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Original Research Article

Outcome of intrapleural fibrinolytic therapy with streptokinase in loculated pleural effusion patients- An experience from zonal hospital of Eastern India

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ABSTRACT

Background: Loculated pleural effusion is one of the most common clinical entities which are usually caused by empyema, tubercular pleural effusion, malignancy, and hemothorax. The role of Intra-pleural Fibrinolytic Therapy (IPFT) with various fibrinolytics has been studied, however its clinical, radiological and functional outcomes are not assessed completely.

Objective : This is a pre and post intervention study conducted at tertiary care hospital to assess the role of IPFT with streptokinase in patients with loculated pleural effusion.

Results: 102 patients underwent IPFT with streptokinase. Out of 102 patients, 84 patient were male and 18 were females. Main preprocedure diagnosis were tuberculosis (n=70), pneumonia (n=21) and malignancy (n=11). The patients were subdivided into three groups based on sonologically assessed amount of intrapleural fluid - Group 1 (<100ml), Group 2 (100-200ml) and Group 3 (>200ml). During pre and post IPFT procedure the number of patients identified in group 1 were 30 and 80, group 2 were 40 and 22, group 3 were 32 and none respectively. The mean residual pleural fluid drained before and after IPFT were 190.80ml and 57.84ml (p value<0.001), which had statistically significant reduction after IPFT. Mean FVC before and after IPFT were 46.43% and 69.56% (p value<0.05). Chest x-ray resolution was observed in 80 of the 102 patients with postprocedure IPFT (p value<0.05). Adverse effects noticed were chest pain, fever, tachycardia and bleeding. However no major bleeding was observed.

Conclusion: IPFT with streptokinase is a safe option in loculated pleural effusion with no major adverse effects.

1. Introduction

Loculated pleural effusions are a common sequelae of complicated parapneumonic effusions and empyema followed by tubercular pleural effusions, haemothorax and malignant effusions. Loculations develop due to delayed initiation and inadvertent use of antibiotics and due to prolonged pleural effusion in the setting of inflammation due to various causes. This results in fibrosis in the pleural cavity leading to pleural thickening and loss of pulmonary function in due course.

The use of intrapleural fibrinolytics is a safer, easier and economical option and studies have shown it to be a useful alternative[1] of the difficult surgical procedures like VATS (video- assisted thoracoscopic surgery), thoracotomy and decortication. If the intercostal drainage tube is positioned correctly and there appears to be pleural fluid left in the cavity, then the reasons for failed drainage are loculated pleural fluid collection or tube

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obstruction due to viscous fluid.[2] The other treatment modalities are; flushing with saline, placement of more catheters in loculi after ultrasound localisation, debridement thoracoscopically, thoracotomy along with decortication. The initial two treatment modalities are not so effective in removal of pleural fluid.[3] The other surgical modalities are more invasive, not accessible and if accessible, are not affordable by patients in India and other developing countries.[4] Therefore early use of fibrinolytic agents in loculated pleural effusion will result in breaking of loculi and hence increasing pleural space drainage.[2,3] The BTS guidelines have also recommended consideration of intra-pleural fibrinolytics in failed drainage in complicated parapneumonic effusion and empyema.[5]

Tillet and Sherry were the pioneers in using fibrinolytics along with anti DNase intra-pleurally. They employed instillation of these agents in 23 patients who had complicated pleural effusion in the form of loculations or haemothorax. These compounds were synthesised from Streptococci lancefield group 'C'. There was significant improvement in drainage of fluid.[4–6]

This therapy was discontinued until Bergh et al. used purified streptokinase which resulted in significant improvement in 10 of 12 patients who had empyema. This was without the need for any major surgical intervention and decrease in major side effects.[7] The newer agents such as urokinase, alteplase, reteplase have overtaken streptokinase for thrombolytic therapy. The answer to successful drainage using fibrinolysis of complicated effusions is correct placement of tubes or catheters under ultrasound guidance as early as possible in patients with complicated pleural effusions, followed by frequent monitoring (more than once daily) of tube placement and fibrinolytic effectiveness by assessing the volume of tube drainage and immediate re-instillation of the fibrinolytic agent if necessary. In the properly selected patient, attention to detail using a strict protocol will be critical in determining a successful outcome.[8]

The present study is to assess the outcome of intrapleural fibrinolytic therapy with streptokinase in patients with Loculated pleural effusion.

2. Materials and Methods

2.1. Place of study

Department of Respiratory Medicine in a tertiary care zonal hospital.

2.2. Duration of study

Three year.

2.3. Study population

All cases diagnosed as loculated pleural effusion in a tertiary care zonal hospital.

2.4. Inclusion criteria

1. Persistent fluid and poor chest tube drainage despite an appropriately positioned and patent drain.
2. Multiple loculi or fibrin strands in pleura as depicted by Ultrasonography or CT scan chest.

2.5. Exclusion criteria

1. Patients who are less than 18 years of age.
2. Known sensitivity to streptokinase.
3. Contraindication to thrombolytic therapy - haemorrhagic stroke, intracranial neoplasm, cranial surgery or head trauma within 14 days, major thoracic or abdominal surgery within 10 days and PT INR greater than 2.
4. Haemothorax and haemorrhagic pleural effusion.

2.6. Study design

It is a pre-post intervention study which was carried out at tertiary care zonal hospital. The study was approved by the Institutional Ethics Committee and informed consent was obtained from the study participants.

2.7. Sample size

102 patients were selected for the study from a tertiary care centre, using suitable sampling technique and when patient satisfied the eligibility criteria.

2.8. Methodology

Diagnosis of a patient with suspected pleural effusion was confirmed initially by chest radiography. Baseline spirometry of the patient was recorded. Ultrasonography of chest was done for quantification of fluid, presence of loculations and marking of chest wall for site of insertion of Intercostal Drainage Tube (ICD). Chest tube or pigtail thoracostomy catheter was inserted and fluid drained daily. Amount of fluid drained was noted in a chart. If the patient has persistent fluid and poor tube drainage despite an appropriately positioned and patent drain (confirmed by ultrasonography) or multiple loculi or fibrin strands depicted by ultrasonography or CT scan of chest, then the patient was included in the study and IPFT was initiated.

Six doses of streptokinase (2.5 lakh IU in 50 ml normal saline) was instilled in the chest tube at 8 hours interval. Tube was clamped for 2 hours after instillation of each dose. Clinical response along with daily and cumulative drainage of the tube was noted. X-ray and ultrasonography of chest was done after 48 hours after the instillation of last dose of

streptokinase.

If there is insignificant drainage and reduction in amount of fluid radiologically (less than 50%), then another cycle of streptokinase was given. The chest tube was removed after daily drainage of pleural fluid is less than 50 ml and is clear and ultrasonography chest also confirms presence of less than 50 ml of fluid in pleural cavity.

The cumulative amount of pleural fluid drained after administration of all doses of streptokinase through the thoracostomy tube was calculated and entered in a chart. The expansion of the lung was assessed radiologically by chest X-ray taken before and after the administration of streptokinase. The reduction in the amount of residual pleural fluid by ultrasonography after IPFT was calculated. Spirometry was done after 48 hours of removal of chest tube. Forced Vital Capacity (FVC) before and after the administration of IPFT was calculated. All patients who undergo the study was observed for complications of intra-pleural streptokinase therapy.

2.9. Statistical analysis

The study protocol followed in the patients was depicted in flow chart (Supplemental file 1). On completion of the study analysis of data was carried out by paired 't' test, using SPSS Inc. PASW Statistics for Windows, Version 18.0. Chicago: USA. All continuous variables were summarized in terms of mean ± standard variation and other categorical variables were calculated as percentage. $P < 0.05$ was considered statistically significant.

3. Results

3.1. Demographic profile

A total of 102 patients admitted to the tertiary care centre who had radiologically proven loculated pleural effusion were enrolled in the study. The subjects fulfilling the criteria for exclusion were not included.

- Age distribution-The age of patients was between 18 and 72. The number of patients with age more than 50 is 22 (21.56%). However patients of less than 30 years of age and between 30 and 50 were evenly distributed, 41% and 45% respectively (Table 1).
- Gender distribution- 84 patients were males (82.35%) and 18 patients were females. This skewed distribution is due to admission of exclusively males in this hospital, where the study was conducted (Table 1).

3.2. Site of pleural effusion

61 patients had right sided pleural effusion (59%), 32 patients had left sided pleural effusion (31%). However, 9 patients had bilateral pleural effusion and out of them 6 were more than 50 years of age and 3 between 30 and 50 (Table 1).

3.3. Cause of Pleural effusion

The cause of pleural effusion is tuberculosis in 69% of patients due to predominantly young soldiers and recruits being treated at this hospital. However, there were 21 cases of pneumonia with complicated parapneumonic effusion and 11 cases of malignant pleural effusion (Table 1). The indications of ICD insertion in all cases of malignant pleural effusion were to improve the symptoms and to prevent residual pleural thickening. Amount of fluid in chest before and after ICD insertion on ultrasonography:

30 Patients had < 100 ml of pleural fluid followed by 50 and 58 patients who had more than >100 and >200 ml of pleural fluid respectively. However, the ultrasonography method of estimation of fluid is an approximate method and hence fluid extracted were usually more than the fluid estimated by ultrasound. As shown in the graph the patients who had pleural fluid more than 100 and 200 ml were 50 & 58 who were reduced to 40 and 48 after ICD insertion. There were 10 patients with less than 100ml pleural fluid who increased to 30 after ICD insertion (Figure 1A).

70 patients and 48 patients had >100 ml and >200ml of pleural fluid respectively. Out of 48 patients, the chest tube was repositioned and residual fluid drained in 16 of 48 patients and in remaining 32 patients IPFT was administered. But the cases in whom ICD was repositioned were not included in the study.

3.4. Amount of residual pleural fluid preprocedure and postprocedure IPFT on Ultrasonography

The patients who had residual fluid with loculations were given Streptokinase in six doses as per study protocol and reassessed for the amount of remaining pleural fluid. The ultrasonography chest was performed after the chest tube stopped draining fluid in order to assess the amount of residual pleural fluid and loculation. The number of patients who had residual pleural fluid drastically decreased after IPFT, 80 patients had <100ml of fluid left after Streptokinase therapy. However around 22 patients had residual pleural fluid more than 100ml after the therapy. The amount of pleural fluid estimated by ultrasound didn't correlate with the actual amount of fluid drained. Hence the patients were grouped into three groups i.e. <100 ml, 100-200 ml, 200-300ml preprocedure and postprocedure IPFT. The graph plotted against three groups of the patients were depicted in Figure 1B.

3.5. Mean residual pleural after IPFT

The mean amount of residual pleural fluid present before the study is 190.80 ml with a standard deviation of 83.26. The mean amount of residual pleural fluid present after administration of Streptokinase was 57.84 ml with a standard deviation of 53.14 (Figure 2A).

By using paired t-test p-value < 0.05, therefore there is significant difference between mean amount of residual pleural fluid before and after IPFT. This reduction in residual pleural fluid also resulted in improved lung function (Figure 2A).

Moreover the use of IPFT for patients with malignant pleural effusion also resulted in improvement of symptoms and these patients underwent chemical pleurodesis as per the standard recommendation.

3.6. Lung function before and after IPFT

The patients underwent FVC maneuver to assess the functional response to IPFT.

Since the patients were on ICD in-situ they were made to undergo this procedure with suboptimal effort. They were not made to repeat the procedure more than 3 times and best out of the 3 were recorded.

It was found that there were 22 people who had FVC of less than 40% which decreased to 4. The patients who had FVC between 40 and 50% decreased from 50 to 28. However 30 patients had FVC between 50 and 60% which increased to 48 and there were 20 patients who were able to produce an FVC of 60-70%. The maximum FVC attained after IPFT was 70% (Figure 2B and Figure 3).

3.7. Number of cycles of IPFT

Most of the patients in study required only one cycle of IPFT(six doses of streptokinase) 54% of the study population required one cycle of IPFT followed by 36% required 02 cycles of IPFT and 10 % required 03 cycles of IPFT(Figure 4).

3.8. Chest X-ray resolution

Apparent chest X ray resolution was present in 80 out of102patients after administration of IPFT. By using paired t-test p-value < 0.05, therefore there is significant resolution of chest x ray before and after IPFT (Figure 5).

3.9. Adverse effects of IPFT

Most common among them were chest pain at the site of ICD and fever which was 14% and 10% respectively, followed by tachycardia and bleeding (Figure 6).

4. Discussion

This study represents an institutional experience of Intrapleural Fibrinolytic Therapy. These patients represent those individuals who usually do not respond to traditional modes of treatment for tubercular/parapneumonic/malignant pleural effusion.

The first study by Bergh et al.[9] and further studies by Taylor et al.[10] Sanchez et al.[11] clearly showed that intra-pleural streptokinase is safe and effective in improving chest-tube drainage and reducing the hospital stay of patients with complicated parapneumonic effusion and empyema. The above studies[9–11] showed that the patients who receive intra-pleural Streptokinase have a reduced necessity for further surgery and a decreased need for hospitalization. Hence these results support the hypothesis that Streptokinase acts through the lysis of pleural adhesions, and not through the volume of the instilled fluid. This formed the basis of intra-pleural fibrinolysis with Streptokinase in loculated pleural effusion.

102 patients underwent this study and was done in hospital patients irrespective of the etiology of effusion. The patients were admitted and observed regarding the outcome of fibrinolytic therapy. The age of patients were between 18 and 72. The number of patients with age more than 50 is 16(16%). However, patients of less than 30 years of age and between 30 and 50 were homogenously distributed, 41% and 45% respectively. The patients with extremes of age were less in the study since this study was done in consecutive 102 patients with the diagnosis of loculated pleural effusion who satisfied the inclusion criteria. Out of 102 patients, 84 patients were males (82%), although female gender and characteristics were not exclusion. This skewed distribution is due to admission and observation of male soldiers in a military hospital, where the study was conducted.

The cause of pleural effusion is tuberculosis in 69% of patients due to predominantly younger population being treated at this hospital. However there were 21 cases of pneumonia with parapneumonic effusion and 11 cases of malignant pleural effusion. The indication of ICD insertion in all cases was to improve the symptoms and to prevent residual pleural thickening in those patients with loculated pleural effusion. The patients with malignant pleural effusion were more than 40 years of age. Among them there were 08 smokers and three nonsmokers and 6 were females. Two of the patients underwent diagnostic thoracoscopy to establish the diagnosis of malignant pleural effusion. One patient was a case of carcinoma breast with metastasis while the other patient was primary carcinoma lung. Sixty one patients had right sided pleural effusion (59%), 32 patients had left sided pleural effusion (31%). However, 9 patients had bilateral pleural effusion and out of them 6 were more than 50 years of age and 3 between 30 and 50.

Total 118 patient's underweight ICD insertion in the present study. 70 patients had <100 ml of pleural fluid left after ICD insertion. However around 48 patients had pleural fluid more than 200 ml of intrapleural fluid. The ultrasonography chest done post procedure revealed persistence of loculi in a different site of chest than the loculi in which ICD is placed. The tube was repositioned and residual fluid drained in 16 of 48 patients and in rest 32 patients Streptokinase was used to break the loculi.

These patients had residual fluid along with loculations or septations and hence were taken up for the study.

In 90 of the 102 patients the pleural fluid extracted was more than estimated volume. The patients who had residual fluid with loculations were administered IPFT with Streptokinase. The patients who had residual fluid along with loculations were included in the study and in most of the patients residual pleural effusion had drastically decreased with 80 patients showing <100 ml of fluid left after IPFT and while 22 patients had only >100 ml after IPFT.

The mean amount of intrapleural fluid present before the study is 190.80 ml with a standard deviation of 83.26. The mean amount of intrapleural fluid present after administration of Streptokinase was 57.84ml with a standard deviation of 53.14 (Table 3), similar findings were reported in earlier study.[12] There is significant difference between mean amount of intrapleural fluid before and after IPFT. Thus, the use of IPFT with Streptokinase in loculated pleural effusion results in statistically significant reduction in the residual amount of intra pleural fluid (p value <0.001). The use of IPFT in malignant pleural effusion patients relieved their respiratory symptomatology and also facilitated the patients recuperate for chemical pleurodesis before ICD removal.[13]

The use of Streptokinase in usual six doses resulted in suboptimal drainage of pleural fluid in few patients. The cases with multiple loculi on ultrasound and increased viscosity of pleural fluid on appearance resulted in reduced pleural fluid drainage. These patients were administered 2 or 3 cycles of IPFT to break loculi and to aid drainage. Each cycle consisted of 6 doses of Streptokinase administered in 8 hourly intervals as mentioned earlier. However, it was also found that patients did not require more than 3 cycles of streptokinase to remove the fluid. Eleven out of 102 cases that is 10% of patients required 3 cycles of IPFT. Among them 6 were malignant pleural effusion and 5 were tubercular pleural effusion. Apparent chest X-ray resolution was present in 80 out of 102 patients after administration of IPFT. By using paired t-test p-value < 0.05, therefore there is significant resolution of chest X-ray before and after IPFT.

The patients underwent FVC maneuver to assess the functional response to IPFT. The maximum FVC attained after IPFT was 70%. The mean FVC before IPFT was 46% with a standard deviation of 11. The mean FVC post IPFT showed an increase of 46% to 70% which is statistically significant (P<0.05) and were comparable to previous study[12] (Table 3).

Most of the patients (76%) did not complain of any perceivable side effects to the fibrinolytic therapy to Streptokinase. The side effects recorded were new onset side effects after fibrinolytic therapy and not those complaints which were present before Streptokinase therapy. All patients experienced pain at the site of ICD, but only those patients who had new onset chest pain or fever were accounted for as the adverse effect of Streptokinase. The most common among them were chest pain at the site of ICD which was 14%. The incidence of bleeding post-IPFT in the literature ranges between 2% and 15%[14–17] which was comparable to our present study. In the MIST II trial,[18] Rahman and Maskell report on five cases of bleeding, including two cases of intra-pleural bleeding and one case of haemoptysis that occurred in the tPA and DNase arm (5.76%). Apropos there were few and transient side effects to the application of intra-pleural streptokinase.

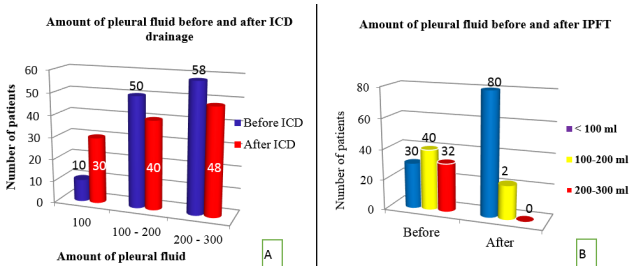

Fig. 1: A: Amount of pleural fluid before and after ICD drainage, **B:** Amount of pleural fluid before and after IPFT

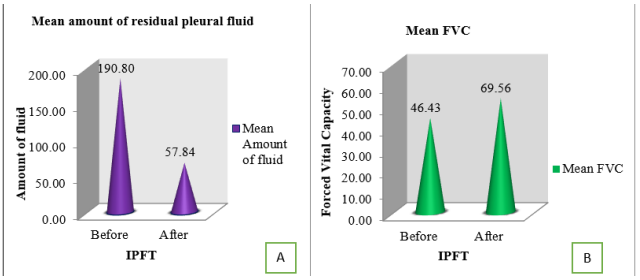

Fig. 2: A: Mean amount of residual pleural fluid, **B:** Mean FVC before and after IPFT

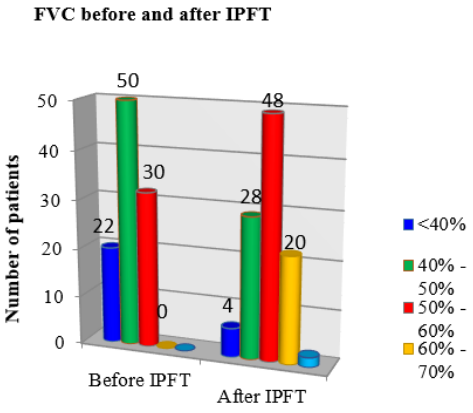

Fig. 3: FVC before and after IPFT

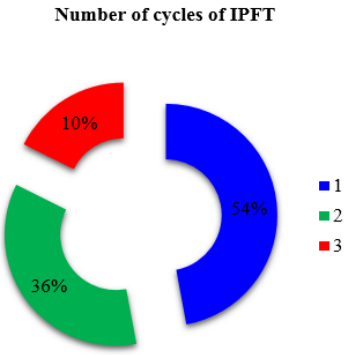

Fig. 4: Number of cycles of IPFT

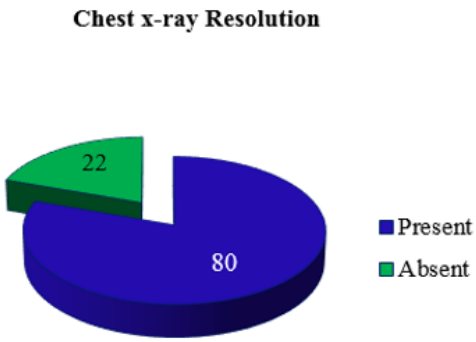

Fig. 5: Chest x-ray resolution

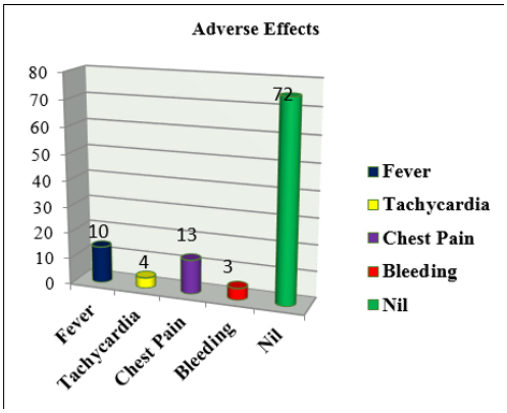

Fig. 6: Adverse effects

Table 1: Demographic, Anatomical, and Etiological profile (n=102)

Characteristic	Number	Percent
Age (years)		
<30	41	40.19
30-50	45	44.11
>50	16	15.68
Gender		
Male	84	82.35
Female	18	17.64
Site of pleural effusion		
Right	61	59.80
Left	32	31.37
Bilateral	9	8.82
Final diagnosis		
Tuberculosis	70	68.62
Pneumonia	21	20.58
Malignancy	11	10.70

Table 2: IPFT with Streptokinase: intervention, Outcome, and Adverse Effect Profile (n=102)

Characteristic	Number	Percent
Number of IPFT Cycle		
1	54	55
2	36	35
3	10	10
Chest radiography resolution after IPFT		
Yes	80	78.43
No	22	21.56
Adverse effects associated with IPFT		
Fever	10	10.0
Tachycardia (Heart rate > 100/min)	4	4.0
Chest pain	13	12.7
Bleeding	3	3.0
None	72	70.3

Table 3: Mean residual Intra-pleural Fluid and Mean FVC Before and After IPFT (n=102)

Parameter	Mean	SD	Difference in mean	95% cl of difference in Mean	P Value
Intrapleural Fluid-Before IPFT	190.80	83.26	132.96	116.6- 149.3	<0.001
Intrapleural Fluid-After IPFT	57.84	53.14			
FVC-Before IPFT	46.43	11.04	23.13	20.96- 25.3	<0.05
FVC- After IPFT	69.56	9.67			

5. Conclusion

In our prospective intervention study conducted among the patients with loculated pleural effusion, the response of Intrapleural Fibrinolytic Therapy with Streptokinase was assessed. The mean amount of intrapleural fluid present after IPFT decreased significantly due to fibrinolysis of loculations. Multiple doses of IPFT were required to drain the fluid in patients with multiple loculi and increased viscosity of the pleural fluid. The assessment of lung function by FVC also showed a statistically significant improvement in most of the patients. The incidence of adverse effects after IPFT were low and did not require cessation of the fibrinolytic therapy. No cases of major bleeding was observed in the study population.

6. Limitation

However the study population was not representative in terms of age and sex distribution. The maximum number of patients who underwent the intervention were cases of tubercular pleural effusion. The intervention however showed improvement in pleural fluid drainage and lung function irrespective of the cause of effusion. There is a dearth of indian studies on the use of Streptokinase for intra-pleural fibrinolysis inspite of its proven efficacy in the management of loculated pleural effusion as shown in various international studies. The outcomes of the present study cannot be applied to the general population as the sample size was small and subjects were not representative of the general population.

7. Contributors

Authors A K Singh and Sumeet Arora had done equal contribution to the research work in second authorship while author A R Rajan had contributed solely towards third authorship /as third Author.

8. Acknowledgments

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9. Source of Funding

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10. Conflict of Interest

The authors declare they have no conflict of interest.

References

1. Simpson G, Roomes D, Heron M. Effects of Streptokinase and Deoxyribonuclease on Viscosity of Human Surgical and Empyema Pus. *Chest*. 2000;117(6):1728–33. doi:10.1378/chest.117.6.1728.
2. Boland GW, Lee MJ, Silverman S, Mueller PR. Interventional radiology of the pleural space. *Clin Radiol*. 1995;50(4):205–14. doi:10.1016/s0009-9260(05)83471-3.
3. Light RW, Nguyen T, Mulligan ME, Sasse SA. The In Vitro Efficacy of Varidase Versus Streptokinase or Urokinase for Liquefying Thick Purulent Exudative Material from Loculated Empyema. *Lung*. 2000;178(1):13–8. doi:10.1007/s004080000002.
4. Barthwal MS, Marwah V, Chopra M, Garg Y, Tyagi R, Kishore K, et al. A Five-Year Study of Intrapleural Fibrinolytic Therapy in Loculated Pleural Collections. *Indian J Chest Dis Allied Sci*. 2016;58:17–20.
5. Davies CW, Gleeson FV, Davies RJ. BTS guidelines for the management of pleural infection. *Thorax*. 2003;58(2):18–8.
6. Sherry S, Johnson A, Tillett WS. The Action Of Streptococcal Desoxyribose Nuclease (Streptodornase)In Vitro and on Purulent Pleural Exudations of Patients. *J Clin Investig*. 1949;28(5 Pt 2):1094–104. doi:10.1172/jci102142.
7. Tillett WS, Sherry S, Christensen LR, Johnson AJ, Hazlehurst G. STREPTOCOCCAL ENZYMATIC DEBRIDEMENT. *Ann Surg*. 1950;131(1):12–22. doi:10.1097/00000658-195001000-00002.
8. Tillett WS, Sherry S, Read CT. The use of streptokinase-streptodornase in the treatment of postneumonic empyema. *J Thoracic Surg*. 1951;21:275–7. doi:10.1016/s0096-5588(20)31273-3.
9. Bergh NP, Ekroth R, Larsson S, Nagy P. Intrapleural streptokinase in the treatment of haemothorax and empyema. *Scand J Thorac Cardiovasc Surg*. 1977;11(3):265–8.
10. Taylor RF, Rubens MB, Pearson MC, Barnes NC. Intrapleural streptokinase in the management of empyema. *Thorax*. 1994;49(9):856–9. doi:10.1136/thx.49.9.856.
11. Jerjes-Sanchez C, Ramirez-Rivera A, Elizalde JJ, Delgado R, Cicero R, Ibarra-Perez C, et al. Intrapleural Fibrinolysis With Streptokinase as an Adjunctive Treatment in Hemothorax and Empyema. *Chest*. 1996;109(6):1514–9. doi:10.1378/chest.109.6.1514.
12. Subramanian N, Bhattacharyya D, Khan ID, Prasad V, Kotaru A, Vardhan V, et al. Intrapleural Fibrinolysis in Post-tubercular Loculated Pleural Effusions at a Tertiary-Care Respiratory Center: An Uncontrolled Blinded Before-After Intervention Study. *Hosp Pract Res*. 2018;3(2):59–63. doi:10.15171/hpr.2018.12.
13. Tassi GF, Cardillo G, Marchetti GP, Carleo F, Martelli M. Diagnostic and therapeutical management of malignant pleural effusion. *Ann Oncol*. 2006;17(2):ii11–2.
14. Maskell NA, Davies CWH, Nunn AJ, Hedley EL, Gleeson FV, Miller R, et al. U.K. Controlled Trial of Intrapleural Streptokinase for Pleural Infection. *N Engl J Med*. 2005;352(9):865–74. doi:10.1056/nejmoa042473.
15. Skeete DA, Rutherford EJ, Schlidt SA, Abrams JE, Parker LA, Rich PB, et al. Intrapleural Tissue Plasminogen Activator for Complicated Pleural Effusions. *J Trauma: Injury, Infect, Crit Care*. 2004;57(6):1178–83. doi:10.1097/01.ta.0000141879.67441.52.
16. Thommi G, Nair CK, Aronow WS, Shehan C, Meyers P, McLeay M, et al. Efficacy and Safety of Intrapleural Instillation of Alteplase in the Management of Complicated Pleural Effusion or Empyema. *Am J Ther*. 2007;14(4):341–5. doi:10.1097/01.mjt.0000208275.88120.d1.
17. Froudarakis ME, Kouliatsis G, Steiropoulos P, Anevlavis S, Pataka A, Popidou M, et al. Recombinant tissue plasminogen activator in the treatment of pleural infections in adults. *Respir Med*. 2008;102(12):1694–700. doi:10.1016/j.rmed.2008.08.012.
18. Rahman NM, Maskell NA, West A, Teoh R, Arnold A, Mackinlay C, et al. Intrapleural use of tissue plasminogen activator and DNase in pleural infection. *N Engl J Med*. 2011;365:518–26.

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