Journal of the Egyptian Society of Cardio-Thoracic Surgery xxx (2017) 1–5

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Contents lists available at ScienceDirect

Journal of the Egyptian Society of Cardio-Thoracic Surgery

journal homepage: http://www.journals.elsevier.com/journal-of-the-egyptian-society-of-cardio-thoracic-surgery/

Comparative study between outcome of intercostal tube drainage and video assisted thoracoscopic surgery in management of complicated parapneumonic effusion in children

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ARTICLE INFO

Article history:
Received 21 November 2017
Received in revised form 17 December 2017
Accepted 26 December 2017
Available online xxx

Keywords:
Parapneumonic effusion
Videos-assisted thoracoscopy
Intercostal tube
Empyema

ABSTRACT

Background: Intercostal tube drainage (ICTD) has been known for the management of complicated parapneumonic effusion (PPE) since the early 1870s. Video assisted thoracoscopic surgery (VATS) has been applied since the early 1990s. The aim of this study was to compare between both surgical procedures in children.

Methods: This randomized clinical study included 75 children for drainage of complicated PPE in the Cardiothoracic Surgery Department of Alexandria University hospital, Egypt. They were classified into two groups. Group I included 35 children managed by ICTD while group II included 40 children managed by VATS.

Results: The mean age in group I was 7.81 ± 4.04 years and 8.93 ± 1.73 years in group II. Mean duration on medical therapy before and after intervention was 0.74 ± 2.83 days in group I and 4.80 ± 0.94 days in group II, and 11.06 ± 5.31 days in group I, and 2.88 ± 1.52 days in group II respectively. Success rate following primary intervention was 17.1% in group I and 90% in group II. Average amount of pleural fluid drained was 291.14 ± 94.86 ml in group I and 156.50 ± 76.28 ml in group II.

The mean hospital stay following primary intervention was 11.06 days in the first group and 2.43 days in group II. The mean hospital stay after secondary intervention in group I was 3.74 ± 2.79. In contrast, it was 1.38 days in group II which was significantly shorter than that of the group I. Moreover, the mean total hospital stay was 14.77 ± 7.12 days in the first group and 7.68 ± 2.07 days in the second group.

Conclusions: VATS is a safe and effective procedure with low rates of complications. Early VATS should be the first treatment of choice in children with PPE.

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Peer review under responsibility of The Egyptian Society of Cardio-thoracic Surgery.

https://doi.org/10.1016/j.jescts.2017.12.002

Please cite this article in press as: Shatila M, et al., Comparative study between outcome of intercostal tube drainage and video assisted thoracoscopic surgery in management of complicated parapneumonic effusion in children, Journal of the Egyptian Society of Cardio-Thoracic Surgery (2017), https://doi.org/10.1016/j.jescts.2017.12.002

1. Introduction

Parapneumonic effusion (PPE) develops in approximately 40% of children hospitalized with bacterial pneumonia [1]. In the United States, the rate of pneumonia in children is 20–40 cases per 100 000 and pneumococcal pneumonia comprises 20%–60% of community-acquired cases [2]. The steps that lead to the development of PPE and empyema are the following: stage I, also described as the early exudative phase, constitutes the collection of thin reactive fluid and few cells in the pleural space; stage II, described as the fibropurulent phase, involves the formation of loculations; and stage III is the organizing phase and it involves the creation of a thick layer of fibrin that encloses the lung [3].

The preferred treatment of PPE is prevention via up-to-date immunization [4]. The initial treatment of all pleural effusion should be the use of antibiotics. For children with small effusions (<10 mm on lateral decubitus chest radiograph or opacification of less than one-fourth of the hemithorax), the choice of broad-spectrum antibiotics, chest radiographs, and good clinical exam should suffice on an outpatient basis [5]. Thoracocentesis is recommended for small PPE in older children and it can guide the physician toward the appropriate antibiotic use; however, if repeated thoracocentesis is required, then chest tube will be the better choice [6]. Small tubes (8–12 French) are reported as good as larger tubes [7].

Patients can progress to stage II if adequate medical treatment is not provided. This stage is characterized by deposition of fibrin in the pleural space, leading to formation of loculations and isolated collections of fluid [5]. Typically, the pleural fluid at this stage has a glucose level less than 60 mg/dl, pH below 7.20, and pleural LDH more than three times the upper limit normal for serum (often >1000 units/L) [6]. If pleural fluid in stage II is not drained; in conjunction with effective antibiotic therapy; the effusion may progress to stage III. This final stage is characterized by fibroblasts that proliferate and invade the pleural fluid from both; visceral and parietal pleura; forming a thick pleural peel. The fibrin membranes are transformed by fibroblast into a web of thick non-elastic pleura that can encase the lung, preventing re-expansion and resulting in trapped lung [7].

The treatment options for pediatric PPE and empyema that is currently available include antibiotics alone or in combination with thoracocentesis, intercostals tube drainage (ICTD) with or without instillation of fibrinolytic agents, video-assisted thoracoscopic surgery (VATS) or open thoracotomy with decortication [8].

ICTD with intra-pleural fibrinolytic treatment was associated with superior results than ICTD alone [9]. Intrapleural fibrinolytic treatment with streptokinase should be attempted in any child who has persistent PPE inresponsive to simple chest tube drainage as it is found increasing drainage [10]. Open thoracotomy remains an excellent option for management of multiloculated empyema in children. When open thoracotomy is performed in a timely manner there is low morbidity and it provides rapid resolution of symptoms with a short hospital stay [10]. Thoracoscope is a safe and accurate diagnostic procedure which can be performed under local anaesthesia with minimal or no complications. The overall diagnostic yield of thoracoscopy superceded other modalities including pleural fluid cytology and blind pleural biopsy [11]. The British Thoracic Society in 2005 recommended drainage plus intra-pleural fibrinolytics as treatment for empyema in children. However, many retrospective and observational studies have recommended VATS as a first-line treatment for empyema because of its proved benefit of a shorter hospital stay compared to other procedures [12,13].

2. Patients and methods

This was a randomized prospective clinical study that was approved by Ethical Committee of Alexandria Faculty of Medicine, Egypt. Seventy-five children with complicated PPE were included in this study. They were classified into two groups. Group I; included thirty-five patients who underwent ICTD; and group II; included forty patients who underwent VATS drainage. All of these patients were on broad spectrum antibiotics before being referred to cardiothoracic surgery.

Exclusion criteria included patients above age of 18 years of age, patients having tuberculous empyema and patients who refused to continue the study after initial enrollment.

Data collected from both groups included age, sex, history, clinical picture, chest x-ray, Ultrasound (U/S) chest, CT-Chest without contrast, number of days on medical therapy following intervention, number of antibiotic classes given following intervention, duration of analgesia required, amount drained by each procedure, pleural fluid culture and sensitivity, persistence of symptoms following each procedures, secondary operative procedure intervention, total hospital stay (THS) and final outcome.

2.1. Statistical analysis

The data was collected, tabulated and statistically analyzed by SPSS (Statistical Package for Social Science) version 22.0.Two types of statistics were used. Descriptive statistics as percentage (%), mean and standard deviation (SD) and analytic statistics, Chi-squared test ($\chi 2$) were used to study association between two qualitative variables and Fisher's exact test was used to study association between two qualitative variables and at least one cell of expected was less than 5. Student t-test was the test of significance used for comparison between two groups having normally distributed quantitative variables, Paired *t*-test used as a test of significance was used for one group of units that has been tested twice (a “repeated measures” *t*-test) i.e. between two related normally distributed quantitative variables. P value < 0.05 was considered to be statistically significant.

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