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Impact of a new paediatric pleural empyema guideline on outcomes

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Abstract

Background

The management of pleural empyema in children varies across different paediatric centres across the world. Most international guidelines recommend either treatment with a chest drain and fibrinolytics or video-assisted thoracoscopic surgery (VATS)[1].

Methods

A retrospective study was performed on children admitted with a pleural empyema to Children's Health Ireland (CHI), Crumlin from 2008 to 2019 to examine the impact of new clinical guideline that was introduced in June 2014. Our study compared empyema cases pre- and post-guideline to identify any difference in the clinical outcomes between the two groups.

Results

Data on 21 children pre and 20 children post-guideline were examined. Chest drain and intrapleural fibrinolytic was the commonest treatment modality across both groups (10 (50%) versus 5(23.8%)). The number of patients who required surgical decortication decreased from 11 (52.4%) to 7 (35%) post-guideline. The median length of stay at our centre decreased post guideline from 15 (5-32) to 11 (6-27) days but this difference was not statistically significant (p=0.83).

Discussion

This study demonstrated a trend towards less invasive surgery and decreased days in hospital post introduction of a clinical guideline on the management of pleural empyema in children. The findings reflect the importance of standardising the management in this rare but significant respiratory illness.

Introduction

Pleural empyema is defined by the presence of intrapleural pus in the pleural cavity[2]. Pleural empyema is a rare complication of bacterial pneumonia[3]. The most commonly causative

organisms are streptococcus pneumoniae and staphylococcus aureus[4,5]. The incidence of pleural empyema in children is 3.3 per 100,000 children[1,6].

The management of pleural empyema in children involves antibiotics alone, chest drain insertion with or without intrapleural fibrinolytics or video-assisted thoracoscopic surgery (VATS)[1,7,8]. Paediatric centres across the world adopt different approaches to the management of pleural empyema[7,8]. A number of randomised controlled trials have been published over the past 15 years comparing the different management modalities[9]. The studies demonstrated that chest drain insertion with fibrinolytics was just as effective as VATS but that it more cost effective[9,10].

At our tertiary paediatric centre, there was no unified approach to the management of pleural empyema so a clinical guideline was developed to standardise treatment. This study examines the impact of this clinical guideline on the clinical outcomes of children with pleural empyema.

Methods

We performed a retrospective review of children who were admitted to Children's Health Ireland (CHI), Crumlin with a pleural empyema from 2009 to 2019. Pleural empyema was defined as a collection of pus in the pleural cavity identified by lung ultrasound. CHI, Crumlin is the largest paediatric centre in Ireland and the national centre for cardiothoracic surgery. Data on their clinical course obtained from medical records was included in the analysis. Data was collected on a random selection of patients admitted before and after the clinical guideline was introduced. The new clinical guideline was introduced in June 2014 *(Figure 1)* so we compared cases of pleural empyema five years before and after the introduction of the guideline to examine if there were differences in clinical outcomes between the two groups. The guideline was developed from the BTS guideline on pleural empyema in children[6]. The study was approved by the local hospital ethics committee.

Statistical analysis was performed using SPSS 24.0. Wilcoxon signed rank and McNemar tests were used to compare pre and post guideline data.

Results

Data on 41 children was collected, 21 children pre and 20 children post guideline introduction. Overall, the male: female ratio was 1:1.7 and the mean age was 5.6 ± 4.5 years. When comparing the two groups, there was no statistical difference in their patient characteristics (*Table 1)*. In respect to clinical outcomes between the two groups, there was no statistical difference in the median number of days of symptoms pre-admission (5 (4-12.5) versus 4.5

(3-8.5), p=0.89), length of stay at the referring hospital (4 (1.75-9.5) versus 3.5 (1-8), p=0.59) or length of stay at treating hospital (15 (10.5-20.5) versus 11 (9-16.5), p=0.83).

Chest drain insertion (+/- intrapleural fibrinolytics) was the commonest primary treatment strategy used pre and post guideline. Chest drain and intrapleural fibrinolytics was used more commonly post implementation of the guideline (6 (28.6% versus 10 (50.0%), p=0.01). Surgical decortication as a primary treatment strategy decreased from 8 (38.1%) to 5 (25%) patients post guideline but this figure did not reach statistical significance (p=0.34). There was no difference in the median number of days with a chest drain between the two groups (7(4-9) versus 6 (5-8), p=0.48). Similar numbers of patients in both groups were admitted to the paediatric intensive care unit (PICU) (10 (47.6%) versus 11 (55%), p=0.79). However, the majority of these admissions were routine overnight admissions post-surgical procedure. One patient in each timeframe studied developed a pneumothorax post CD insertion. There were no other significant complications seen. There was no statistical difference between the failure rate requiring a surgical decortication during either time period (4 (19.0% versus 1 (5%), p=0.20). The readmission rate was similar across the two groups (3 (14.3%) versus 3 (15%), p=1.00). No patient died across the timeframe of the study.

In respect to investigations performed, there was no difference between the two groups, except that more children had a nasopharyngeal aspirate (NPA) taken after the guideline was implemented (8 (38.1%) versus 15 (71.4%), p=0.02). Of note, blood cultures rarely demonstrated a positive growth. Group A streptococcus was identified on blood cultures in one patient from each group. Also, pleural fluid cultures were rarely positive in both groups, with one positive results pre-guideline and two positive results post-guideline. Pleural fluid PCR results were positive in 6/16 (37.5%) versus 10/20 (52.5%) of patients pre and post guideline. Streptococcus pneumonia was the pathogen identified in all positive samples apart from one sample that identified haemophilus influenza. Most children (18 (85.7%) and 17 (85%)) received a Chest X-ray (CXR) at their outpatient follow up visit.

Discussion

This study demonstrates that the introduction of a clinical guideline for the management of pleural empyema resulted in a more standardized approach. The rate of CD insertion and intrapleural fibrinolytics significantly increased from 28.6% to 50% post introduction of the guideline. Although there was no statistically significant difference in clinical outcomes between the two groups, it is important to highlight that a less invasive approach did not result in worsening clinical outcomes.

There are few randomised controlled trials or systematic reviews published in the literature on the management of pleural empyema in children. A recent systematic review examined

video-assisted thoracoscopic surgery (VATS) versus thoracentesis and chest drain insertion (with or without the use of intrapleural fibrinolytics) for the management of pleural empyema in all age groups[11]. Six RCTs on children were included in this analysis and there was no significant statistical difference identified in clinical outcomes between the two groups.

In this study, the majority of patients (70%) were managed with a CD insertion (+/- intrapleural fibrinolytics) post guideline. A number of studies have supported the use of chest drain insertion and intrapleural fibrinolytics as a first line treatment option for pleural empyema in children[12]. These reports confirm that this therapeutic option is safe, reliable and minimally invasive. Cobanoglu et al demonstrated that chest drain insertion and intrapleural fibrinolytics can be used as first line option in treating empyema in children with high success rate (13,14). Intrapleural fibrinolytics have been shown to decrease the length of hospital stay in cases of pleural empyema in a number of studies[15,16]. In a similar study to ours, one centre introduced a clinical pathway for the management of pleural empyema with intrapleural and reported less days requiring less days with the chest drain in situ[16]. In this study, although more children received intrapleural fibrinolytics post guideline; there was no significant improvement in clinical outcomes with the addition of intrapleural fibrinolytics.

In general, studies have demonstrated favourable clinical outcomes for children with empyema irrespective of the chosen treatment modality[17]. Our study demonstrated a failure rate requiring surgical decortication of 5% post introduction of the guideline. A recent observational study with similar numbers to our study examining the clinical outcomes for children demonstrated a failure rate requiring surgical intervention of 33%[18]. The lower failure rate in our study may be due to the fact that not all cases presenting to our centre were included in the analysis. The main limitation of this study was the small number of patients and that only a random selection of patients with empyema who were admitted to our centre were included in the analysis. The fact that data on all cases presenting to our hospital was not collected may have biased our findings. However, the numbers included in the analysis here are comparable to a number of similar studies presented elsewhere[18-20]. In addition to the small numbers included in the analysis being a limitation, there is diminished generalisability due to this being a single centre retrospective study.

The introduction of a standardised approach for the management of pleural empyema resulted in a less invasive surgical approach being adopted more frequently but this did not reach statistical significance. The clinical outcomes did not change post introduction of the guideline. This study demonstrates the importance role clinical guidelines play in standardising management for a rare but important paediatric respiratory issue.

Declarations of Conflicts of Interest:

None declared.

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Figure 1: Pleural empyema algorithm