DOI: https://doi.org/10.53350/pjmhs20231711458

ORIGINAL ARTICLE

Clinical Spectrum and Outcome in Children Presenting with Empyema Thoracis in Tertiary Care Hospital: Role of Intrapleural Streptokinase

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ABSTRACT

Aims and Objectives:

1. To correlate clinical symptoms of empyema thoracis with treatment outcome.
2. To analyze role of intra-pleural streptokinase in Empyema thoracis.

Material and Methods: This cross sectional study was carried out at the department of pediatric medicine unit, UCHS and The Children Hospital, Lahore, spanning from December 10, 2022, to June 9, 2023. Non-Probability, Consecutive sampling technique was used. A total of 70 children who met the inclusion criteria were enrolled in the study. The patients were classified based on their need for various treatment options such as IV antibiotics with chest tube drainage, intrapleural streptokinase, and decortication surgery. The data was inputted and analyzed using SPSS version 25, stratified by age and gender in relation to treatment outcomes. A significance level of p≤0.05 was deemed as significant.

Results: Of these 70 study cases, 55(78.6%) were male patients and 15(21.4%) were female patients. Mean age of our study cases was 7.6±4.6 years. According to clinical spectrum of empyema thoracis distribution, 70(100.0%) had fever, 59(84.3%) had respiratory distress, 61(87.1%) had cough, 42(60.0%) had hemoptysis and 32(45.7%) had chest pain.

Conclusion: Prompt recognition and appropriate management of pneumonia can avert the progression to empyema. Utilizing antibiotics alongside chest tube placement and administration of streptokinase has shown to be a successful approach in addressing pyogenic empyema thoracis in children residing in resource-limited environments.

Keywords: Parapneumonic Effusion, Complications, Clinical Spectrum, Outcome, Chest Tube.

INTRODUCTION

Parapneumonic effusion, a term used to describe pleural effusion stemming from a lung infection such as pneumonia, represents a significant clinical concern. This condition is characterized by the presence of bacterial organisms detected on Gram stain analysis and/or the observation of grossly purulent fluid within the pleural cavity, which is officially termed Empyema. Empyema, a manifestation of severe infection, requires prompt recognition and appropriate management to prevent potential complications and ensure optimal patient outcomes.[1]Parapneumonic effusions are seen in up to 28% of hospitalizations with complicated pneumonia. Pleural empyema is frequently caused by Staphylococcus aureus, Streptococcus pneumoniae and Haemophilus influenza in children. Because these microorganisms are often detected in childhood pleural empyemas, prompt diagnosis and treatment of the clinical cases with good outcome depend on fast and sensitive techniques.[2-3]These children present with features of pneumonia including cough, respiratory distress, fever and other common symptoms but their illness tends to be more severe than typical having frequently suffered pleuritic chest pains. Clinical features include unilateral findings of reduced chest expansion, dullness to percussion and decreased or absence breath sounds corresponding with pleural effusion. Chest X-rays are essential to confirm the diagnosis and ultrasounds provided important information on how to treat children with empyema.[4]Ultrasound imaging can detect septations, loculations and thickness of pleural fluid with great accuracy that is crucial in management strategy for these pediatric population. Not to mention, by actually being able to see these features on an ultrasound image helps also in making a more accurate treatment plan that achieves the best intervention results which then leads into better patient outcomes and care. Incorporation of ultrasound technology in the diagnostic evaluation and management of children with empyema maximum precision for better therapeutic direction, this makes them faster clinic good Pretreatment ultimate patient perspective.[5]Pleural fluid samples should be harvested in a sealed container from which cytological examination can be carried out and must include not only Gram stain but also bacterial culture to identify possible infective processes. Particularly in patients with a Parapneumonic pleural effusion, this pattern should essentially show an increase of the predominant cell population being neutrophils; conversely pay attention because associated values higher than 50% lymphocytes can indicate that they are actually exudates and one must think about tuberculosis or malignancies.[6]Patients with complex pleural empyema are occasionally indicated for diagnostic CT scans to identify special findings, such as multiloculated septations, malposition of chest tube and impaired lung re-expansion. There is essential need to carry out these added studies in implementing accurate management strategies on an increasingly complex entity of patients.[7]The vast majority of these effusions exhibit enhancement following the administration of conventional antibiotic treatment for the concurrent pneumonia. Nevertheless, in a small number of instances, parapneumonic effusions progress to necessitate more invasive interventions such as chest tube thoracotomy, intrapleural fibrinolytic therapy, and occasionally thoracic decortication. Streptokinase, a type of fibrinolytic agent, can be administered intrapleurally in instances of complicated empyema, serving as an effective treatment option in such challenging cases. It is crucial for healthcare providers to be aware of these advanced treatment modalities to effectively manage parapneumonic effusions that do not respond adequately to standard antibiotic therapy.[8]Baram A et al. carried out a research study involving 95 patients who received intrapleural streptokinase treatment. The main goal of complete lung re-expansion was achieved in 94 patients (98.9%). A mere 2 patients needed decortication post streptokinase therapy. Therefore, the efficacy of intrapleural streptokinase in resolving empyema was demonstrated.[9]Raza et al. carried out a comparative analysis investigating the safety and effectiveness of intrapleural streptokinase in a cohort of 100 patients. Reduction in the decortication requirement was used to grade outcomes from this study. In 24% of patients in the streptokinase group and 60% who were on placebo decortication was required. Consequently, the use of intrapleural streptokinase greatly reduces the decortication rate.[10]We aimed to evaluate the role of intrapleural streptokinase in treating empyema and we assessed pre-empyemic symptoms as predictors of final outcome of pediatric patients with empyema. The present study aimed to examine the effectiveness of intrapleural streptokinase in treating empyema and investigate whether symptoms can predict long-term outcomes among children with empyema.

Received on 02-07-2023
Accepted on 21-10-2023

MATERIALS AND METHODS

This study was conducted at the department of pediatrics Medicine Unit-II, UCHS & The Children Hospital Lahore from December 10, 2022 to June 9, 2023. Using the WHO calculator, a 95% confidence level and an absolute precision of 8.6%, we determined our required sample size for pediatric population was to be at least 70 cases with expected percentage of outcome REAF equal or higher than,84%.[10] The study included children of both gender between the age groups 2 months to 14 years who were admitted or referred in two different hospitals with empyema and those having any bleeding disorder, previous tuberculosis treatment, history of surgery previously, proof of bronchogenic obstruction at admission (Chest X-ray confirmation) as well excised samples not available for PCR testing from the hospital record were excluded. A total of 70 eligible children were enrolled from indoor department of Pediatric Medicine at UCHS & The children hospital lahore. After obtaining written informed consent, demographic data (name, age, sex, weight and duration of fever) were obtained. A detailed history and physical examination were carried out on a specially designed form, in which data was recorded. Laboratory tests such as CXR, chest ultrasound, and pleural fluid analysis were conducted for all patients, with CT chest being necessary in complex cases. Patients were classified based on the treatment required, such as intravenous antibiotics with chest tube drainage, intrapleural streptokinase, and decortication surgery. Empyema thoracis was defined as the presence of bacterial organisms or visibly purulent pleural fluid. Intrapleural streptokinase, a fibrinolytic agent, was utilized intrapleurally after dilution in normal saline for septations and multi-loculated empyema. Data was collected and analyzed using SPSS version 25. Quantitative variables like age and pleural fluid analysis were reported as mean and standard deviation, while qualitative variables like gender, clinical spectrum, treatment, complications, examination findings, and empyema thoracis outcomes were presented as frequency and percentage. Data was further analyzed by age and gender concerning treatment outcomes, with a p-value of ≤0.05 considered significant.

RESULTS

Our study comprised a total of 70 children meeting the selection criteria. Of these 70 study cases, 55(78.6%) were male patients and 15(21.4%) were female patients. Mean age of our study cases was 7.6±4.6 years. The age distribution of the sample of 70 individuals indicates a substantial majority of individuals between the ages of 5 and 10 (68.6%), with the next largest group being individuals aged 2 months to 5 years (22.9%). The smallest share, accounting for 8.6%, is comprised of individuals who are older than 10 years. This indicates a significant clustering of children between the ages of 5 and 10 within the population. According to clinical spectrum of empyema thoracis distribution, 70(100.0%) had fever, 59(84.3%) had respiratory distress, 61(87.1%) had cough, 42(60.0%) had hemoptysis and 32(45.7%) had chest pain. According to examination distribution, 56(80.0%) had reduced chest movements, 43(61.4%) had stony dull percussion note, 54(77.1%) had absent/decreased breath sound and 46(65.7%) had reduced vocal resonance/fremitus. The treatment modalities and utilization rates for empyema thoracis are shown in Fig:1. It showed that both chest tube insertion and intravenous antibiotics were given to all patients (100%) demonstrating that these are typical treatments. Of the patients, 74.3% received an intrapleural streptokinase injection, whereas 25.7% did not. In 42.9% of cases, decortication was done surgically; in 57.1% of cases, this treatment was not done. This demonstrated how different therapies were employed depending on the needs of each patient, even though some were administered generally.According to complications of empyema thoracis distribution, 13 (18.6%) had pulmonary hemorrhage, 16 (22.9%) had secondary infection, 15 (21.4%) had chest tube blockage and 0(0.0%) had anaphylaxis. Among 70 patients, 44(62.9%) had REAF (resolution of empyema with removal of chest tube).Pleural fluid analysis contains the following parameters: protein levels, total leukocyte count (TLC), lymphocytes, neutrophils, and lactate dehydrogenase (LDH) levels. The lymphocyte count ranged from 1 to 4, while the total lymphocyte count (TLC) had a mean of 2.59 and a standard deviation of 0.142. The neutrophil count was 1.76 on average with a standard deviation of 0.094, ranging from 1 to 3. A mean of 1.23 and a standard deviation of 0.051 were the protein levels, which varied from 1 to 2. LDH levels were similarly non-standard, ranging from 1 to 2 with a standard deviation of 0.057 and an average of 1.34. Understanding the clinical implications of pleural fluid parameters within the research setting and patient outcomes is made easier with the use of these data, which provide insights into their distribution and variability. The relationship between the various treatment modalities and resolution of empyema following removal of the chest tube (REAF) revealed variable degrees of efficacy. The relevance of chest tube insertion with IV antibiotics was demonstrated by the 63% resolution rate; no cases of resolution were observed without it. Although intrapleural streptokinase injection resulted in a 65% resolution rate, 56% of cases still resolved, suggesting a moderate association. With an 80% resolution rate, decortication proved to be the most effective, outperforming 50% in the absence of it. Therefore, even though every treatment helped to resolve empyema, decortication showed the most positive link with favorable results.FIG:3

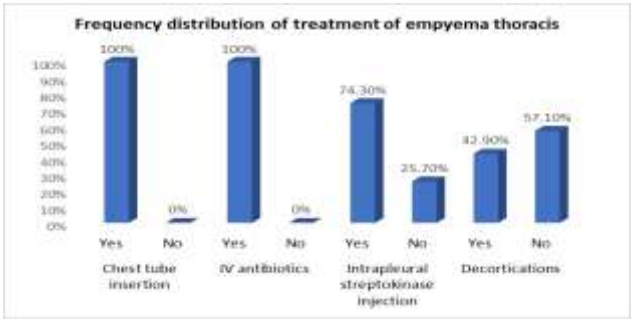

Figure 1: Frequency distribution of treatment of empyema thoracis

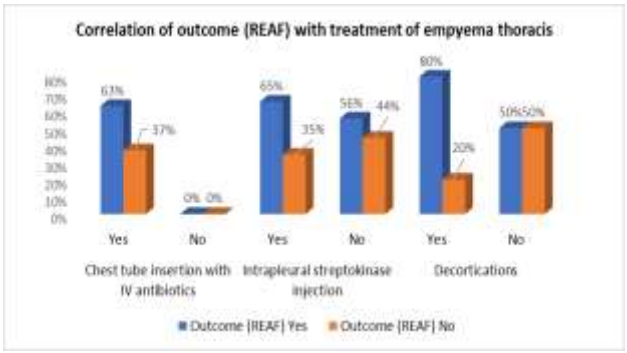

Figure 2: Correlation of outcome (REAF:Resolution of empyema with removal of chest tube) with treatment of empyema thoracis

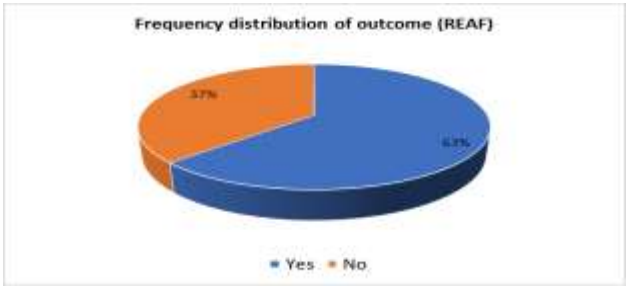

Figure 3: Frequency distribution of outcome (REAF:Resolution of empyema with removal of chest tube).

Table 1: Correlation of treatment with complications of empyema thoracis

Complications of empyema thoracis		Treatment of empyema thoracis					
		Chest Tube Insertion with IV antibiotics		Intrapleural streptokinase injection		Decortications	
		Yes	No	Yes	No	Yes	No
Pulmonary hemorrhage	Yes	13(100.0%)	0(0.0%)	6(46.2%)	7(53.8%)	5(38.5%)	8(61.5%)
	No	57(100.0%)	0(0.0%)	46(80.7%)	11(19.3%)	25(43.9%)	32(56.1%)
p-value		N/A		0.010		0.723	
Secondary infection	Yes	16(100.0%)	3(0.0%)	14(87.5%)	2(12.5%)	14(87.5%)	2(12.5%)
	No	54(100.0%)	0(0.0%)	38(70.4%)	16(29.6%)	16(29.6%)	38(70.4%)
p-value		N/A		0.169		0.001	
Chest tube blockage	Yes	15(100.0%)	0(0.0%)	13(86.7%)	2(13.3%)	13(86.7%)	2(13.3%)
	No	55(100.0%)	0(0.0%)	39(70.9%)	16(29.1%)	17(30.9%)	38(69.1%)
p-value		N/A		0.216		0.001	
Anaphylaxis	Yes	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)
	No	70(100.0%)	0(0.0%)	52(74.3%)	18(25.7%)	30(42.9%)	40(57.1%)
p-value		N/A		N/A		N/A	

FIG:3 showed that 63% of patients had their empyema successfully resolved when the chest tube was removed, but 37% did not which indicated that while a sizeable percentage of patients did not experience success, the majority of patients profited from this therapy strategy. Correlation of treatment with complications of empyema thoracis was shown in table 1.By comparing the treatment outcomes and consequences for empyema thoracis, the table highlighted significant differences between treatments. It was found that insertion of a chest tube was associated with higher rates of pulmonary bleeding, while decortication and intrapleural streptokinase injection were associated with lower rates of secondary infections. Additionally, there was a higher rate of tube blockage following chest tube insertion. Furthermore, no treatment was found to cause anaphylaxis. These findings demonstrated how important it was to select therapies for empyema thoracis based on the benefits and risks associated with them.Table 2 showed stratification of outcome (REAF) with respect age groups. A noteworthy correlation (p = 0.003) between age group and positive outcome rates is seen, with children 6–10 years old exhibiting the highest rates of positive outcomes(REAF), followed by those 5 months–5 years old, and those more than 10 years old showing no positive outcomes. Age is a significant factor determining the studied outcome, as these results highlight.

There was a significant relationship observed between intrapleural streptokinase injection and pulmonary hemorrhage with a p-value of 0.01 (p-value less than 0.05 is considered significant). There was a significant relationship observed between decortication and secondary infection(p value 0.001) and chest tube blockage with a p-value of 0.001 (p-value less than 0.05 is considered significant).

Table 2: Stratification of outcome (REAF) with respect to age groups

Variables		Outcome (REAF)		p-value
		Yes	No	
Age groups	5 months – 5 years	10(62.5%)	6(37.5%)	0.003
	6-10 years	34(70.8%)	14(29.2%)	
	>10 years	0(0.0%)	6(100.0%)	

There was a significant relationship observed between age groups and outcome with a p-value of 0.03 (p-value less than 0.05 is considered significant).

DISCUSSION

Parapneumonic effusion (PPE) and empyema thoracic (ET) arise as consequences of pneumonia and typically manifest due to suboptimal management of pneumonia, such as inadequate selection of antimicrobial agents, improper dosing, extended dosing intervals, and delayed treatment approach; in addition, these complications may also develop in individuals with compromised immune responses, for instance, immunosuppressed patients, who struggle to mount an effective defense against virulent pathogens.[11]In numerous developing nations such as Pakistan, the presence of inadequate functional infrastructure, particularly in primary health care services and basic health units, coupled with suboptimal vaccination coverage rates, elevated prevalence of tuberculosis, and a high incidence of chronic malnutrition, may collectively contribute to a heightened risk of developing empyema.[12]The prevalence of essential tremor (ET) in the subcontinent region falls within the range of 0.6% to 0.8%, as reported in existing studies. Despite this, there is a notable scarcity of literature focusing specifically on the incidence and prevalence of ET in the pediatric population of Pakistan. It is observed that infants and young children exhibit a higher propensity to manifest ET compared to their older counterparts, possibly due to certain unique physiological characteristics that are more pronounced in early stages of growth and development.[13-14]In our study population, it is evident that a higher incidence of disease was observed in younger children in comparison to their elder counterparts. This finding suggests that age may play a significant role in susceptibility to the disease within this particular demographic group. Additionally, our study indicates that the prevalence of the disease tends to be higher during the winter season, highlighting a potential seasonal pattern in disease occurrence among the population under investigation.[15]Demographic analysis showed significantly more males (78.6%) than females (21.4%). The difference observed in these studies may suggest a prevailing trend of male predominance and patriarchal structure within the domain of South Asia. For all these countries, a high proportion of males were consistently recorded between 57% in Taiwan and Vietnam versus 62% in China and Korea. These results highlight the requirement for a deeper understanding of the driving forces behind these gender disparities and their implications on health care and societal processes.[16]A study conducted in Bangladesh also demonstrated a greater prevalence of positive results among male children, with a percentage of 66.7%, indicating a notable disparity in the rate of infection between genders in that particular demographic sample.[17]In our series, a striking 91.4% of the patient cohort observed was under the age of ten years at presentation which is indicative that - in contrast to adolescents and older children- essential thrombocythemia (ET) might develop more commonly during childhood also as evidenced elsewhere. This underscores the need to be aware that there may exist age-related variations within prevalence and clinical presentation in ET, particularly as reflected by diagnostic data entered from a pediatric practice setting. Likewise, a study conducted in India by Baranwal reported that one-third of the children hospitalized with empyema were infants aged <5 years underlining the susceptibility among young age groups to selective disease conditions and calling for an appropriate approach toward management practices considering pediatric population.[18] The mean age of children with empyema and pleural effusion in our research was 4-5 years that is consistent with other studies on this topic. In this study, cough and fever as common clinical features for pleural effusion; other symptoms were dyspnoea followed by chest pain - findings that

supported the results of a previous research which was carried out in Bangladesh and also reported from a community-based rural survey in Pakistan - suggesting constant presentation of cases across different geographical regions on presenting history concerning patient with pleural abnormalities.[17,20]In the present investigation, it was observed that all juvenile subjects underwent a course of intravenous antibiotic therapy. The identification of tuberculosis as a causative factor for pleural effusions aligns with the findings of prior research conducted by Raza AB. Conversely, an investigation carried out by Khanzada indicated that the predominant reason for resorting to tube thoracostomy was attributed to tuberculous effusion, accounting for a substantial percentage of 36.1%.[21-22]In a research conducted in Nepal, it was found that a significant proportion of patients, specifically one out of every three individuals, amounting to 31% of the total participants, were prescribed anti-tubercular medications as part of their treatment regimen. This finding underscores the prevalence of tuberculosis and the importance of timely diagnosis and intervention in regions like Nepal where the disease burden remains high.[23]In our investigation, a significant proportion of 42.9% of the patient cohort under scrutiny were directed towards surgical intervention for decortication, aligning closely with the findings reported in the works of Hasan M et al and Schultz et al, where corresponding rates of 35% and 33.6% were observed, indicating a consistent pattern of resorting to decortication following unsuccessful chest tube drainage attempts.[17,24]

CONCLUSION

Early detection and appropriate management of pneumonia play a crucial role in averting the onset of empyema, a serious complication characterized by the accumulation of pus in the pleural cavity. In resource-limited environments, a combination of antibiotics, chest tube placement, and streptokinase administration has been identified as a highly efficacious approach for addressing pyogenic empyema thoracis in pediatric patients. The incidence of empyema thoracis in the pediatric population is known to lead to considerable morbidity, underscoring the importance of timely intervention and effective treatment strategies. It is worth noting that a majority of individuals undergoing conservative treatment for this condition exhibit positive clinical outcomes and show substantial improvement in pleural health upon subsequent medical evaluations. This highlights the significance of closely monitoring patients with empyema thoracis to ensure optimal recovery and to prevent potential complications. Overall, early recognition, prompt intervention, and appropriate follow-up care are essential components of managing empyema thoracis in children, particularly in settings with limited healthcare resources.

REFERENCES

1. Ibrahim AJ, Khoulood F. Management and prognosis of parapneumonic effusion and empyema in children. UpToDate online. 2013;13.
2. Janahi IA, Fakhoury K. Epidemiology; clinical presentation; and evaluation of parapneumonic effusion and empyema in children. UptoDATE Information Clinicians Trust. 2019.
3. Subhi R, Gelbart B, Ching N, Thompson J, Osowicki J, Rozen TH, Shanthikumar S, Teague W, Duke T. Characteristics, management and changing incidence of children with empyema in a paediatric intensive care unit. Journal of Paediatrics and Child Health. 2022;58(6):1046-52.
4. Balfour-Lynn IM, Abrahamson E, Cohen G, Hartley J, King S, Parikh D, Spencer D, Thomson AH, Urquhart D. BTS guidelines for the management of pleural infection in children. Thorax. 2005;60(1):1-21.
5. Al-Shamrani AS. Management of Complicated Pneumonia in Children: Evidence Beyond Guidelines. Am J Pediatr. 2020;6(3):247-59.
6. Balfour-Lynn IM, Abrahamson E, Cohen G, Hartley J, King S, Parikh D, Spencer D, Thomson AH, Urquhart D. BTS guidelines for the management of pleural infection in children. Thorax. 2005;60(1):1-21.
7. Mandal KC, Mandal G, Halder P, Mitra D, Debnath B, Bhattacharya M. Empyema thoracis in children: A 5-year experience in a tertiary care institute. J Indian Assoc Pediatr Surg. 2019;24(3):197-202.
8. Abd El Moaty HM, Abdallah KM. Intrapleural Streptokinase in Complicated Parapneumonic Effusions and Empyema. The Egyptian Journal of Hospital Medicine. 2022;89(2):6268-73.
9. Baram A, Yaldo F. Pediatric Thoracic Empyema—Outcomes of Intrapleural Thrombolytics: Ten Years of Experience. Global pediatric health. 2020;7:2333794X20928200.
10. Reza A, Aslam M, Gupta M, Haseen MA, Yadav M. Safety and efficacy of streptokinase in multiloculated pleural effusion in pediatric population. Indian Journal of Respiratory Care. 2022;11(1):47-51.
11. Asciak R, Bedawi EO, Bhatnagar R, Clive AO, Hassan M, Lloyd H, et al. British thoracic Society Clinical Statement on pleural procedures. Thorax. 2023;78(3):43-68.
12. Niseteo T, Hojsak I, Kolaček S. Malnourished children acquire nosocomial infections more often and have significantly increased length of hospital stay. Clinical Nutrition. 2020;39(5):1560-3.
13. Addala DN, Bedawi EO, Rahman NM. Parapneumonic effusion and empyema. Clinics in Chest Medicine. 2021;42(4):637-47.
14. Janahi IA, Fakhoury K. Epidemiology; clinical presentation; and evaluation of parapneumonic effusion and empyema in children. Uptodate Information Clinicians Trust. 2019.
15. Angurana SK, Kumar R, Singh M, Verma S, Samujh R, Singhi S. Pediatric empyema thoracis: What has changed over a decade?. J Tropical Pediatr. 2019;65(3):231-9.
16. Batmunkh N, Kilroge P E, Yong D E, Anh DD. Survey of childhood empyema in Asia: Implications for detecting the unmeasured burden of culture-negative bacterial disease. BMC Infect Dis. 2018;8:90.
17. Hasan M, Islam MR, Matin A, Khan R, Rahman M et al. Clinical profile of children with pleural effusion admitted in a tertiary care hospital of Bangladesh. J ShSMC. 2012;4:7-9.
18. Baranwal AK, Singh M, Marwaha RK, Kumar L. Empyema thoracis: a 10-year comparative review of hospitalised children from south Asia. Arch Dis Child. 2013;88:1009–14.
19. Cirino LM, Gomes FM, Batista BN. The etiology of extensive pleural effusions with troublesome clinical course among children. Sao Paulo Med J. 2014;122:269–272.
20. Memon SA, Shaikh SJ. The Etiology of pleural effusion in Children: Hyderabad Experience. Pak J Med Sci. 2017;23:86-87.
21. Raza AB, Hamid MH, Ahmad TM, Naz F, et al. Microbial profile and treatment options of empyema thoracis in children. Pak Ped J. 2018;35:25-30.
22. Khanzada TW, Samad A. Indications and complications of tube thoracostomy performed by general surgeons. J Pak Med Assoc. 2018;58:39-40.
23. Shrestha PN, Rayamajhi A. Pleural Effusion in Children: How often do we suspect Tubercular origin? J Nep Paedtr Soc. 2018;30:132-34.
24. Schultz KD, Fan LL, Pinsky J, Ochoa L, Smith EO, Kaplan SL, et al. The changing face of pleural empyemas in children. Pediatrics. 2014;113:1735-37.

This article may be cited as: Qasim S, Aslam T, Raza AB: Clinical Spectrum and Outcome in Children Presenting with Empyema Thoracis in Tertiary Care Hospital: Role of Intrapleural Streptokinase. Pak J Med Health Sci, 2023;17(11):458-461.