Original Article

Imaging guided streptokinase injected through small bore pigtail tail catheter in management of complicated empyema in pediatrics

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ABSTRACT

Purpose: This study was done targeting the role of streptokinase injected through pigtail catheter in treatment of pleural empyema in pediatric.

Subjects and methods: 15 patients were involved in this study of age ranged from 5 months to 15 years were subjected to STK injection once daily until the drainage don't exceed 100 ml/day and managed by ultrasound guided insertion of pigtail catheter. Broad spectrum antibiotics were given to all patients, after that the antibiotics were adapted according to result of microbial culture because of failed chest tube drainage intrapleural STK is recommended.

Results: 13 cases show significant improvement, as the total amount of fluid before streptokinase injection was 5 cc in average and significantly rose to 220 cc after streptokinase instillation, while 2 cases do not response to this treatment.

Conclusion: Imaging guided streptokinase injected through a pigtail catheter provides a powerful protocol for managing of complicated empyema in pediatrics.

1. Introduction

Empyema is a dynamic process causes significant morbidity and mortality. Preventing the progression of empyema by adequate evaluation and intervention is the way to reduce morbidity and mortality and also the health care cost [1,2].

Intrinsic empyema: it is the type of empyema that described in patients who had not received any surgical procedures in the chest, as parapneumonic effusion. Tuberculous or malignant effusion [2,3].

Extrinsic thoracic empyema results from instrumentation, as surgical trauma, lung resection, penetrating and blunt chest trauma.

The nature of this disease has been described in 3 known phases in which evolution of empyema takes around 5–6 weeks [2].

Typical patient of empyema shows symptoms of pneumonia or sepsis including cough, rising of body temperature, shortness of breath and chest pain. By clinical examination: reduction chest wall expansion, along with leukocytosis and raised C reactive protein. While, elderly patients may be asymptomatic, without any pulmonary symptoms. Other factors, such as temperature, age, white blood cells count, cannot foretell the presence of parapneumonic effusions (PPE) or differentiate between persons with and persons without a PPE [4]. Chest radiography may be helpful in following related conditions with empyema such as lobar consolidation, air fluid level, pneumatocele.

The essential corners of empyema thoracis management were: discharge and detriment of the pleural cavity with inflation of affected lung.

1.1. Non surgical management

Involves antibiotic therapy through intravenous line to manage pneumonia by cephalosporin antibiotic in combination with another antibiotic may be recommended depending on microbial culture result and clinical state of the patient [5].
Insertion of chest drains; the use of intercostals tube drainage (ICTD) is limited by thick consistency of pus, which tends to hinder the tube or presence of multiple loculations that may not be discharged by single chest tube [6,7].

Chemical decortication; fibrinolytic drugs are placed in the pleural space to cut off the septations in pleural cavity and breakdown the necrotic components [2]. A proteolytic enzyme (streptokinase), converts plasminogen to plasmin resulting in degrading of fibrin.

Usually insertion of intercostal tubes associated with fibrinolytic therapy led to favorable results [35].

1.2. Surgical intervention

When unsuccessful resolution occurred due to chest tube drainage and/or antibiotic management; surgery is recommended [2].

The biphasic corners of surgical procedure are: removal of necrotic tissue to limit the septic condition. Decortication: the cutting of organized cortex over the visceral pleura to eliminate the empyema space, resulting in inflation of the lung. Rib resection: This operation is old technique and is deforming with narrow view of pleural space [2].

Apart from performing under general anesthetic, in debilitating patients it can be performed under local anesthesia in the spontaneously breathing patient.

Video assisted thoracoscopic surgery: it has two roles: the first; is aggressive, the second is conservative approach done in high risk patient, this procedure was performed under local anesthesia that may be risky [8,9]. VATS techniques firstly were dedicated for diagnosis later on, many interventional techniques were attempted [10–14].

The use of small-bore pigtail catheter is a less invasive way to drain pleural effusions than chest tube thoracostomy. Hampering of pigtail catheter by thick consistency of pus, which tends to hinder the catheter or presence of multiple loculi of pus that cannot be drained.

So, use of fibrinolytic drugs into the pleural space is indicated to overcome the problem of loculations to avoid surgery.

The aim of our work will be directed to study the role of streptokinase injected through pigtail catheter in management of complicated pleural empyema.

2. Subjects and methods

2.1. Patients

Patients admitted were referred to the interventional unit of Radiodiagnosis department, Alexandria University Hospitals, with lung infection and pleural effusion. In this prospective study, informed consent were taken from patients. In case of incompetent patients the informed consent were taken from the guardians.

All patients were subjected to: complete history taking, real time gray scale ultrasound chest, computed tomography (CT chest), ultrasound guided insertion of pig tail with injection of streptokinase, follow up by using ultrasound and CT to evaluate the response of the drug. A control group of patients were subjected to pigtail insertion without streptokinase injection. While, patients with age over 16 years, trauma, hemorrhage and bleeding tendency patient were excluded.

2.2. Treatment protocol

Drug was taken one time/day for 3 successive days and/or stopped when the total drainage don’t exceed 100 ml/day. Constituents of rinse solution was as following: normal saline (100 ml), dissolved STK (Sidonase); 250,000 IU of in 5% glucose. The pigtail catheter was irrigated with 20 ml saline then closed for 8 h after injection, number of doses used were from 2 to 5 doses. Broad-spectrum antibiotics were given to all patients, after that the antibiotics were adapted according to results of microbial culture and examined by CT, ultrasound before and after injection. Because of failed chest tube drainage; intrapleural streptokinase is recommended. 9 cases using 10 Fr and 6 cases using 12 Fr. CT images were analyzed and evaluated to determine the efficacy of STK injected small bore pigtail catheter.

2.3. Outcome measures

The two main outcome measures are clinical response to treatment and demand for surgery.

Patients were evaluated daily. The promising treatment success was based on improved clinical state and limited systemic manifestation, appropriate pleural evacuation, and improvement of radiological signs.

Surgery was recommended based on progressive septic manifestations associated with remaining pleural fluid collection, absence of favorable results clinically and radiologically more than 7 days after pigtail drainage.

Other final points: volume of drained fluid, number of doses, number of days on pigtail catheter, days of hospital admission.

2.4. Statistical aspects

This work was organized in a randomized manner with analysis targeting the treatment principles. Patients were categorized in a table. Other statistical details are reported.

3. Results

15 patients were involved in the current study, with an age range from five months to fifteen years. The most commonly affected age group was between 1 and 5 years (60%).

Thirteen patients were males (86%) and two patients were females (13%).

All of patients have fever and cough at time of presentation while 60% were dyspneic. Mean duration of symptoms was 6 weeks.

All of patients have parapneumonic effusion, 10 cases (66.6%) had empyema on the right side of the chest and 5 cases (33.3%) had empyema on the left side.

All of the patients were managed by ultrasound guided insertion of pigtail catheter, 9 cases using 10 Fr and 6 cases using 12 Fr (see Figs. 1–5 and Tables 1 and 2).

In the current study, four doses were given to nine cases successively each dose every 24 h. 5 doses are also given successively to 4 patients. Only 2 doses are given to 2 cases.

It was found that 13 cases (86.6%) had thick pus, only (2) cases (6.7%) had fluid pus.

It was found that all patients had no significant drainage (0–10 ml) after insertion of pigtail catheter.

Collectively, the total amount of fluid before streptokinase injection was 5 cc in average and this was significantly increased to 220 cc after streptokinase instillation.

We found that 13 patients has clinically improved, however, two patients have no clinical improvement.

It was found that duration of hospital stay in patients before injection of streptokinase ranged from (14 to 40 days) with mean ± SD (27.67 ± 7.84), while duration of hospital stay in same patients after injection of streptokinase ranged from (3 to 10 days)
with mean ± SD (6.5 ± 4.5 days). None of our patients experienced any of the known streptokinase related complications namely fever, bleeding and allergy. The success rate of the study was 86.6%. Regarding referral to surgery: it was found that 2 cases need referral to surgery. Follow up after 3 months: it was found that 10 cases have total inflated lung after 3 months. 5 cases are lost.

4. Discussion

Age in our study ranged from 5 months to 15 years. To the best of our knowledge, none of the available published reports have studied the efficacy of STK in pediatric age group as most of them included patients with mean age of 40 years [15,16]. The duration of symptoms (fever & cough) in the present study ranged from 7 to 20 days, before our intervention which was very close to the mean duration encountered by Maskell et al. [17]. A higher mean duration of complaint up to 35 days was recorded by Davies et al. [18].

In our study, pus with thick consistency was most commonly drained 13 cases showed thick pus, while only 2 cases have serous fluid. Diacon et al. [15] got nearly similar finding. This may be due to prolonged duration of patient symptoms before referral to the interventional unit.

In our study, collection was noticed more on the right side (66% of cases) similarly Maskell et al. [17] reported that slightly high incidence on right side affection (55% of cases). we don’t have definite explanation of the side predilection is available, which might be only a coincidence.

No significant amount of the fluid was drained in our patients at the first day of the study before STK injection likely due to thick consistency of the drained fluid, inversely Amit et al. [19] could...
have drained a larger amount of fluid in first day reaching mean volume of 215 ml. This may be due to lighter consistency of the drained fluid in adult patients.

After STK we showed significant larger amount of drained fluid reaching 450 ml in the first day. These results are in agreement with Diacon et al. [15] who showed significantly higher amount of drained fluid after STK injection than that of control group in the same period after ICTs insertion. These results show clearly the beneficial effect of fibrinolytic drug.

In the present study; 6 cases (40%) have marked radiological improvement, 5 cases (33.3%) have moderate improvement, 2 cases (13.3%) have mild improvement, 2 cases (13.3%) have no improvement after STK injection. Overall rate of success in our study reached 87% (13/15).

Similarly, Talib et al. [20], found that 4 cases (33.33%) have moderate improvement, these results were in disagreement with Davies et al. [18], who studied 12 cases, 10 of them (83.33%) showed marked improvement and 2 cases (16.77%) have moderate improvement.

The period of hospital admission in our study after beginning of STK injection ranged from 3 to 10 days. this was relatively better than the results of the reports when their patients had to stay for longer duration in hospital; 8–24 days and 10–80 days in two different studies [21,18].

We referred 2 cases out of fifteen (13.3%) for decortication. Davies et al. [18] got better result when none of their patients was operated.

Misthos et al. [16] found that 50 out of 57 cases had favorable outcome and 7 cases (12.3%) referred to surgery. the difference in result between our study and Misthos et al. [16] study may be due to difference in total number of the studied cases. But the success rate may be similar to our results.

None of our patients experienced any of the known streptokinase related complications namely fever, bleeding and allergy.

Fig. 3. Case 3: 4 years old male patient, complaining of fever and productive cough. A (A1, A2 and A3): Axial non contrast CT chest showing right moderate pleural effusion and by us reveled thick septa. B (B1 and B2): Marked resolution of previously noted right encysted empyema.
Misthos et al. [16] reported a single case of death after STK injection; due to overwhelming sepsis and subsequent multiple organ and this may be the cause of difference between our results and Misthos study.

Out of 13 cases with successful STK injection therapy, ten cases kept persistent favorable result at 3 months follow up, while the remainder 3 cases were missed. These results are in disagreement with Maskell et al. [17] in which after 3 months there were 77 cases (75%) from (102) had totally inflated lung and 25 cases still had residual opacity.

The present work shows a great improvement in the net result of empyema and parapneumonic effusion by streptokinase infusion through pigtail catheter. Using small-bore pigtail catheter is a less invasive way to drain pleural effusion than chest tube. Hampering of pigtail catheter by thick pus, or multiple loculations remains a problem. So, intrapleural injection by fibrinolytic drugs can solve this issue to avoid surgery.

Streptokinase management reaches its maximum efficacy starting from the day one till the day three indicating that the surgical intervention could be limited.

High amounts of drainage and improved radiologic signs could prove the benefit of early STK injection as illustrated in previous
Multiple questions about injection of fibrinolytic drugs still persist, involving the time of doses and efficacy of doses. The current studies support usage of extended doses of these drugs as streptokinase and urokinase [33].

Recent studies [30,31] reported that there is maximum efficacy by using tissue plasminogen activator and DNase.

5. Conclusion

The present work illustrate the importance of streptokinase injected through pigtail catheter in treatment of empyema. This drug is safe with no evidence of significant side effects and early beginning of this medication could limit the need or surgical procedures [32,33].

Several doses of STK up to 1.5 million units was proven to be safe in humans [18,29].

Conflict of interest

We have a competing interest to declare.

References


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<th>Table 1</th>
<th>Comparison between total drainage before and after SK injection.</th>
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<td>Total drainage</td>
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<th>Drainage of pus after injection of fibrinolytics: average amount of fluid drainage after streptokinase instillation.</th>
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<td>Volume (ml)</td>
<td>Mean ± SD</td>
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<tr>
<td>1st day</td>
<td>100–800</td>
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<td>2nd day</td>
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<tr>
<td>3rd day</td>
<td>50–150</td>
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<td>4th day</td>
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<td>5th day</td>
<td>20–100</td>
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Studies [18,22,23]. In the present work, the drainage is raised by STK injection which is actually due to immediate effect of the fibrinolytic agent with the biochemical mechanisms concerned in formation of empyema [24].

STK dosing schedule was done daily, in contrary to the study of Barthwal et al. [25] that followed an 8hours schedule instead of a 24h schedule referring to that 75,000 IU is the lowest STK strength with an immediate solution storage at 2–8°C for eight hours. By embracing this system; two doses could be taken, thereby minimizing the loss of this expensive drug with preserving its strength. While, Strange et al. [26] in his research showed that increasing the interval of doses could actually raise the effect of fibrinolytic treatment.

This experimental study in agreement with previous researches investigated that great variety in the number of doses may be due to starting of treatment at different stages of empyema formation.

Early beginning of fibrinolytic therapy before appearance of marked pleural adhesions resulting in high efficacy of pleural drainage as shown in study of Boursos et al. [27]. While, more than 3 days are required to achieve clinical success, that explains this discrepancy of the therapy started in the following day and was continued one dose per day up to 5 days or until net drainage do not exceed 100 ml/day.

Some previous studies of intrapleural STK were performed; a study was done by Davies et al. [18], in which three doses of intrapleural STK was injected daily and compared with saline irrigated in 24 patients. In STK patients had marked drainage of pus and satisfactory radiological improvement.

Other trial was done by Chin and Lim [28], injection of STK into the pleural space was compared with drainage by chest tube in 52 patients, marked pleural drainage is noted in patients receive STK injection. Another study by Talib et al. [20] illustrated that there was considerable pleural drainage in 24 cases of chronic tubercular empyema managed by STK injection in comparison with control group of patients managed by saline.

The study of Barthwal et al. [25] had a success rate 67%.

Fortunately, the successful rate in the present study was due to early beginning of treatment, the two cases that did not show satisfactory results referring to long duration of symptoms (more than two months) before beginning of the treatment.

A recent study of 10 trials showed that injection of fibrinolytics drugs into the pleural space reduce the referral of cases to surgical procedures and days of hospitalization [34].

Urokinase, UK, was fibrinolytic alternative drug which achieved good results in doses ranging 50,000–250,000 IU.

Despite of being an expensive drug, UK was non antigenic and allowed with the needed potency when compared to STK.


Barthwal MS, Deoskar RB, Rajan KE, Chatterjee RS. Intrapleural streptokinase in complicated parapneumonic effusions and empyema.


