Original Article

Comparison of Empyema Treatment in Odontogenic Origin Infections and Post Pneumonic Infections

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Abstract

Context: The empyema, defined as a collection of pus in the pleural cavity, may be caused as a result of primary complication of cervical or odontogenic infections and can spread to the mediastinum through cervical spaces. **Aim:** The results of surgical treatment in the patients with empyema were compared. **Materials and Methods:** The patients suffering from empyema with odontogenic and post-pneumonia infections, treated surgically in 2001-2009, were studied. Twelve patients of odontogenic empyema (Group 1), and 160 patients with post-pneumonia empyema infections (Group 2) were included in this study. Two groups were compared according to the treatments of empyema. Data were extracted from the medical records of the patients which include age, gender, type of treatment, cure rate, mortality rate, hospital stay, and complications. **Statistical analysis:** independent samples T test, Mann-Whitney U test and, Chi – square or Fisher Exact test were used. **Results:** The treatment of Group 1 was carried out through cervical, mediastinal and decortication approaches with cure rate of 75% and mortality rate of 25%. 36 patients of Group 2 were treated with minor surgical procedures. The remaining ones were treated surgically with a total cure rate of 90.8% and mortality rate of 1.8%. There were statistically significant differences on event rates of cure rate, mortality, and hospital stay times between two Groups ($p= 0.001$, $p=0.001$, $p<0.001$), however, there were no differences on postoperative complication rates of prolonged air leakages and wound infections ($p=0.715$, $p=0.057$). **Conclusion:** Due to high mortality and low cure rates of odontogenic empyema, early diagnosis and ample cervicotomy with mediastinal drainage are needed, and hence, thoracotomy-decortication may significantly reduce the mortality rate.

Keywords: Odontogenic infection; Empyema; Post pneumonic infection; Treatment

Introduction

Empyema was first diagnosed by Hippocrates over 2000 years ago. By considering the frequently seen following pneumonia, the empyema can form following oropharyngeal infections especially the odontogenic infections. [1] Poor general health and dental hygiene are regarded as the main predictive factors for developing descending necrotizing mediastinitis (DNM), a term used by Estrera in 1983, and empyema. [2-4]

The incidence rate of mediastinal extension of cervical pus was reported to be 40%-50% of CNF patients. [5]

The mixed polymicrobial aerobic and anaerobic infections of empyema originated from odontogenic infection, mediastinitis, tissue necrosis and even purulent pericarditis are responsible for high mortality rate and poor prognosis of odontogenic empyema infections. [6,7]

Thoracic complications from dental infection have been reported at irregular intervals and referred to DNM with severe tissue necrosis or bilateral empyema, purulent pericarditis, and extension of infection to abdominal parts. [8] If empyema was not treated properly, the mortality and morbidity rates would be increased.

Rapid cervical fascia abscess and DNM with empyema had high mortality rate ranging from 40% to 50% despite the adequate treatment. [3] Moreover, the procedures for treatment of odontogenic empyema infections are different from those of post-pneumonic empyema infections.

In this study, we compared the management and treatment results of two types of empyema infections based on their age, gender, cure rate, mortality rate, hospital stay, and complications.

Patients and Methods

In this retrospective-controlled study, we recruited 172 patients admitted to the Educational Hospital affiliated to our university, who had undergone empyema treatment in two Groups from 2001 to 2009. The ethical approval for this study was obtained from the Ethics Committee of the university (the names of ethics committee, hospital, and university have been removed because of journal's anonymous policy for authors and will be added upon acceptance and proof galley procedure).

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Inclusion criteria:

- Empyema patients with odontogenic and post-pneumonic origins.

Exclusion criteria:

- Patients with other causes of empyema, such as perforation of esophagus, neighboring foreign body infection, extensions from the neck or abdomen (18 patients).

Patients were divided into two Groups:

Group 1 (12 patients) was treated with surgical and minor surgical methods. Two patients were treated by chest tube thoracostomy, cervical, and mediastinal drainages. Ten patients of this Group were treated surgically by surgical drainage of neck, mediastinum and thoracotomy-decortication. Pericardiectomy was required in two patients. Irrigation of pleural cavity and mediastinum with saline was considered as a part of treatment.

36 (22.5%) patients of Group 2 (160 patients) were treated with minor surgical procedure, administering appropriate antibiotics with or without instillation of fibrinolytic agents and chest tube drainage. And, major surgical (Thoracotomy-decortication) approach was used for 124 (77.5%) patients of Group 2.

The data outcomes (i.e., age, sex, types of surgical treatment, cure rate, mortality rate, hospital stay time, and postoperative complications (prolonged air leakages effective for more than seven days, and wound infections) were obtained from medical records for comparison purposes include. All patients were diagnosed based on the clinical and imaging signs. Broad-spectrum antibiotics were initiated for all patients and later were changed according to the antibiogram test if necessary.

The treatment outcomes were evaluated by routine chest x-ray or CT scan of the chest and the clinical statements. All patients were transferred to intensive care unit after surgery.

Operative techniques

Cervicotomy and Mediastinotomy: All of the cervical abscesses were drained with oblique incision parallel to the border of sternocleidomastoid muscles. Retopharyngeal, peritracheal, periesophageal, and superior mediastinal exploration and drainage were performed through the same incision. The submandibular abscess was drained separately and communicated to the cervical spaces if possible. Necrotic materials were debrided and drained with sump-Penrose drains and through the incisions. The procedures were carried out through left side of neck and sometimes through two sides of neck or when mediastinal drainage was required.

Thoracotomy and Decortication: Decortication was performed using classic posterolateral or anterior thoracotomy approaches. All patients underwent general anesthesia and were intubated with double lumen or single lumen endotracheal tubes as collapsing the involved lung would allow the surgeon to enter the chest atraumatically; however, for removing the peel, aerating the involved lobes was inevitable. After obtaining proper access to the pleural space, all purulent pus was drained and the visceral plus parietal pleura were removed. Blunt and sharp dissection by sponge, peanuts, knife, forceps, and clamps were used to develop a cleavage plane over the lung for removing the peel. In the late stage of empyema (Organizing), surgery may cause injury to the underlying lung and lead to major air leakages and hazardous bleeding. Excision of the parietal pleura peel was continued until aorta or other great vessels were reached. Large air leakages were treated by suture closure (3-0 lately absorbed, Vicryl, Ethicon) at the completion of the procedure. Lung resection was necessary when diseased segments were encountered. Two chest tubes were inserted in the thoracic cavity for drainage of posterobasal and apical space of the pleural spaces. For apposition of the lung to chest cavities suction of the bottles may be necessary. Wide mediastinotomy through thoracotomy was performed in DNM patients. Chest tubes were extracted when no air leakages or pneumothrax was observed and complete expansion of the lung was achieved.

Statistical analysis

The endpoints of the present study were assessed by mortality and cure rates in both Groups of empyema thoraces. Descriptive data were expressed as a Mean ± SD & N (%). Continuous variables were analyzed with the independent samples T test, Mann-Whitney U test and, Chi – square or Fisher Exact test for quantitative variables. P-value less than 0.05 were considered statistically significant. The statistical package for social science (SPSS 16) was used for statistical analysis.

The odds ratios and SMD (standard mean difference) and their p-values were calculated using an in-house developed script.

Results

Demographic features of patients of this study in both odontogenic (12 patients) and post-pneumonic empyema infections (160 patients) in relation to their ages and gender are showing in Table 1. The ages of Group 1 and Group 2 varied from 15-59 to 6-78 years old. There were no statistically significant differences between two Groups considering their ages and gender according their p-values.

Two (16.6%) out of twelve patients of Group 1 were treated by drainage of neck and mediastinum, chest tube drainage and appropriate antibiotics which progressed to death. Ten (83.4%) patients of Group 1 required thoracotomy-decortication with cure rate of 75%; however, one patient (8.3%) died due to sepsis. Totally, three (25%) patients of Group 1 died due to sepsis.

Out of 160 empyema patients of Group 2, 36 (22.5%) patients were treated by chest tube drainage with or without instillation of fibrinolytic agents and appropriate antibiotics from which one patient died. In Group 2, 124 empyema patients were treated with thoracotomy and decortication with a cure rate of 98.3% (i.e., 122 patients) and mortality rate of 1.8% (i.e., two cases). Totally, 3 (1.9%) patients of Group 2 died during hospital stay due to sepsis and ARDS (acute respiratory distress syndrome).

There was statistically significant difference in terms of mortality between two Groups ($p<0.001$). Table 2 shows the comparison results of included outcomes of two Groups.

The cure rate result of Group 2 is higher than that of Group 1 according to odds ratio and significant p-value (OR= 0.325, lower limit= 0.057, upper limit= 0.01, p value= 0.001, 95% confidence interval).

Table 1: Demographic features of patients regarding sex and ages in odontogenic and post pneumonic infections (N=172 patients).

	Group 1 (odontogenic)	Group 2 (Post pneumonia)	
	N=12 (%)	N=160 (%)	p-value
Sex			
Male	7 (58.33)	95 (59.4)	0.99
Female	5 (41.64)	65 (40.6)	
Age			
(years)	34.50 ± 11.42	35.20 ± 14.06	0.703

*Data were expressed by Mean ± SD & N (%)

Table 2: Post-operative outcomes of patients in odontogenic and post-pneumonic infections treatments (n=172).

Variables	Group 1 (Odontogenic) N=12 (%)	Group 2 (Post pneumonia) N=160 (%)	P-value	Event rates	p-value
Cure rate	9 (75)	157 (98.125)	0.005	OR=0.325	0.001
Mortality	3 (25)	3 (1.875)	0.005	OR=17.444,	0.001
Total long Hospital stay (days)	10.34 ± 2.31	25.61 ± 8.53	<0.001	SMD = -1.846	<0.001
Prolonged air leakage	3 (25)	48 (30)	0.99	OR= 0.778	0.715
Wound infections	4 (33.3%)	20 (12.5)	0.067	OR= 3.5	0.057

OR: Odds Ratio, SMD: Standard Mean Difference

The mortality rate of Group 1 is higher than that of Group 2 according to odds ratio and significant p value (OR= 17.444, lower limit= 3.075, upper limit= 98.95, p value= 0.001, 95% confidence interval).

Moreover, hospitalization time outcome of Group 2 is higher than that of Group 1 based on SMD and significant p-value (SMD= -1.846, lower limit= -2.465, upper limit= -1.228, p value <0.001, 95% confidence interval).

However, there are no differences in postoperative air leakage complication between two Groups considering the non-significant p-value (OR= 0.778, lower limit= 0.202, upper limit= 2.999, p value= 0.715, 95% confidence interval).

Additionally, there are no differences in postoperative wound infection complication between two Groups based on the non-significant p-value (OR= 3.5, lower limit= 0.965, upper limit= 12.695, p value =0.057, 95% confidence interval) as shown in Table 2.

Discussion

The current retrospective study revealed higher mortality rate in DNM due to odontogenic infections complicated with pleural empyema than in post-pneumonia empyema due to advanced stage of empyema thoraces after their diagnosis. Therefore, in the treatment of empyema with DNM and odontogenic infections, thoracotomy-decortication, wide mediastinotomy with debridement, and antibiotic irrigation were mostly used.

The thoracic empyema is defined as a collection of pus in the sterilized pleural space and it was first classified by Mandal as either primary or secondary. Primary empyema refers to para-pneumonic infection and secondary thoracic empyema includes postoperative complicated thoracic surgery (25%), thoracic trauma sequel (15%) and extension of neighboring infectious processes (10%). [9,10]

DNM is a rare infection results from polymicrobial origin (most commonly bacteroides and streptococcus spp.) and due to the poor prognosis, the rapid progression occurs and produces fascia necrosis and pleural cavity empyema. [11,12] Purulent pericarditis can develop in rare cases with higher mortality rate than post-pneumonic empyema. [4] Moreover, pretracheal, retropharyngeal, perivascular, and parapharyngeal spaces are the important fascia to be involved. [13] The spreading down of pus is facilitated by gravity and negative intrathoracic pressure. Other potential causes of DNM beside dental infections are tonsillitis, pharyngeal infection, epiglottitis include pharyngitis, neck infections such as parotitis and cervical lymphadenitis. [5,12]

In all 12 patients of Group 1 with odontogenic infection, the infection migrated into the mediastinum after deep neck abscess formation. After developing DNM and rupturing of the pleural empyema, empyema or purulent pericarditis could be developed. [4] The medical diagnosis is performed by clinical symptoms, signs, and cervicothoracic computed tomography scans. In all patients, cervico-mediastinal drainage of the abscess was performed by cervical incisions. Thoracotomy-decortication was performed in empyema and pericardial infections by complete opening of the mediastinal abscess and spaces.

The reports showed that the DNM can affect patients with ages varying from an age of 4 months to the eighty with a mean value of fifty, [14] (the ages range of Group 1 is from 15-50 years).

Despite huge improvements in critical care unit and antibiotic treatment, the mortality rate of DNM especially in diffuse forms remains very high [12] as the results of this study confirm too.

The DNM was classified by Endo into three types. (i) type I (localized DNM) localized to the upper mediastinal space above the carina, (ii) type IIA infection was extended to the lower anterior mediastinum, and in (iii) type IIB, both anterior and posterior lower mediastinum was infected. Mediastinal drainage through the neck or pleural space is the most important part of DNM treatment [15] and associated with high mortality and morbidity rates. DNM with gram- negative pathogens has higher hospital mortality rate with severe complications. Pathogenesis of sepsis and dangerous effects of endotoxins on organ functions are well-known. [16]

Mixed aerobic and anaerobic organisms have been identified as causative agents in many patients. In Endo's series, 24/43 patients had empyema thoraces and 8/43 patients had purulent pericarditis in comparison to the current study's series (12/12 DNM empyema and 2/12 with purulent pericarditis). The trans-cervical drainage approaches (100%), thoracotomy (100%), mediastinotomy (66%) were performed for drainage of DNM infections. All of twelve patients of the current study developed empyema and underwent thoracotomy–decortication with wide mediastinotomy. In reviewing the literature, subxiphoid, thoracoscopic, and trans-mediastinal approaches, and clamshell transverse sternotomy were performed whereas none of them was required in our cases.

Post-pneumonic empyema patients required minor and major surgical treatment and because of no involvement of mediastinum, mediastinal drainage and debridment were not needed. Hirai proposed that cervical mediastinotomy, debridment and drainage of pleural cavities through thoracostomy or thoracotomy-decortication provided an effective treatment. [15,17]

Surgical treatment (thoracotomy-decortication) is the preferred method in advanced and organizing stages of empyema thoraces. Delayed surgical treatment is responsible for prolonging hospital stay and increasing mortality and morbidity rates. [18]

25% (3 patients) of mortality rate postoperatively was seen in DNM series of Group 1 in comparison to Group 2 with 1.9% (3 patients) mortality rate. Due to this reason and high mortality rate of odontogenic origin empyema (24% to 40% in the literature), the treatment of DNM is difficult and challenging with poor prognosis in comparison to post-pneumonia empyema. [19,20]

Recently video-assisted thoracoscopic surgery (VATS) treatment in early fibrinolytic stage of empyema and mediastinotomy has been used successfully. [21] However, in organizing stage of empyema and when peel is developed, it is not effective and therefore not recommended. [22] We did not use VATS procedure in any form of empyema treatment, due to advanced stages of empyema when diagnosed. [23]

Limitations

The current study has some limitations as followings which need to be taken in consideration:

- The single center, retrospective nature, and the possibility of bias present in selection criteria might influence the results.
- Surgeon's method of preference with retrospective study.
- The number of our patients was not abundant, therefore further experimental validation in low socioeconomic areas and large multicenter studies with larger sample sizes are required to confirm the current results.
- There was no study comparing the DNM and post-pneumonia in the literature, so the results of this article could not be compared with literature results.

Conclusion

Due to high mortality and low cure rates of odontogenic empyema, early diagnosis and ample cervicotomy with mediastinal drainage are needed, and hence, thoracotomy-decortication may subsequently reduce the mortality rate significantly.

Conflict of Interest

The authors disclose that they have no conflicts of interest.

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