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EMPYEMA THORACIS;

POSSIBLE FACTORS FOR PREDICTING THIS COMPLICATION IN CHILDREN WITH COMMUNITY ACQUIRED BACTERIAL PNEUMONIA

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ABSTRACT: Empyema as a complication of community acquired pneumonia (CAP) is relatively common occurrence in developing countries. **Study Design:** Prospective study. **Period:** 4 year Jan 2001- Dec 2004. **Setting:** Department of Pediatric surgery the Children's hospital Lahore. **Patients & Method:** A total of 114 cases of empyema thoracic secondary to CAP were dealt with during this period, while in the same duration a total of 1768 cases of pneumonia were treated at the Children's hospital Lahore. **Results:** Majority of the patients with CAP (59.61%) were below one year of age whereas the patients who developed empyema, were mainly (45.67%) between 2 to 5 years of age. Patients above 5 years of age having CAP (31.70%) and having repeated attacks of respiratory tract infection were most susceptible to develop empyema. Staphylococcus aureus was the most common organism found (40.35%) in this series. Vaccination, poverty and gender did not significant affected the development of empyema among the patients of CAP. Antibiotic resistance had no role in the development of empyema. Ibuprofen may be a risk factor. All the patients were initially managed with tube thoracostomy and antibiotics. Forty-eight patients (42.10%) needed subsequently operative management. Three patients (2.63%) had fatal course in this series same as seen in patients of CAP (2%). **Conclusions:** Immunization against causative organism and modification of out patient treatment may affect the incidence of empyema in children and should be studied prospectively.

Key words: Community Acquired Bacterial Pneumonia, Empyema Thoracis, Parapneumonic Effusion, Child, Risk Factors.

INTRODUCTION

Para pneumonic effusion and empyema are well documented complications of community acquired bacterial pneumonias (CAP)[1-3]. Recent studies have shown that the incidence of empyema in CAP is on an increase and causes significant childhood morbidity[2-5]. Despite the advances in the diagnostic facilities, and wide spread use of more effective antibiotics, and early referral, empyema thoracic is still one of the most serious chest surgical problems in children and especially in neonates[4].

The reported incidence of empyema annually is 1-5 cases per 100000 inhabitants per year below 19 years of age[2]. Pneumococcal infection remains the most isolated cause in developed countries[1-3,5] while Staphylococcus aureus is the most common causative organism in developing world[4,6-9]. The risk factors which predispose certain patients of CAP to develop empyema, are not very clear and are still under investigation[1,2,3,5]. Very few studies address these issues in children. A significant number of patients hospitalized with CAP at The children's hospital Lahore were noted to have empyema, an observation

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that led us to conduct this study. The purpose of this study was identification of possible risk factors for predicting this complication in children with community acquired pneumonia.

MATERIALS AND METHODS

This study includes empyema cases only occurring as a complication of CAP. A total of 128 patients of empyema thoracic with age range 1 month to 15 years were hospitalized during the period of four years from January 2001 to December 2004 at the Children's hospital Lahore. Most cases had presented in medical emergency department or to the pediatric medical ward and were then shifted to the surgical ward or few reported directly to the surgical emergency.

Fourteen cases were due to other causes than CAP such as accidental chest injuries (2 patients), immunodeficiency (2 patients), post thoracotomy (1 patient), perforation of esophagus (6 patients) and ruptured liver abscess (3 patients). They were excluded from the study. A total of 114 patients with empyema as result of complication of CAP were evaluated in the results. During this period a total 1764 patient were admitted and treated in this hospital with diagnosis of CAP. The diagnosis was established if there was local infiltrate on chest radiograph, and clinical symptoms. Other patients having viral pneumonia or caused by other factors were excluded from the study.

Complete history was taken and physical examination was performed in all the cases. The data was recorded including age, sex, length of hospital stay, physical findings and symptoms at presentation, duration of symptoms, clinical outcome, and potential risk factors for empyema including antibiotic exposure before admission, immunization status, history of recent viral illness, immunodeficiency, chronic illness and exposure to tobacco and other inhalant irritants. Complete blood counts and ESR was recorded. Median TLC was19000/mm^3 and median ESR was 25. Mantoux test was performed if tuberculosis was suspected on history and clinical examination. Chest X-ray and needle aspiration of pleural fluid was performed in all cases. Culture and sensitivity of the pus was performed along with microscopic examination and antibiotics were adjusted according to the results.

The diagnosis was made if there was finding of pleural effusion on chest radiograph, and/or ultrasound, CAT scan, pleural fluid parameters consistent with empyema (PH < 7.2, glucose < 20 mg/dl, a protein level of > 3000 mg/dl, a WBC count of > 50000 cells/micro liter, positive calture) or need for surgical decortication. Surgical and pathological reports were reviewed to confirm the diagnosis of empyema. The data of patients who had CAP and empyema was compared with patients who had CAP alone.

Appropriate antibiotics were started. Ultrasonography was done in 56 cases. CAT scan was done in 23 patients. All the patients were initially treated with chest intubations. Forty-eight cases later required thoracotomy and decortication.

RESULTS

Over a four year period a total of 114 cases of empyema thoracis secondary to CAP were admitted while during same period a total of 1764 cases of CAP were treated in our institution. The age range was 1 month to 15 years. Fifty two (45.61%) patients of empyema were between 2 to 5 years of age. (Table-I).

Table-I. Age at presentation.

Age at presentation	Patients with CAP No= 1764	Patients with empyema No= 114
	No. of patients (%age)	No. of patients (%age)
0-1 years	1041 (59.61)	23 (20.17)
2-5 years	600 (34.01)	52 (45.61)
5-10 years	90 (05.10)	27 (23.68)
10-15 years	33 (01.87)	12 (10.53)

A comparison of age distribution between both groups and relative ratio of the patients who developed empyema secondary to CAP indicates that group above 5 years of age is more prone to develop this complication as shown in table-II.

Sex distribution of CAP patients and empyema patients was almost same as shown in the table-III.

Fever, respiratory distress and cough were the main presenting complaints (Table-IV). Duration of illness before presentation ranged from 3 to 75 days (average 21.46 days).

Table-II. Comparison of age between the two groups.

Age at presentation	Empyema	Pneumonia	Comparison	
	No. of patients	No. of patients	Ratio	%age
0-1 years	23	1041	23/1041	02.21
2-5 years	52	600	52/600	08.66
5-10 years	27	90	27/90	30.00
10-15 years	12	33	12/33	36.36
P= 0.001				

Table-III. Sex distribution.

Sex	CAP (no= 1764)	Empyema (no= 114)
Male	1120 (63.50%)	73 (64%)
Female	644 (36.50%)	41 (36%)
M:F Ratio	1.74: 1	1.78: 1

Table-IV. Presenting complaints. No= 114

Presenting complaints	No of pts.	%age
Fever	112	98.00
Cough	80	70.17
Respiratory distress	94	82.45
Repeated serious episodes of chest infection in quick succession	45	39.47
Chest pain	09	07.89
Vomiting	02	01.75
Swelling chest wall	02	01.75
Febrile fits	01	00.87
Abdominal distention	02	01.75

It was recorded that 45 patients (39.47%) had two or more serious episodes of chest infection in quick succession. Comparison of age distribution in patients with two or more successive episodes of respiratory tract infection in quick succession with total empyema patients is shown in table-V.

All these patients had history of intake of broad spectrum antibiotics more commonly ceftriaxone, cefotaxime, quinolone derivatives, and aminoglycosides. These were the same antibiotics which were used in the CAP patients who did not develop empyema. Ninety five patients (83.33%) had history of use of ibuprofen with or without combination with paracetamole. Rest of the patients had been prescribed paracetamole alone. There was no history of significant exposure to tobacco or smoke.

Needle aspiration of pleural space was performed in every case and pus was sent for culture and sensitivity. The results are reflected in table-VI.

Table-V. Age distribution.				
Age at presentation	**Patients with repeated episodes of infection**	**Patients with empyema**	**Comparison**	
	No of patients= 45	**No of patients= 114**	**Ratio**	**%age**
0-1 years	05	23	5/23	21.73
2-5 years	27	52	27/52	51.92
5-10 years	08	27	8/27	29.62
10-15 years	03	12	3/12	25.00

Right side was involved in 60 cases (52.63%) and left in 54 cases (47.37%). Sixty six cases were cured with chest tube drainage and antibiotics whereas 48 patients needed decortications out of 114 cases of empyema.

Three patients (2.3%) had a fatal outcome in this series, one patient with decortication and two with closed drainage. While in same period mortality seen in simple CAP patients was 36 (2%).

Table-VI. Bacteriology on culture: No= 114		
Organism	**No of patients**	**%age**
Staphylococcus	46	40.35
Pseudomonas	05	4.38
Klebsiella	10	8.77
No growth	53	46.49

DISCUSSION

Pneumonia is a common childhood disease with an incidence of 1 to 4.5 cases per 100 children per year[10,11,12]. Although most cases are viral in origin, bacteria are causative agents in 20 to 30% of patients[13]. In the developing world CAP is not only more common than in Europe and North America, but is more aggressive and a major killer of children[14-17]. It is a life threatening condition and the estimated word wide mortality especially from the poor countries is 3 millions per year[18].

Empyema is usually the result of infected pleural effusion that is associated with ongoing, uncontrolled, pulmonary sepsis or pneumonia[5]. Pleural effusions and empyemas are known complications of bacterial pneumonia. The reported occurrence of parapneumonic effusions in patients with CAP in different series is, 14.65% to 57%[1,19-22] with around 60% of effusions progressing to empyema in all age groups[19,20]. Half of patients with empyema develop it as a complication of CAP[23-25]. Reported incidence of occurrence of empyema in patients with CAP in different series varies from 0.6% to 36%[1-3,26-28]. It was 6.46% in our series.

Age plays an important role in the development CAP and empyema. In terms of actual numbers, the neonates and infants are more commonly affected than older children both in complicated and non complicated CAP patients[7,8]. In different series of empyema 25% to 35.5% patients were below 2 years of age[8,29]. It was 23% in this series. But the percentage of children who developed empyema secondary to CAP were significantly older than those with CAP alone in this series. This finding is also reported in other series (71 months vs 47 months[2], 47 months vs 27 months[3])[2,3,5]. The reason may be the larger percentage of older children may have received antibiotics before diagnosis. This antibiotic therapy may partially suppress the infection for a period of time but was insufficient to prevent its progression to a complication. So these children of older age group with CAP are more prone to develop complicated pneumonia[3]. Another possibility to explain the increased occurrence of empyema in older children of CAP is the appearance of a new virulent serotype[2].

A male to female ratio was almost the same in both complicated and non complicated CAP patients. In the

present study it is noted that the patients (39.47%) with history of bronchospasm or repeated episodes of acute respiratory tract infection in quick succession are more prone to develop empyema. A series from Brazil also supports this by reporting 57.3% of patients of empyema having history of repeated respiratory tract infections previously[1].

The identification of the causative agents for non complicated bacterial pneumonia is difficult but if pleural effusion occurs then culture from pleural effusion is considered to be reasonably reliable. The yield of blood culture varies between 5 to 11.4% in different series[2,30]. The identification of causative agents in children with empyema can be achieved by culturing blood or pleural fluid. Reported diagnostic yield from pleural and or blood culture ranges from 32% to 70%[1,2,6,31]. It was 53.50% in our series. The most commonly reported causative organism in CAP is streptococcal pneumoniae, followed by staphylococcal aureus, and H influenzae in the developed world[1,2,3,5,30,32]. In case of empyema secondary to CAP, earlier reports showed that pneumococci, streptococcus pyogenes, and mixed infections were the common causative organisms[4,31]. Subsequently staphylococcus aureus emerged as a major pathogen especially in children below one year and is still the leading agent in pediatric age group especially in the developing countries[4,6-9,31]. In the developed countries, Pneumococcus especially serotype 1 is the commonest organism found. In one study from USA, it was found that serotype 1 and 3 accounted for 3.6% and 2.7% of cases of pneumonia respectively. They were together more common in patients who developed empyema later on accounting for 24.4% and 8.4% respectively[3]. In one of the study it is evident that pneumococcal isolates recovered from patients with empyema secondary to CAP, 50% were serotype 1, compared to 7% of those recovered from patients of non complicated pneumonia[2]. The reported incidence of staphylococcal infection in different series of empyema varies between 44%[2] and 77%[3]. It was 40% in this series. Haemophilus influenzae and klebsiella pneumoniae were also increasing in frequency in recent series[4,8]. Pseudomonas aeruginosa[1,10] as causative organism is rarely reported. But in our series the incidence of Pseudomonas aeruginosa and klebsiella was 4.38% and 8.77% respectively. From this discussion it evident that patients of CAP caused by staphylococcal aureus and those caused by serotype I and III of streptococcal pneumoniae are more prone to develop empyema.

Some bacteria causing pneumonia produce pleural effusions more often than others. It has been shown that pleural effusion occurs in 10 % of pneumonia cases caused by streptococcus pneumoniae, 35% of patients caused by anaerobes, and 50% of patients caused by streptococcus pyogenes[1].

The antibiotics used for treating pneumonia, found to be associated with development of empyema were azithromycin, cefaclor, and ceftriaxone[2]. It had been reported that streptococcal pneumoniae is resistant to theses drugs especially to azithromycin and cefaclor and this may be an important factor for progression of pneumonia to empyema. Although ceftriaxone is effective against drug resistant streptococcus pneumoniae, single daily dose with inadequate drug level in pleural fluid may be responsible for development of empyema[2]. The study of Hsieh et al does not support it[5]. In literature no significant difference is reported between penicillin susceptible versus penicillin non susceptible organism in complicated versus non complicated pneumonia[3,5,27,31]. In fact Byington et al found an increase in the percentage of penicillin non susceptible organisms in patient with simple pneumonia as compared to those who developed an empyema[2]. In our series antibiotic had no role in the development of empyema among the CAP patients.

Ibuprofen is also reported to be associated with high occurrence of empyema in patients with CAP[2]. In our series 83.33% of patients had history of ibuprofen intake in the patients of complicated pneumonias supporting it. Ibuprofen use might allow children with significant disease to be managed more comfortably at home, delaying definitive treatment. It is also possible that its use may directly contribute to the development of empyema. Its low dose use is said to be pro-inflammatory encouraging influx of neutrophils and increasing the level

of cytokines in the lungs of animals and humans with cystic fibrosis[33,34]. Ibuprofen use has been considered a risk factor in the development of necrotizing fasciitis with streptococcus pyogenes infection in children[35,36]. Further investigations are needed regarding the immunomodulating properties of ibuprofen in children especially in those with streptococcal infections.

Recent varicella-zoster virus infection is reported to be strongly associated with development of empyema[2,6]. The incidence of measles has decreased significantly from 11% to 1.2% during the past two decades[6]. Immunization of this viral illness has the potential to reduce the development of empyema[2,6].

Poor socioeconomic groups with pneumonia are more predisposed to progress to empyema,[6] but there are studies from children that contradict this[1]. In one series from India, 62% of patients were malnourished[6]. In our series 70% of patients were malnourished but same figures were seen among the non complicated CAP patients.

Early recognition of pneumonia may be an important factor in prevention of empyema and this also plays a vital role in the prognosis of empyema thoracic especially in neonates. The overall mortality seen in different series averages 8%[7,29,37,38]. It was 2.63% in this series, which was almost the same as seen in non-complicated pneumonia cases.

CONCLUSION

Empyema as a complication of CAP is a serious public health problem in Lahore and its periphery. Although more number of cases are found between 2 to 5 year of age but actually a very high percentage of CAP patients above 5 years of age are prone to develop empyema. The bacteriological profile of empyema cases secondary to CAP in this series does match with reports from other under developed countries, revealing staphylococcal aureus being most common organism in our setup. This also indicates that patients of CAP infected with staphylococcal aureus are more prone to develop empyema. More over repeated episodes of severe respiratory tract infection in quick succession predispose the children more to develop empyema among the patients of CAP. Vaccination, poverty and sex had no significant effect on development of empyema among the patients of CAP. Antibiotic resistance has no role in the development of empyema. Ibuprofen may be a risk factor.

Immunization against causative organism and modification of out patient treatment may affect the incidence of empyema in children and should be studied prospectively.

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