Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2016; 4(4A):1112-1115 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Original Research Article

Diagnostic value of the biochemical parameters in patients with empyema thoracis

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Abstract: Empyema thoracis means an accumulation purulent effusion in the pleural cavity. Its incidence has gradually decreased because of the increased availability and use of antibiotics. However empyema still continues to be a significant cause of morbidity, especially in developing countries. The purpose of this study was to examine the diagnostic value of pleural effusion LDH, glucose concentration and pH in patients with purulent pleural effusion. Between November 2005 and August 2012, 20 patients with empyema thoracis admitted to Dursun Odabas Medical Center were included in the study. Patients who had developed empyema thoracis associated pulmonary resection, tuberculosis, or traumas were not included in the study. After the thoracentesis, a specimen was collected to a tube for biochemical analysis (glucose, protein and LDH). A second sample was taken into a heparinized syringe for pH analysis. Pleural aspiration was initially performed in all patients. Most patients required closed chest tube drainage. Decortication was performed, if chest tube drainage failed. There were 18 male and 2 female patients. The age of patients ranged from 2 to 67 years, with a mean age of 29.17±18.52 years. The samples of pleural effusion had had a high protein and LDH levels, but low pH and glucose levels. Pleural aspiration was found successful treatment method only in two patients (10%). Tube thoracostomy was required in 18 patients, of whom four had thoracotomy. Diagnosis of empyema thoracis can be supported by biochemical analysis of pleural effusions. Underwater seal drainage plus antibiotic therapy can cure the empyema in majority of the patients. Treatment should be started without delay if the biochemical markers are positive.
Keywords: Empyema Thoracis, Biochemical Parameters, Drainage

INTRODUCTION:

Empyema thoracis means an accumulation of purulent effusion in the pleural cavity. The diagnosis and treatment of empyema thoracis was first described by Hippocrates in around 600 B.C. At the present time, its incidence has gradually decreased because of the increased availability and use of antibiotics. However empyema still continues to be a significant cause of morbidity, especially in developing countries [1]. The normal pleural fluid amount is usually not more than 20 cc. Excessive accumulation of pleural effusion may result from the pleural, pulmonary or extrapulmonary disorders [2]. Purulent effusion of the pleural space evolves through three distinct stages. The first stage (exudative phase) occurs due to increased pleural permeability of the visceral pleura contiguous to an underlying pulmonary infection. Initially, the effusion is characterized by negative bacterial culture. In this stage an appropriate antibiotic therapy should be performed for early treatment of the underlying pneumonia, otherwise, the second phase (fibrin purulent phase) develops with bacterial invasion of the pleural cavity. During second phase, fibrinolytic activity is disrupted. Then effusion becomes loculated due to impaired fibrinolytic activity. Neutrophils migrate the pleural space, LDH is produced and the effusion becomes frank. In this stage, the pleural effusion is characterized by a pH below 7.02, a glucose level below 60 mg/dl, and a pleural effusion LDH level more than three times the serum level. In this stage pleural effusion should be drained to prevent the evolution of the third stage. However, tube thoracostomy may be insufficient in over 50% of patients. Then, most of these patients will require decortications [3].

If untreated fibrin purulent stage may convert to third stage (organizing phase). In the organizing phase, fibroblasts grow into the pleural effusion from

pleural membranes, producing a thick pleural peel. The thickened visceral pleural membrane prevents lung expansion due to fibrous pleural scaring and trapping lung occurs. Therefore, pleural decortications should be performed in the last stage [4, 5].

The purpose of this study was to examine the diagnostic value of pleural effusion LDH, glucose concentration and pH in patients with purulent pleural effusion.

PATIENTS AND METHODS

Between November 2005 and August 2012, 20 of the patients with empyema thoracis admitted to Dursun Odabas Medical Center were included in the study. Patients who had developed empyema thoracis associated pulmonary resection, tuberculosis, or traumas were not included in the study. The culture-positive patients were also excluded from the study.

PA and lateral chest radiographs were taken in all patients. Routine laboratory tests were performed. Blood cultures were also routinely made. Pleural aspiration (thoracentesis) was initially performed in all patients. After the thoracentesis, a specimen was collected to a tube for biochemical analysis (glucose, protein and LDH). A second sample was taken into a heparinized syringe for pH analysis. To establish the diagnosis of empyema thoracis, biochemical parameters, such as pH, protein, lactic dehydrogenase (LDH) and glucose levels of the effusions, were assessed. All patients have been referred to our hospital from other hospitals due to useless of their initial antibiotic treatments

Most patients required closed chest tube drainage. If chest tube drainage failed, decortication was performed via thoracotomy incision. The lung was freed in an extra pleural plane from the thoracic wall and the diaphragm. Then, the involved parietal and visceral pleural membranes and diaphragm were decorticated.

RESULTS

There were 18 male and 2 female patients. The age of patients ranged from 2 to 67 years, with a mean age of 29.17±18.52 years.

The main symptoms were cough in 18 patients, dyspnea in 15 patients, fever in 16 patients and chest pain in 11 patients. Additionally, anorexia, malaise and weight loss were noted in 14 patients. Results of biochemical tests of pleural effusions are revealed in table 1. The samples of pleural effusion had had a high protein and LDH levels, but low pH and glucose levels. Pleural aspiration was found successful treatment method only in two patients (10%). Tube thoracostomy was required in 18 (90%) patients, of whom two had partial rib resection.

Thoracic drainage tubes were left in pleural cavity between 4 and 20 days with a mean of 12.2±1.41 days. In two patients, closed underwater seal drainage was converted to open drainage after 20 days. The open drainage tube was withdrawn after gradually shortened within two weeks. Chest tube drainage failed to cure in four patients. Then, these four patients underwent subsequent thoracotomy for decortication. Al patients successfully managed and a clinical improvement in terms of dyspnea, fever, and discomfort was observed. A complete resolution was obtained within 2-4 months during follow up in all patients.

Table 1: Mean values of biochemical parameters in patients with empyema thoracis

Biochemical tests	(Mean±SD)
Protein	5.42±2.6 g/dl
Glucose	35.2±12.77 md/dl
LDH	4200±627.6 IU/l
pH	7.01±0.02

Table 2: Treatment methods for the patients with empyema thoracis

Treatment modalities	Patients (%)
Pleural aspiration	2 (10%)
Chest tube drainage	12 (60%)
Rib resection+ chest tube drainage	2 (10%)
Thoracotomy+Decortication	4 (20%)

DISCUSSION

Accumulation of pleural effusion may develop due to presence of pleural, pulmonary or extrapulmonary disorder [2]. Pneumonia, pulmonary resection, esophageal rupture, pneumothorax, trauma, bronchopleural fistula and perforated hydatid cyst may be underlying causative disorders. Parapneumonic pleural effusion develops in at least 40% of the patients

with bacterial pneumonia in any age group. More than 60% of these parapneumonic effusions may progress to empyema thoracis [6].

Low pleural effusion pH of less than 7.2 and effusion glucose concentration of less than 40 mg/dl (due to local metabolic activity of inflammatory cells and bacteria), and effusion LDH concentration of more than 1000 IU/l (as a result of inflammatory cell turnover) indicate empyema thoracis [7]. However, on rare occasions, alkaline effusion may accumulate due to some infections produced by Proteus spp. [4, 7]. Also, systemic acidosis and local anesthetic drugs prepared in acid solutions, which enter the pleural cavity, can lower the pH of pleural effusion [7]. In these circumstances, pleural effusions could be accepted as empyema if pleural glucose level less is than 40 mg/dl and if the LDH concentration is more than 1000 IU/l.

The collection of pleural effusion may occur due to many clinical conditions such as infection, collagen vascular disorders, heart failure and malignancy [8]. The standard treatment of empyema consists of evacuation of the purulent effusion. Tube thoracostomy is initially the first step in the treatment of purulent pleural effusion. However, pneumonia should be taken into account when surgical drainage is performed, because empyema thoracis is usually a complication of underlying pneumonia. The use of only surgical intervention in the presence of active pulmonary infection will frequently lead to postoperative complications [6]. Also, empirical antibiotic therapy should be needed in a significant number of patients, because pleural effusion cultures are negative for microorganisms in around 40% [4]. Therefore, antibiotics should be administered in all patients even with culture negative cases, as was done in our series.

If infection and inflammation continue unchecked, fibroblast proliferation occurs resulting in the formation of an inelastic pleural peel. Therefore, thickened visceral pleural surface prevents pulmonary expansion and permit infection to become chronic [9]. In these cases, decortication should be performed via thoracotomy incision. During operation, both parietal and visceral pleural membranes should be decorticated. The diaphragm should be also decorticated to restore its mechanical function and to improve pulmonary reserve [10].

We believe that chest tube drainage of the pleural space initially should be closed underwater seal drainage, because an open-drainage procedure exposes the pleural space to high atmospheric pressure. High atmospheric pressure will result in tension pneumothorax, if the dense pleural adhesions have not been developed. Closed chest drainage may be converted to open drainage after three weeks, as was done in our one patient. The death of many patients with parapneumonic pleural effusion was attributed to open drainage procedure related tension pneumothorax during the First World War [5].

The success rate of underwater seal drainage has been reported as 46.5% in a study conducted Pakistan [11]. In our series the success rate was found 60%. This difference may be due to early drainage of purulent effusion in our series. We performed partial rib resection to insert a large caliber chest tube in two patients with dense viscous effusion. Partial rib resection and insertion of a large caliber chest tube was found successful in 93% of patients [11].

Bacterial culture of pleural effusion is rarely positive in parapneumonic pleural effusions. Thus, immunochromatographic test (ICT) was used to diagnose of empyema. The application of ICT to pleural fluids can be useful to diagnose of pneumococcal empyema [12].

Septations and flocculation of purulent pleural effusion with fibrin accumulation can prevent effective drainage through chest tube. In these cases, thoracotomy or video assisted thoracoscopic surgery (VATS) is required. Fibrinolytic agents have been proposed to avoid thoracotomy or VATS. The use of fibrinolytic agents to eliminate fibrinous septations or loculations was largely abandoned because intrapleural fibrinolytic drug injection was associated with systemic side effects, such as febrile reactions, malaise, and leukocytosis [5]. But, human recombinant deoxyribonuclease (DNase) was used successfully to reduce the viscosity of dense purulent effusions [3]. Newer fibrinolytics alone or in conjunction with DNase may facilitate the drainage of complicated effusions through chest tube [5]. However, further studies are required.

CONCLUSION

Sometimes, the causative etiologic agent of empyema thoracis may not be determined. In this instance, diagnosis of empyema thoracis can be established using biochemical parameters. The drainage of the purulent effusion and antibiotic therapy should be combined. The drainage of the purulent effusion plus antibiotics therapy should be started immediately without delay, if the biochemical markers are positive.

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