Management of thoracic empyema in children

Abstract The effectiveness of fibrinolytic treatment has been shown in cases of thoracic empyema in adults. In pediatric patients experience is, however, very limited. The aim of this study was to determine the success and complication rates of fibrinolytic treatment in thoracic empyema in children. A series of 25 consecutive children who had loculated pleural empyemas that did not respond to tube thoracostomy and antibiotics is presented. Their ages ranged from 1 to 12 years (mean 4.2). There were 19 boys and 6 girls, and all empyemas were post-pneumonic. The fibrinolytic agent used was urokinase in 17 and streptokinase in 8. The mean duration of fibrinolytic treatment was 4.3 days (range 2 to 8) and the mean duration of chest-tube drainage was 8.9 days (range 7 to 13). In 20 patients the fluid output from the chest tube increased significantly after instillation of the fibrinolytic agent, and these patients showed almost complete resolution of the effusion on chest radiograph and ultrasound examinations (80%). Only 5 patients developed complications: bronchopleural fistula and pleural thickening in 3, and recurrent effusion, multilocation, and pleural thickening in other 2 which were managed by surgical intervention (20%). Our study suggests that intrapleural fibrinolytic treatment is an effective and safe adjunctive therapy in children with thoracic empyema and can obviate a thoracotomy in most cases.

Keywords Emphyema thoracic · Fibrinolytic treatment · Children

Introduction

Pleural effusions are a common complication of pediatric bacterial pneumonia, with a reported frequency ranging from 21% to 91% [5,15]. When such effusions become loculated or progress to empyema formation, tube thoracostomy may become a necessary adjunct to thoracentesis and antibiotic therapy. The consequences of inadequate drainage can carry significant morbidity and mortality. As fibrin is laid down and organizes, thoracotomy and decortication may be necessary [5,13,15]. The effectiveness of fibrinolytic treatment has been shown in cases of thoracic empyema in adults [9,14]. In pediatric patients experience is, however, limited [5,6,8,15]. The aim of this study was to determine the success and complication rates of fibrinolytic treatment in the management of thoracic empyema in children.

Patients and methods

A series of 25 consecutive children who had loculated pleural empyemas were studied by retrospective review of their patient records and radiographic studies from January 1998 to September 2000. There were 19 boys and 6 girls, and all had postpneumonic empyemas. Their ages ranged from 1 to 12 years (mean 4.2). All patients had anteroposterior, lateral, and/or lateral decubitus chest radiographs. Thoracic ultrasonographic scans were performed in all cases during the early stages of disease, and many patients had computed tomographic scans upon completion of therapy. All patients had postpneumonic empyemas that had been diagnosed clinically and radiologically; most showed clinical signs and symptoms of a septic condition.

Children with a loculated pleural effusion that fulfilled at least, one of the following criteria were included in this study [1]:

(1) gross purulent exudate;
(2) positive pleural-fluid culture; and
(3) positive pleural-fluid Gram stain. Successful chest-tube drainage was evidenced by improvement in the clinical and radiologic status within 24 to 48 h. Indications for fibrinolysis were per-
sistent fluid not adequately drained by the chest tube and the presence of fever and leucocytosis despite appropriate antibiotic treatment.

The fibrinolytic agents used for treatment were urokinase (UK) in 17 cases and streptokinase (SK) in the rest. A dose of 100,000 U UK or 250,000 IU SK diluted in 100 ml normal saline was instilled through a chest tube once a day [7,8]. The activated partial thromboplastin time, prothrombin time, and hemogram were determined routinely before instillation of the fibrinolytic agent. The vital signs were closely observed, and any specific complaint by the child was recorded. The tube was clamped for 8 h and then left open for 16 h. Obvious incomplete drainage, bronchopleural fistula (BPF) formation, the presence of systemic sepsis, thick pleural peel, and atelectasis despite appropriate fibrinolytic treatment were indications to proceed with thoracotomy and decortication.

**Results**

The mean duration of fibrinolytic instillation was 4.3 days (range 2 to 8) and the mean duration of chest-tube drainage was 8.9 days (range 8 to 17). In 20 patients the fluid output from the chest tube increased significantly after fibrinolysis, and these patients showed almost complete resolution of the effusion on chest X-ray and US examinations (80%). The patients’ vital signs in the normal range, and there was no evidence of a hemorrhagic diathesis. The average amount of drainage via the thoracic tube prior to instillation of the fibrinolytic agent was 24.4 ml (day 1) (Fig. 1). After treatment, the average drainage was 91.6, 86.3, 54.4, 34.4, and 15.8 ml, on days 0–4, respectively.

No complications occurred during the treatment in 20 patients; 5 developed complications: BPF and pleural thickening in 3, and recurrent effusion, multiloculation and pleural thickening in 2, which were managed by surgical intervention. The first 3 patients underwent thoracotomy, decortication, and wedge segmental resection the and other 2 thoracotomy and decortication only.

**Discussion**

The management of children with thoracic empyma is dependent on the stage of the disease. In the exudative stage, antibiotics and thoracentesis or tube thoracostomy usually result in cure. In the fibrinopulent stage, antibiotics with properly positioned chest tube drainage may resolve the empyema. Failure of chest-tube drainage is related to several factors, of which the most critical are believed to be early, thick peel on the lung, loculation, and high viscosity of the pleural fluid [12].

Intrapleural instillation of a fibrinolytic agent to accelerate drainage of a loculated effusion was first reported in the 1950s [15] but this method has received limited attention in the literature over the past 3 decades [3, 12]. Problems encountered with this modality were allergic reactions and antibody neutralization of the fibrinolytic agent during prolonged therapy.

The fibrinolytic agent degrades a variety of proteins, including fibrin and fibrin blood clots. The fibrinolytic reaction is the result of SK- or UK-mediated enzymatic activation of the plasminogen-SK or -UK complex to plasmin. Furthermore, plasmin may act in the lysis of septa of loculated pleural-space collections [7].

In 20 of our 25 patients (80%), significant clinical improvement was observed after the first or second instillation of the fibrinolytic agent. This success rate was in good correlation with the literature [8, 15]. Fibrinolytic instillation precluded the need for a major thoracotomy in 80% of children with loculated empymas who traditionally would have required open surgical therapy.

A loculated empyma is a potentially lethal condition. Failure to respond to chest-tube drainage or fibrinolytic therapy is an indication to proceed with operative intervention, as occurred in 2 of our patients [2]. Serious complications from fibrinolytic treatment did not occur in this series; only 3 patients developed a BPF after instillation of the fibrinolytic agent, but the others tolerated the procedure well. Similar observations have been described in the literature [10, 11].

Our study suggests that intrapleural fibrinolytic treatment is an effective and safe adjunctive therapy in children with thoracic empyma and can obviate a thoracotomy in most cases. Further studies are necessary to determine the indications, dosage, and optimal method of treatment in children with thoracic empyma.

**References**