta ble-6 : Extrapleural decortication

	48hours	48-72hours	72 hours
air leak	21	5	5
pleural drainage	12	10	9
lung expansion	21	8	2
clinical improvement	18	7	6

Graph -2: Extrapleural decortication



V. Discussion

The organization phase of empyema requires direct removal of restrictive coagulum (Decortication). Decortication performed earlier in the clinical course has been demonstrated to reduce morbidity and hospital stay. Pleural decortication can be done in either intrapleural or extrapleural approach. If the entire pleural sac is to be excised, the extrapleural decortication can be done which avoids opening up of empyema cavity thereby reducing contamination of hemithorax. The critical feature of the extrapleural dissection is location of this reflection and changing the dissection plane from extrapleural on chest wall to the space between peel and pleura to begin decortication of lung. This was termed turning the corner by Samson". Failure to recognize this plane may result in carrying dissection plane behind aorta or esophagus. In the present study all the cases were initially treated conservatively with antibiotics and intercostal drainage tube, the cases which did not respond to conservative treatment and showed clinical deterioration were taken up for surgery. Extrapleural decortication was possible in 31 cases out of 74 cases. The cases in which extrapleural decortication was not possible were mostly associated with either prolonged duration of symptoms or underlying disease of lung parenchyma. Postoperative morbidity was less when decortication was performed by extrapleural approach. This may be due to either less contamination of hemithorax or because duration of symptoms was less in the cases where extrapteural decortication was done. Postoperative air leaks. ICD drainage and morbidity were less in cases where extrapleural decortication was done. Complete removal of fibrous pleurae was possible in extrapleural decortication with less contamination of hemithorax. Post operative morbidity was less with an early expansion of trapped lung when done in correct plane in selected cases. All the patients were put on long term post operative antibiotics therapy and antituberculous treatment was given in cases where the biopsy was confirmed as tuberculosis.

To summarize, the advantages of extrapleural decorication include; complete removal of restrictive fibrous pleurae, less morbidity and hospital stay, early expansion of the trapped lung, minimal contamination of the hemithorax. less postoperative air leaks and the morbid deformity of chest wall can also be reduced.

VI. Conclusions

1. Management of empyema thoracis has to be individually tailored taking into consideration the age of the patient, duration and extent of empyema, presence or absence of systemic symptoms and signs, and general condition of the patient.
2. Decortication is the treatment of the choice in cases not responding to conservative treatment.
3. Post operative recovery is better with early decortication.
4. Morbid deformity of chest can be reduced by extra pleural decortication.
5. Extrapleural decortication was ideal when performed during early stages of empyema.
6. Extrapleural approach on contrary to intrapleural approach is associated with less contamination of hemithorax and less post operative morbidity& hospital slay.

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