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# CLINICAL CHARACTERISTICS OF CHILDREN WITH COMPLICATED COMMUNITY- ACQUIRED PNEUMONIA WHO WERE ADMITTED AT MAKATI MEDICAL CENTER FROM JANUARY 1999 TO AUGUST 2009.

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**KEYWORDS**
pneumonia, complicated pneumonia, pleural effusion, Staphylococcus, Streptococcus,

**ABSTRACT**
Pneumonia is a prevalent cause of death in children. This study was undertaken to determine the clinical characteristics, outcomes and bacterial etiology of children with complicated community-acquired pneumonia.

**Methodology:** All patients who were between one month and 18 years old and diagnosed with complicated community-acquired pneumonia at the Makati Medical Center from January 1999 to August 2009 were included. Each case was matched with four controls of uncomplicated pneumonia. Data collected were demographic information, laboratory results, management and outcome.

**Results:** Thirty-five cases of complicated community-acquired pneumonia were included in the study. There was no significant difference between the demographic profile, class of antibiotics prior to admission, and underlying conditions in both groups. The complicated cases seen were those who developed pleural effusion or intubated or mechanically ventilated. These cases also constitute those who significantly presented fever of longer duration (mean 7.3 days SD ±6.8), higher respiratory rates (34.3 breaths/minute SD± 12.1 p=0.0003) and presented more frequently with retractions (42.9%, p=0.0003). Complicated community-acquired pneumonia had significantly more antimicrobial changes, greater number of days to fever lysis and had longer hospital stays. Cultures of complicated cases had a low yield (23%); positive cultures had growths of *Staphylococcus aureus*, *Streptococcus pneumoniae* and Pseudomonas species. Mortality rate was 14.3% for complicated cases, there was none for the control group.

**Conclusion:** There were no significant differences in the demographic profile, class of antibiotics prior to admission, and underlying conditions between the two groups. Complicated cases presented with fever of longer duration, higher respiratory rates and had more frequent retractions, of longer hospital stay, more frequent changes of antibiotics and a 14.3% mortality rate.

## INTRODUCTION

Pneumonia is the most prevalent cause of death in children, causing an estimated two million childhood deaths every year, most of them in developing countries.[1] Children less than five years are at high risk for severe, life threatening diseases due to bacterial and viral pathogens.

Complicated community-acquired pneumonia is defined as community-acquired pneumonia complicated by necrosis, empyema, parapneumonic effusion, and lung abscess or were intubated or had an outcome of death.[6]

In developed countries, pleural empyema, an infrequent complication of pneumonia, is often quickly identified and promptly treated with surgical or pharmacologic therapy. Nevertheless, it is still associated with prolonged hospitalization and has case fatality rates of 5% to 7%. While predictors of empyema in hospitalized children are not well-known, it appears that host factors play predisposing roles.[2] Bacterial pathogens, such as *Staphylococcus aureus, Streptococcus pneumoniae, Streptococcus pyogenes and Haemophilus influenzae* type b (Hib), were associated with empyema in children.[3] Emerging bodies of literature suggest that *Streptococcus pneumoniae* is the major cause of empyema and that selected serotypes of pneumococcus play an important role in this emerging disease pattern.[4]

In developing countries, severe pneumonia in children may be associated with necrotizing changes in a unilateral or bilateral pattern. Antecedent conditions, such as malnutrition, measles or infection with antibiotic-resistant organisms, may increase the risk of severe pneumonia accompanied by empyema. As etiology of complicated pneumonia is difficult to identify in a timely manner, treatment of complicated pneumonia is usually empirical. Another factor complicating empiric antibiotic selection is an increase in drug-resistant organisms especially due *to Streptococcus pneumoniae* and *Staphylococcus aureus*.[5]

In the Asia-Pacific region, a limited number of clinical and laboratory studies suggest that *Streptococcus pneumoniae* may also be the most common etiologic agent in empyema and pleural effusion specimens. Treatment options include antibiotics alone or in combination with thoracentesis, tube thoracostomy, intrapleural fibrinolytics, thoracoscopy and open decortications. [4]

This study was undertaken to determine the clinical characteristics, management outcomes and bacterial etiology of children with complicated community-acquired pneumonia treated at the Makati Medical Center from January 1999 to August 2009.

## OBJECTIVES

The aim of this study is to determine clinical characteristics, microbiologic patterns and management outcomes of children with complicated community-acquired pneumonia who were admitted at the Makati Medical Center from January 1, 1999 to August 31, 2009

## MATERIALS AND METHODS

This is a case-control study of complicated community-acquired pneumonia among hospitalized children.

All patients between one month and 18 years old who were diagnosed with complicated community-acquired pneumonia at the Makati Medical Center and discharged between January 1, 1999 to August 31, 2009 were included in the study. Study patients were identified through the medical records section using ICD 9 codes indicating either pleural effusion (code 510), abscess of lung, including necrotic pneumonia (code 513), or post endotracheal intubation (code 96.02) as part of their diagnosis and an additional diagnosis code for pneumonia (codes 480-86).

Each of the cases was randomly matched with four controls who were in the same age group, were admitted in the same year, were discharged with pneumonia (ICD 9 codes 480-86) and were not given an ICD code for complicated pneumonia (ICD 9 codes 510, 513,

96.02) as part of the diagnosis. The random matching was done in Microsoft excel by entering and grouping the hospital numbers of the uncomplicated cases of community-acquired pneumonia by age and year of discharge and each case was then paired with a random number assigned by Microsoft excel. The pairs of numbers (hospital number and assigned random number) were sorted from lowest to highest based on the random number, then the top four rows were used to make up the random sample.

Data was collected with the use of a standardized data form for each subject. Information collected were age, gender, co-morbid conditions, presenting signs, symptoms, and findings on physical examination; radiographic studies and laboratory data (culture, gram stain, white blood cell count, C-Reactive protein) from tests performed within 24 hours after admission and pleural fluid analysis; duration of hospitalization and duration of fever; chest tube placement and duration; and antimicrobial therapy.

The collected data were encoded and processed in a Microsoft Excel spreadsheet. Statistical analyses used the Number Cruncher Statistical System software at a significance level of 0.05. Means, standard deviations, proportions and 95% confidence intervals (CI) were used for univariate analysis. T tests, and if necessary, Mann Whitney U tests, were employed for bivariate analysis of continuous variables. Chi–square tests, and if applicable, Fisher's exact tests were performed for bivariate analysis of nominal variables. Multiple regression was used for multivariate analysis of factors predictive of complicated outcome. Kaplan Meier product limit method and log rank tests were done to compare the survival probabilities between the complicated and uncomplicated cases of community-acquired pneumonia among pediatric patients.

## RESULTS

There were a total of 88 patients identified as cases of complicated community-acquired pneumonia; thirty-five of the patients identified were included in the study. Fifty-three patients were excluded due to the following reasons: charts of 23 patients could not be retrieved by the medical records section; 20 patients had incomplete data for analysis; and 10 patients had primary diagnoses of dengue hemorrhagic fever in which the pleural effusions were likely part of the illness rather than due to pneumonia.

### Demographics of subjects

Table 1 shows the demographic and clinical characteristics of patients with complicated versus uncomplicated community-acquired pneumonia. There were no significant differences between the demographic profiles of both groups. There were no significant differences in class of antibiotics taken prior to admission and the underlying conditions present in both groups. Hence, the cases and controls were matched.

Upon presentation, the most common clinical symptoms were cough, fever and dyspnea. Among these symptoms, complicated cases significantly presented with fever of longer duration (mean 7.3 day SD±6.8).

The clinical signs found in all subjects were tachypnea, retractions and abnormal breath sounds. Complicated cases of pneumonia significantly had higher respiratory rates (34.4 SD±12.1 versus 29.1 SD±12.1, p value 0.03) and significantly had retractions [15 (42.9%) versus 21 (15.0%), p value 0.0003] more frequently.

Though there was a significant difference between the two groups, when multiple regressions were used, none of the variables is predictive of complicated pneumonia.

In terms of antimicrobial use and course, children with complicated pneumonia were significantly more likely to have antimicrobial changes (up to four times, for some), and had greater number of days to fever lysis and longer hospital stays.

Table 2 shows the white blood cell count of complicated cases as significantly higher than those of the controls (p 0.03). Eight of the

Table 1. Demographic and clinical characteristics of complicated and uncomplicated pneumonia (N=175).

| Variables | Type of Pneumonia | | Bivariate Analysis | Multivariate Analysis |
|---|---|---|---|---|
| | Complicated (n=35) | Uncomplicated (n=140) | p value | p value |
| **Patient Characteristics** | | | | |
| Age in Years | 7.3 ± 4.8 | 7.5 ± 4.2 | 0.80 | 0.95 |
| Gender – Male<br>Female | 16 (45.7%)<br>19 (54.3%) | 85 (60.7%)<br>55 (39.3%) | 0.11 | 0.09 |
| Co – Morbid Diseases* | 15 (42.9%) | 69 (49.3%) | 0.50 | 0.95 |
| History of Antibiotic Intake[∞] | 15 (42.9%) | 56 (40.0%) | 0.76 | 0.79 |
| **Clinical Symptoms** | | | | |
| Days with Fever | 7.3 ± 6.8 | 4.3 ± 4.7 | 0.0008 | 0.25 |
| Days with Cough | 8.1 ± 10.1 | 5.7 ± 5.7 | 0.87 | 0.19 |
| Days with Dyspnea | 1.1 ± 2.2 | 0.7 ± 1.8 | 0.20 | 0.69 |
| Days with Chest Pain | 0.2 ± 0.9 | 0.2 ± 1.3 | 0.77 | 0.27 |
| Days with Vomiting | 0.6 ± 1.5 | 0.3 ± 0.9 | 0.34 | 0.88 |
| Days with Abdominal Pain | 0.1 ± 0.4 | 0.2 ± 0.9 | 0.18 | 0.82 |
| **Clinical Signs** | | | | |
| Respiratory Rate in breaths/min | 34.3 ± 12.1 | 29.1 ± 12.1 | 0.03 | 0.51 |
| Retractions | 15 (42.9%) | 21 (15.0%) | 0.0003 | 0.23 |
| Abnormal Breath Sounds | 27 (77.1%) | 112 (80.0%) | 0.71 | 0.52 |
| **Diagnostic Examinations** | | | | |
| White Blood Cell Count in cells/mm$^3$ | 15,528.6 ± 9,117.1 | 11,581.5± 9,907.3 | 0.03 | 0.22 |
| Abnormal Chest X – Ray | 33 (94.3%) | 116 (82.9%) | 0.11 | 0.79 |
| C-Reactive Protein | 87.0+135 | 73.3+202.7 | 0.85 | |
| **Course in the Wards** | | | | |
| Shift in Antibiotics – None<br>1x<br>2x<br>3x<br>4x | 19 (54.3%)<br>4 (11.4%)<br>4 (11.4%)<br>7 (20.0%)<br>1 (2.9%) | 136 (97.2%)<br>2 (1.4%)<br>2 (1.4%)<br>0 (0.0%)<br>0 (0.0%) | < 0.00001 | 0.29 |
| Days for Fever Lysis | 6.9 ± 5.4 | 1.6 ± 1.2 | < 0.00001 | 0.09 |
| Days of Hospital Stay | 15.4 ± 8.4 | 5.2 ± 2.0 | < 0.00001 | 0.00001 |

*Comorbid Illnesses: Asthma, Ventricular septal defect, Rheumatic Heart Disease, Seizure disorder, Pulmonary tuberculosis, immunosupression due to chemotherapy

[∞] No statistical difference in the class of antibiotic coverage used prior to admission

complicated cases and 14 of the uncomplicated cases had C-reactive protein done; and there were no significant differences. Blood culture was done in 33 of 35 cases of complicated pneumonia and 35 of 140 cases of uncomplicated pneumonia. Three of the 33 complicated cases (9.1%) had growth on blood culture, while two of the 35 uncomplicated cases had positive culture result (5.7%).

For chest radiography, abnormal findings were found in both groups, however, there was a significant difference between the lobes affected (p=0.05). Complicated pneumonia presented with greater, right middle lobe involvement (51.4%) while uncomplicated case presented more as bronchopneumonia (30%).

Table 2 Blood examinations of complicated and uncomplicated pneumonia (N=174).

| Variables | Type of Pneumonia | | Bivariate Analysis |
|---|---|---|---|
| | Complicated (n=35) | Uncomplicated (n=140) | p value |
| **Blood Examinations** | | | |
| White Blood Cell Count in cells/mm$^3$ | 15,528.6 ± 9,117.1 | 11,581.5± 9,907.3 | 0.03 |
| Segmenters in % | 69.1 + 17.6 | 65.8 + 17.9 | 0.33 |
| Lymphocytes in % | 24.0 + 16.8 | 26.6 + 16.3 | 0.39 |
| C-Reactive protein (mg/dl) | 87+120 | 73+202 | 0.72 |
| Positive Blood Culture[♱] | 3 (9.1%) | 2 (5.7%) | 0.94 |

[*] 8 complicated, 14 uncomplicated

[♱] 33 complicated, 35 uncomplicated

**Outcome of Complicated vs. Uncomplicated Pneumonia**

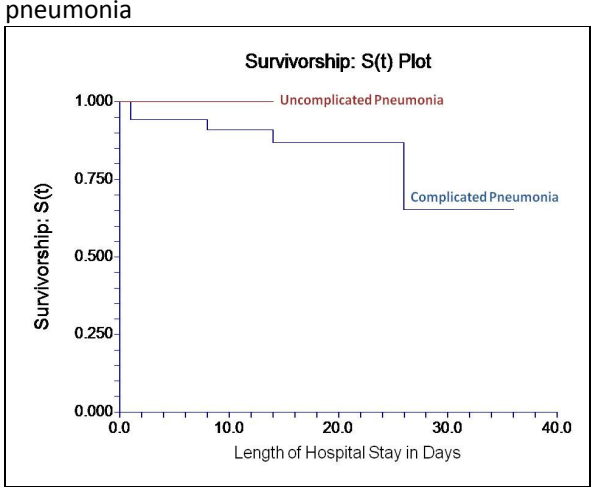
No mortality was seen among uncomplicated cases (95% CI of 0% to 2.1%). Using Kaplan–Meier survival analysis and log rank test, probability of survival was maintained at 100% during the whole hospital stay for patients with uncomplicated pneumonia. However, chances of survival significantly declined to 94%, 91%, 87% and 65% for patients with complicated course at the 1$^{st}$, 8$^{th}$, 14$^{th}$ and 26$^{th}$ day of hospitalization (p = 0.02), respectively as shown in figure 1.

**Clinical course, management and outcome of Complicated Community-Acquired Pneumonia**

The complicated pneumonia cases were composed of: 51.4% (n=18) with significant pleural effusion by radiographic studies; 28.6% (n=10) with minimal pleural effusion by chest x-ray; 11.4% (n=4) with empyema thoracis with

significant pleural effusion; 5.7% (n=2) with significant pleural effusion atelectasis; and 2.8% (n=1) was intubated with no pleural effusion or empyema. There was no case of lung abscess.

Figure 1. Survivorship plot comparing patients with complicated pneumonia and uncomplicated pneumonia




Additional diagnostic procedures done for complicated pneumonia cases included chest ultrasound, chest CT-scan and pleural fluid or endotracheal aspirate cultures. Eleven (31.4%) patients had ultrasonographic estimation of pleural volume, with a mean of 229.9 ± 202.6 ml. Chest CT scan was done on nine of the cases with ultrasonography and the scan revealed additional findings of atelectasis (two of the nine subjects with ultrasonography) and empyema thoracis (three of the nine with ultrasonography).

Thirteen (37.1%) of the cases had chest tube thoracotomy (CTT) done; all were still febrile and tachypneic at the time of procedure and had been receiving antibiotics for seven-to-14 days. Six of the cases (17%) had additional surgical procedures (four had thoracotomy, one had video-assisted thoracoscopic surgery and one had fibrinolysis) due to non-resolution of the pleural effusion. The mean length of time for fever to lyse after CTT was 4.8 (SD± 4.8 days). The mean duration of CTT was 8.5 days (SD±3.4 days).

Table 3. Univariate analysis of complicated pneumonia (N=35).

| Variables | Univariate Analysis | |
|---|---|---|
| | No. (%) | 95% CI |
| **Microbiology Profile*** | | |
| Positive Blood Culture | 3 (9.1%) | 2.4% - 22.8% |
| Positive Pleural Effusion Culture | 3 (17.6%) | 4.7% - 40.9% |
| Positive Endotracheal Aspirate Culture | 3 (100%) | 9.3% - 66.8% |
| **Therapeutic Procedures** | | |
| CTT | 13 (37.1%) | 22.5% - 53.9% |
| Thoracentesis | 8 (22.9%) | 11.2% - 38.8% |
| Intubation | 5 (14.3%) | 5.4% - 28.9% |
| Thoracotomy | 5 (14.3%) | 5.4% - 28.9% |
| Fibrinolysis | 1 (2.9%) | 0.1% - 13.3% |
| VATS | 1 (2.9%) | 0.1% - 13.3% |
| **Outcome** | | |
| Mortality | 5 (14.3%) | 5.4% - 28.9% |

* 33, 17, 3 cases with blood, pleural and endotracheal aspirate culture

Cultures done for complicated cases included blood, pleural fluid and sputum culture. Three percent of the cases with specimen for each culture had positive growths (Table 4). One case had oxacillin-resistant *Staphylococcus aureus* growth in his blood, pleural fluid and tracheal aspirate culture; other growths in blood cultures were *Staphylococcus aureus* (3%) and *Streptococcus pneumoniae* (3%). For pleural fluid, oxacillin-resistant *Staphylococcus aureus* (5.9%) and pseudomonas (5.9%) grew in culture. Positive endotracheal cultures grew oxacillin-resistant *Staphylococcus aureus*, (33.3%) and Pseudomonas species (66.7%).

The sensitivity pattern for each of the organism were as follows: Oxacillin-resistant Staphylococcus aureus were sensitive to vancomycin, clindamycin, azithromycin and linezolid; Staphylococcus aureus were sensitive to vancomycin, amikacin, ampicillin, cefuroxime, linezolid, clindamycin; Streptococcus pneumoniae was sensitive to ampicillin, penicillin; and Pseudomonas sp. was sensitive to amikacin, piperacillin-tazobactam, cefepime, imipenem.

The final intravenous antibiotics were clindamycin and macrolide, combined with either a penicillin-based antibiotic (Ampicillin-Sulbactam, extended spectrum penicillin (Oxacillin or Cloxacillin) or a second generation cephalosporin (Cefuroxime) or vancomycin, combined with amikacin and carbapenem. Less frequently used antibiotics were oxacillin or ceftriaxone alone. (Table 5)

Table 4. Culture results of complicated community-acquired pneumonia.

| | Blood (n=33) | Pleural Fluid (n=17) | Endotracheal aspirate (n=3) | Sputum (n=6) | Total |
|---|---|---|---|---|---|
| *Staphylococcus aureus,* | 1 (3%) | 1 (5.9%) | - | - | 2 |
| *Staphylococcus aureus, oxacillin resistant* | 1 (3%) | 1 (5.9%) | 1 (33.3%) | - | 3 |
| *Streptococcus pneumoniae* | 1 (3%) | - | - | - | 1 |
| *Pseudomonas spp.* | - | 1 (5.9%) | 2 (66.7%) | - | 3 |
| No Growth | 30 (90.9%) | 14 (82.3%) | - | 6 (100%) | 50 |
| Total | 33 | 17 | 3 | 6 | 59 |

Table 5. Final antibiotics used in complicated pneumonia cases (n=35).

| Antibiotic Used | Frequency (%) |
|---|---|
| Clindamycin with | |
| Ampi-Sulbactam | 3 (8.6) |
| Cefuroxime | 4 (11.4) |
| Extended spectrum penicillin | 5 (14.2) |
| Macrolide | |
| Cefuroxime | 3 (8.6) |
| Extended spectrum penicillin | 5 (14.3) |
| Vancomycin with Amikacin | 6 (17.1) |
| Carbapenem | 5 (14.2) |
| Oxacillin | 2 (5.7) |
| Ceftriaxone | 2 (5.7) |

The average duration of hospital stay for patients who underwent medical therapy alone was 11.2 days (SD±6.8 days vs. 20 days SD±6.8 days). Using the T-test, there was a significant difference in the length of hospital stay between complicated patients who underwent medical therapy alone and with surgical management (p=0.001).

There were five mortalities among the 35 cases of complicated pneumonia. (Table 6) Comparing the expired and recovered cases of complicated pneumonia, expired cases had more days with abdominal pain (0.6 ± 1.6 vs. 0.07 ± 0.3, p 0.03); there were significantly more expired patients who were intubated (p 0.01).

The average length of hospital stay before expiration was 9.8 ± 10.5 days for complicated cases. The average length of hospital stay among 30 complicated patients who did not expire before being discharged was 16.3 ± 7.9 days. Using T test, no significant difference in the length of hospital stay was found among complicated patients who expired and who survived (p = 0.12).

## DISCUSSION

Complicated pneumonia occurs mostly in healthy children below five years of age and is associated with considerable morbidity. In the study, incidence rate of complicated pneumonia was 2.19% which is comparable to those observed elsewhere (1-3% of pneumonia admissions).[2,8] In a study by Tan et al, patients with pneumonia complicated by a pleural effusion were more likely to be older, of white race, had chest pain and had a longer duration of fever upon presentation unlike patients with uncomplicated pneumonia.[6] In our study, patients with complicated pneumonia were observed to be febrile for longer durations, had significantly greater respiratory rates, had greater likelihood to have retractions, and had longer duration of abdominal pains prior to admission compared to cases of uncomplicated pneumonia.

Identification of the causative agents in children with pleural effusion and empyema is often difficult. Reported diagnostic yield from pleural and/or blood cultures has ranged from 60% to 70% with *Streptococcus pneumoniae* being the most common isolates followed by

Table 6. Bivariate analysis between expired and recovered cases of complicated pneumonia.

| Variables | Outcome of Complicated Pneumonia | | Bivariate Analysis |
|---|---|---|---|
| | Mortality (n=5) | Recovery (n=30) | p value |
| **Patient Characteristics** | | | |
| Age in Years | 4.4 ± 2.5 | 7.8 ± 4.9 | 0.14 |
| Gender – Male<br>Female | 2 (40.0%)<br>3 (60.0%) | 14 (46.7%)<br>16 (53.3%) | 1.00 |
| Co – Morbid Diseases | 2 (40.0%) | 13 (43.3%) | 1.00 |
| History of Antibiotic Intake | 1 (20.0%) | 14 (46.7%) | 0.36 |
| **Clinical Symptoms** | | | |
| Days with Fever | 5.2 ± 1.3 | 7.7 ± 7.3 | 0.69 |
| Days with Cough | 3.4 ± 3.3 | 8.9 ± 10.7 | 0.27 |
| Days with Dyspnea | 0.8 ± 0.8 | 1.2 ± 2.4 | 0.52 |
| Days with Chest Pain | 0.2 ± 0.4 | 0.2 ± 0.9 | 0.36 |
| Days with Vomiting | 0.4 ± 0.9 | 0.6 ± 1.6 | 0.97 |
| Days with Abdominal Pain | 0.6 ± 1.6 | 0.07 ± 0.3 | 0.03 |
| **Clinical Signs** | | | |
| Respiratory Rate in breaths/min | 42.8 ± 14.3 | 33.2 ± 11.6 | 0.14 |
| Retractions | 1 (20.0%) | 14 (46.7%) | 0.36 |
| Abnormal Breath Sounds | 2 (40.0%) | 25 (83.3%) | 0.07 |
| **Diagnostic Examinations** | | | |
| White Blood Cell Count in cells/mm$^3$ | 14,736.0 ± 12,695.9 | 15,660.7± 8,665.7 | 0.84 |
| Abnormal Chest X – Ray | 5 (100.0%) | 28 (93.3%) | 1.00 |
| Positive Blood Culture | 1 (20.0%) | 2 (7.1%) | 0.45 |
| Positive Pleural Effusion Culture | 1 (33.3%) | 2 (14.3%) | 0.53 |
| Positive Sputum Culture | 1 (100.0%) | 2 (25.0%) | 0.33 |
| **Therapeutic Management** | | | |
| Shift in Antibiotics – None<br>1x<br>2x<br>3x<br>4x | 4 (80.0%)<br>0 (0.0%)<br>0 (0.0%)<br>1 (20.0%)<br>0 (0.0%) | 15 (50.0%)<br>4 (13.3%)<br>4 (13.3%)<br>6 (20.0%)<br>1 (3.3%) | 0.70 |
| CTT | 3 (60.0%) | 10 (33.3%) | 0.31 |
| Fibrinolysis | 0 (0.0%) | 1 (3.3%) | 0.86 |
| Intubation | 3 (60.0%) | 2 (6.7%) | 0.01 |
| Thoracotomy | 1 (20.0%) | 4 (13.3%) | 0.70 |
| Thoracentesis | 1 (20.0%) | 7 (23.3%) | 0.93 |
| VAT | 0 (0.0%) | 1 (3.3%) | 0.86 |
| **Course in the Wards** | | | |
| Days for Fever Lysis | 5.2 ± 5.5 | 7.2 ± 5.5 | 0.42 |
| Days of Hospital Stay | 9.8 ± 10.5 | 16.3 ± 7.9 | 0.11 |

*Staphylococcus aureus* and group A streptococcus.[8-9] In this study, 15.1% (5 of the 33 cases with culture studies) had an established etiology by either pleural fluid or blood or tracheal aspirate cultures, which revealed a growth of either oxacillin-resistant *Staphylococcus aureus, Streptococcus pneumoniae* or Pseudomonas sp. A high proportion (84.7%) of all specimens grew no bacterial pathogen; this finding is consistent with a number of previous studies suggesting that the negative cultures are not the result of limitations in routine microbiology laboratory procedures. The negative cultures are more likely due to the widespread use of antibiotics (including inappropriately-chosen or -dosed antibiotics even before blood cultures and pleural taps are done), as well as, the potential for occasional severe viral lower respiratory tract infection to cause pleural effusion or bacterial superinfections that may result in necrotizing pneumonia and/or empyema.[10,11] In addition, the high rate of negative cultures may also be due to the presence of fastidious organisms such as anaerobic bacteria. Based on previous studies done in Asia, it was found that many hospital laboratories do not use anaerobic culture media, [4, 12] which was also the case in our setting.

The management of complicated pneumonia, specifically, empyema, in children remains controversial. The use of antibiotics alone is an effective therapy in patients with simple pneumonia and those with early effusion. Empiric therapy of empyema and pleural effusions associated with community-acquired pneumonia should cover Methicillin-resistant *staphylococcus aureus* (MRSA), and penicillin-resistant *Streptococcus pneumoniae*. Vancomycin is the gold standard therapy for treating serious infections caused by MRSA. Clindamycin is a valuable agent for treating less severe pneumonia/empyema caused by susceptible community-acquired MRSA isolates; but, the laboratory must screen for the inducible form of macrolide-lincosamide-streptogramin resistance.[13] For most penicillin-resistant *Streptococcus pn*eumoniae, a second generation cephalosporin (cefuroxime) or a third generation cephalosporin (cefotaxime or ceftriaxone) is more effective than either ampicillin or penicillin.[15] In this study, positive

cultures revealed MRSA to be susceptible to Vancomycin, Linezolid and Clindamycin; *Streptococcus pneumoniae* to be susceptible to penicillin; and *Pseudomonas spp* to be susceptible to carbapenems, quinolones, amikacin and third generation cephalosporins.

The optimal length of antimicrobial therapy for the treatment of uncomplicated or complicated pneumonia has not been well established for most pathogens. There is data to suggest that a seven- to 14-day course of therapy (or a five-day course of azithromycin) is adequate.[15] For pneumococcal pneumonia, treatment probably should continue until the patient has been afebrile for 72 hours, and the total duration of therapy should not likely be less than ten to 14 days (or 5 days if using azithromycin because of its long tissue half-life). Fever may persist for several days after initiation of appropriate therapy which reflects a resultant inflammatory cascade and tissue damage.

Drainage of the pleural space is often necessary in later stages of parapneumonic effusions and empyemas. Nonsurgical methods to drain the pleural space include thoracentesis and CTT, with or without the use of fibrinolytics. Historically, CTT has been the mainstay of therapy; however, other methods such as decortication and open thoracotomy are gaining favor. Surgical debridement or decortication in patients with empyema has been reserved for those with disease refractory to medical management. However, some authorities advocate early surgical intervention in the treatment of empyema, especially in patients with severe disease.[16-17] In our study, thirteen (37.1%) of the cases with pleural effusion underwent CTT and six (17%) of these cases had an additional surgical procedure either thoracotomy, video-assisted thorascopic surgery or fibrinolysis. All of the six patients with additional procedure either had atelectasis or loculated pleural effusion. These radiologic findings could be a basis for advocating early surgical intervention.

A recent meta-analysis, which included eight well-designed clinical studies, revealed a failure rate that was 11 times higher in patients who received medical treatment versus the primary surgical group.[8] Some studies seem to suggest that an early surgical approach by thoracoscopy could be beneficial, but there are no well-designed studies that compare both treatments in children to draw conclusions on the subject.[18-21] Another meta-analysis found that surgical treatment required a shorter hospital stay and a lower dose of antibiotic than antibiotic therapy alone, although the number of complications were similar between the cases treated with antibiotic alone and those with surgical intervention.[20]

Among our cases, the common initial antibiotics used were appropriate for *Streptococcus pneumoniae*; however, these often did not offer coverage for oxacillin-resistant *Staphylococcus aureus* or Pseudomonas sp which could explain the persistence of fever and the need for changes in antibiotics. The result of the cultures done revealed two patients with MRSA; beta-lactam drugs like penicillin, cephalosporin and carbapenems will not cover these organisms. Vancomycin, linezolid or less often Clindamycin is needed for MRSA. This is to be kept in mind when presented with a case of potential MRSA infection like pneumonia with effusion or empyema.

Patients who presented with significant amounts of pleural effusion underwent thoracentesis and/ or CTT drainage; patients with additional findings of empyema thoracis and atelectasis had additional surgical procedures done (either VATS, thoracotomy or fibrinolysis). Any conclusion about the efficacy of different interventions could not be done in this study since no subject underwent early drainage but it was observed that fever lysis was noted four days after undergoing a procedure for drainage of pleural fluid.

There are a number of limitations in this study. First, as this is a retrospective study, data was restricted to hospital database and log

books; this is not a population based thus may be a source of bias in terms of choice of antibiotics. Second, since patient selection was based from the list provided by the hospital's medical records section, diagnosis codes may be inaccurate and cases of complicated pneumonia may be underreported. An attempt to minimize this underreporting was made by checking with log books and/or census from the sections of pediatric pulmonology and pediatric ICU and floor census of the institution's department of pediatrics. Third, immunization status was not included in the profile because of lack of data in the history of the patients included in the study.

**CONCLUSIONS/RECOMMENDATIONS**

Children who developed complicated and uncomplicated community-acquired pneumonia had no significant difference in their demographic profile. Most of the patients affected were previously well children below five years old. There was no significant difference in the co-morbid conditions between the two groups.

Children with complicated pneumonia presented with a longer duration of fever prior to admission and had significantly higher respiratory rate and were more likely to have retractions. Both groups had similar histories of antibiotic intake with no significant differences in the class of antibiotics.

Work-up done on admission revealed a significantly elevated white blood cell count for complicated cases. Though both groups had abnormal findings in the chest x-ray, complicated pneumonias greater involved the right middle lobe.

Additional work-up done for complicated pneumonia cases included ultrasounds which revealed effusion, and chest CT scan which were able to detect empyema or atelectasis. Blood culture yield was low (9.09%); this can be attributed to frequent use of antibiotics among our patients. The growths in the cultures were Oxacillin-resistant *Staphylococcus aureus*, *Streptococcus pneumoniae* and Pseudomonas *spp*. In this study, Oxacillin-resistant Staphylococcus aureus were susceptible to Vancomycin, Linezolid and Clindamycin; *Streptococcus pneumoniae* to be susceptible to penicillin; and *Pseudomonas spp* to be susceptible to carbapenems, quinolones, amikacin and third generation cephalosporins.

Patients with minimal pleural effusion recovered with antibiotic therapy alone, while those who had significant pleural effusion had CTT or thoracentesis. Patients with empyema thoracis had surgical procedures done in addition to CTT. The antibiotics used for said patients included either clindamycin or macrolide with an extended spectrum penicillin or second generation cephalosporin taken for 14 days or more.

There was no mortality for the uncomplicated cases while complicated cases had 14.3% mortality rate. The length of hospital stay was significantly longer for complicated cases especially for subjects who underwent a procedure for evacuation of pleural effusion. Expired patients presented with significant and longer duration of abdominal pain were more likely to have been intubated and mechanically ventilated.

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