Characteristics of Community-Acquired Pneumonia in Hospitalized Lebanese Children and their Correlation

Abstract

**Aim:** To study the radiological findings of community-acquired pneumonia in correlation with clinical signs and symptoms, as well as laboratory findings in children and adolescents hospitalized.

**Material and methods:** We retrospectively reviewed the medical records of children who were hospitalized for community-acquired pneumonia. A descriptive study was followed by a correlation study of patients’ clinical signs and symptoms, physical examination, and laboratory studies, with the patients’ radiologic finding.

**Results:** We reviewed the medical records of 268 pediatric patients who met criteria. The most common symptoms were cough (94.4%) and fever (89.9%). Crackles (36.9%) heard and focal infiltrate (37.7%) were the most common findings on physical exam and radiologic imaging, respectively. Among the laboratory studies performed, only C-reactive protein was found to be elevated with prolonged duration of symptoms (p< 0.05). With the exception of abdominal pain (p=0.009), there were no significant differences relating patient symptoms with radiologic findings.

**Conclusion:** In this study, no clinical or laboratory finding could be sufficient for the diagnosis and therapeutic decision as found in previous studies. Newer laboratory tests and etiologic search methods should be made available, until then, a high clinical index of suspicion is useful in our developing country.

**Keywords:** Community-acquired pneumonia; Clinical findings; Laboratory results; Radiologic features

Introduction

One of the most prevalent and potentially lethal illnesses is community-acquired pneumonia (CAP). About half of affected children worldwide receive appropriate medical care [1,2]. Even though children in developing countries suffer the highest burden of the disease [3-5], children in developed countries continue to face high disease burden despite better nourishment and immunizations [6].

The era of infectious vaccination and antimicrobial therapy has led to a decline in the incidence of infections and mortality related to community-acquired pneumonia [7,8]. However, despite all efforts, it remains one of the leading causes of morbidity and mortality in children and accounts for a good proportion of hospitalizations [2,9]. The frequent use of antibiotics has led to increasing antibiotic resistance among bacterial infections. This underlines the importance of an accurate diagnosis and knowledge of the etiologic agent responsible for developing pneumonia.

Despite CAP’s widespread impact, childhood data on causative infectious organisms are few, mainly due to the difficulty of establishing the underline primary etiology [7]. There are no definitive findings in a patient’s medical history, physical examination, or chest radiograph that can categorically differentiate bacterial from viral or atypical pneumonia [9]. Therefore, we sought to analyze for a correlation between the clinical history, physical exam findings, and radiological features characteristics of community acquired pneumonia at a university hospital in Lebanon. Therefore, we sought to analyze for a correlation between our patients’ clinical signs and symptoms, physical examination, and laboratory studies, with the patients’ radiologic finding.

Material and Methods

Study design

This is a single-centered retrospective study involving children hospitalized for CAP at Saint Georges Hospital-University Medical Center, Beirut, Lebanon between January 2004 and December 2008. The study was approved by the hospital’s institutional review board. Patient selection was based on the discharge diagnoses divided according to the ICD-9 code: viral, pneumococcal, bronchopneumonia (organism unspecified), pneumonia (organism unspecified), acute bronchitis and viral illness. Excluded from the study were patients with the diagnoses of foreign body aspiration, drowning, chronic neurologic and respiratory illnesses, cardiac anomalies, and the patients hospitalized in the last 15 days before their admission. To note, patients treated for asthma, hyperreactive airways, or previous episodes of bronchitis were not excluded from this study.

Data collection and analysis

Data was obtained from the patients’ medical records and involved epidemiologic information, clinical information, pertinent physical exam findings, paraclinical information,
treatment, and complications were collected.

Data collection and descriptive analysis were performed on SPSS software (19th version). We used the statistical technique ANOVA to compare the mean white blood cell (WBC) count, absolute neutrophil count (ANC) and C-reactive protein (CRP) level with different radiographic studies. Mean values considered statistically different had a p-value <0.05.

Significant difference between groups was identified by a multiple comparison test (Bonferroni test). X2-square or fisher exact test were used to compare the symptoms and physical findings among patients with the following radiologic findings: focal consolidation, focal infiltrates, diffuse infiltrates or normal chest X-ray (CXR). In addition, the fisher’s exact test was used to correlate clinical signs and symptoms with blood culture results.

Results

Patient characteristics

We reviewed the medical records of 268 patients who met criteria. The study included 53.0% males and 47.0% females. The majority of patients were under 24 months (38.4%) and between 25 to 60 months (42.2%) of age. Only 19.4% of patients were over the age of 61 months. The 3 months throughout the year that accounted for highest number of admissions were the winter months of January (16.4%), February (13.0%) and December (11.9%). The period from the beginning of October till the end of March (autumn-winter months) accounted for 61.3%. About one-third (31.7%) of the patients were treated with antibiotics prior to their admission.

Medical history

After collecting and analyzing each patient’s medical history, we then categorized pertinent information into 4 categories: No pertinent past medical history (77.2%), hyperreactive airways (14.9%), frequent otitis media (OM) or recurrent upper respiratory tract infection (URTI) (7.8%), and premature birth (14.2%).

Symptoms

Figure 1 lists the symptoms of the 268 patients included in this report. The most common symptoms reported were cough (94.4%) and fever (89.9%). What was noted and not mentioned in this figure that the patients had good general condition in 47.4% (94.4%) and fever (89.9%). What was noted and not mentioned in this report. The most common symptoms reported were cough (14.2%).

Results

Etiologic agents

Etiology remained unknown in 93.7% of the cases. A bacterial
agent was found by blood culture, pleural fluid culture or pleural fluid PCR in 7 cases (2.6%), and RSV was found in 4 cases of which one had radiographic findings of focal consolidation and pleural effusion with clinical symptoms lasting more than 5 days with recent deterioration. Mycoplasma pneumonia was suspected in 4 cases.

**Complication and video-assisted thoracoscopic surgery (VATS)**

Pleural effusion was seen in 5.6% of the cases and empyemas in 8 cases (3%) where VATS or chest tube insertion were necessary. Lung abscess was not seen in any case.

**Correlation results**

**Correlation of clinical and laboratory findings with presence of consolidation:** All symptoms showed no significant difference related to the radiographic findings except for abdominal pain; 23% of patients with consolidation had abdominal pain and 48.5% of the patients who had abdominal pain had focal consolidation while only 6% of the patients who had abdominal pain had normal CXR. Xi square test showed significant p value (p=0.009).

Table 1 represents the prevalence of clinical findings in relation to different radiographic features. Table 2 shows the physical findings with the radiologic features.

**Table 1:** Radiologic findings in relation with patient(s) symptoms.

| Radiologic Findings | Normal CXR N=52 | Focal Consolidation N=69 | Focal Infiltrates N=101 | Diffuse Infiltrates N=45 | \( \chi^2 \) | P value |
|---------------------|-----------------|--------------------------|------------------------|-------------------------|----------|--------|
| Cough               |                 |                          |                        |                         | 0.327*   |        |
| Rhinorrhea          | 37 (71.2%)      | 39 (58.2%)               | 57 (56.4%)             | 23 (51.1%)              | 0.202    |        |
| Diarrhea            | 8 (15.4%)       | 14 (20.3%)               | 19 (18.8%)             | 13 (28.9%)              | 0.396    |        |
| Vomiting            | 25 (48.1%)      | 23 (33.3%)               | 39 (38.6%)             | 16 (35.6%)              | 0.399    |        |
| Conjunctivitis      | 2 (3.8%)        | 0 (0%)                   | 3 (3.0%)               | 1 (2.2%)                | 0.488*   |        |
| Abdominal pain      | 2 (3.8%)        | 16 (23.2%)               | 11 (10.9%)             | 2 (8.9%)                | 0.009*   |        |
| Decreased oral intake | 39 (75.0%)    | 48 (69.6%)               | 77 (76.2%)             | 35 (77.8%)              | 0.727    |        |
| Non pruritic rash  | 2 (3.8%)        | 0 (0%)                   | 5 (5.0%)               | 0 (0%)                  | 0.137*   |        |
| Stomatitis          | 1 (1.9%)        | 1 (1.4%)                 | 3 (3.0%)               | 1 (2.2%)                | 0.926*   |        |
| Irritability        | 7 (13.5%)       | 5 (7.2%)                 | 15 (14.9%)             | 9 (20.0%)               | 0.251    |        |

*The test of independence (chi-square) has a p value statistically significant.
*a Fisher exact test

**Table 2:** Radiologic findings in relation to physical exam findings.

| Radiologic Findings | Normal CXR N=52 | Focal Consolidation N=69 | Focal Infiltrates N=101 | Diffuse Infiltrates N=45 | \( \chi^2 \) | P value |
|---------------------|-----------------|--------------------------|------------------------|-------------------------|----------|--------|
| Cracks              |                 |                          |                        |                         | 0.536    |        |
| No cracks           | 33 (63.4%)      | 39 (56.5%)               | 65 (64.3%)             | 31 (68.8%)              |          |        |
| Presence of crackles| 19 (36.5%)      | 30 (43.5%)               | 36 (35.6%)             | 14 (45.1%)              |          |        |
| Decreased air entry| yes             | 11 (21.2%)               | 31 (44.9%)             | 23 (22.8%)              | 0.008*   |        |
| No                  | 41 (78.8%)      | 38 (55.1%)               | 78 (77.2%)             | 32 (71.1%)              |          |        |
| Wheezing            | yes             | 41 (78.8%)               | 66 (95.6%)             | 81 (80.2)               | 38 (84.4%)|        |
| No                  | 11 (21.2%)      | 3 (4.4%)                 | 20 (19.8%)             | 7 (15.6%)               | 0.026*   |        |

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We also looked at the WBC count, ANC and CRP in relation to the radiographic features. Table 3 shows these results. When the p value of the analysis of variance (ANOVA) is less than 0.05, two or more groups have statistically different means. Therefore, a multiple comparison test was performed using the Bonferroni method (Table 4).

**Table 3: Laboratory results in correlation with radiological findings.**

|                | N  | Mean  | Std. Deviation | ANOVA p value |
|----------------|----|-------|----------------|---------------|
| **White Blood Cells** |    |       |                |               |
| Normal CXR     | 52 | 14326 | 6695           | 0.002*        |
| Focal consolidation | 68 | 18720 | 9172           |               |
| Focal infiltrates | 101 | 14200 | 7663           |               |
| Diffuse infiltrates | 45 | 16280 | 7416           |               |
| Total           | 266 | 15732 | 8050           |               |
| **Neutrophil Count** |    |       |                | 0.0001*       |
| Normal CXR     | 52 | 9357  | 6527           |               |
| Focal consolidation | 69 | 14252 | 9129           |               |
| Focal infiltrates | 101 | 14252 | 7458           |               |
| Diffuse infiltrates | 45 | 10564 | 6984           |               |
| Total           | 267 | 10786 | 7929           |               |
| **CRP mg/dl**   |    |       |                | 0.0001*       |
| Normal CXR     | 44 | 6.37  | 10.55          |               |
| Focal consolidation | 56 | 18.27 | 14.87          |               |
| Focal infiltrates | 83  | 6.71  | 8.50           |               |
| Diffuse infiltrates | 34 | 12.99 | 14.41          |               |
| Total           | 217 | 10.61 | 12.78          |               |

*Means differences are statistically significant.

**Correlation of clinical and laboratory findings with positive blood cultures:** Table 5 illustrates the clinical symptoms in correlation with blood cultures. Results show no correlation of clinical signs and symptoms with the known positive bacterial etiology. Table 6 studies the clinical exam findings of crackles and decreased air entry with the streptococcal infection.

**Table 4: Bonferroni multiple comparison test.**

|                 | Neutrophil count | CRP mg/dl |
|-----------------|------------------|-----------|
| White Blood Cells | Normal CXR v/s Focal Consolidation p value =0.016 | Normal CXR v/s Focal Consolidation p value =0.004 | Normal CXR v/s Focal Consolidation p value =0.0001 |
| Focal infiltrates v/s Focal Consolidation p value=0.002 | Focal infiltrates v/s Focal Consolidation p value=0.0001 | Focal infiltrates v/s Focal Consolidation p value=0.0001 |
|                 | Focal infiltrates v/s Diffuse infiltrates p value=0.05 |               |               |

All other comparisons were not statistically significant.
Table 5: Clinical symptoms in correlation with a positive blood cultures S. pneumoniae.

| S. pneumoniae detected | No N=261 | Yes N=7 | p value |
|------------------------|----------|---------|---------|
| Abdominal pain         | 31 (11.9%) | 2 (28.6%) | >0.05 b |
| Decreased oral intake  | 192 (73.9%) | 6 (85.7%) | >0.05 b |
| Non pruritic rash      | 7 (2.7%) | 0 (0%) | >0.05 b |
| Diarrhea               | 54 (20.7%) | 0 (0%) | >0.05 b |
| Vomiting               | 101 (38.7%) | 2 (28.6%) | >0.05 b |
| Fever                  | 235 (90.0%) | 7 (100.0%) | >0.05 b |
| Cough                  | 247 (94.6%) | 6 (85.7%) | >0.05 b |
| Rhinorrhea             | 152 (58.7%) | 5 (71.4%) | >0.05 b |
| Irritability           | 36 (13.8%) | 0 (0%) | >0.05 b |

White Blood Cells

| Mean (standard deviation) | No | Yes |
|---------------------------|----|-----|
| Neutrophil count          | 10729 (7896) | 13078 (8899) | >0.05 b |

CRP mg/dl

| Mean (standard deviation) | No | Yes |
|---------------------------|----|-----|
| Mean                     | 10 (12) | 31 (17) | <0.05* |

Table 6: Difference between steacoustic findings in S. pneumoniae.

| No crackles | Crackles on the right side | Crackles on the left side | Crackles bilaterally | p value |
|-------------|-----------------------------|---------------------------|----------------------|---------|
| 164 (62.8%) | 35 (13.4%)                  | 33 (12.6%)                | 29 (11.1%)           | c       |

| No crackles | Yes | Bilateral | GBAE | Left | Right | p value |
|-------------|-----|-----------|-----|------|-------|---------|
| 164 (62.8%) | 97  | 21 (8%)   | 186 (71.3%) | 30 (11.5%) | 24 (9.2%) | >0.05 b |

| No crackles | Yes | Decreased air entry | p value |
|-------------|-----|---------------------|---------|
| 166 (62%)   | 58  | Bilateral           | >0.05 b |
| 21 (8%)     | 0   | GBAE                |         |
| 186 (71.3%) | 4   | Left                |         |
| 30 (11.5%)  | 1   | Right               |         |
| 24 (9.2%)   | 2   |                      |         |
| 186 (71.3%) | 4   |                      |         |
| 75 (28.6%)  | 3   |                      |         |

*Mean difference is statistically significant.
a Independent samples t test.
b Fisher exact test.
c No parametric statistical test is feasible because the conditions are not present.

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Discussion

The clinical signs and symptoms of this study were not related to the radiologic diagnosis of pneumonia. Abdominal pain was the only clinical sign that showed significant difference with the presence of lung consolidation. This result was seen in a study done by Bilki et al. (p=0.009) [10], where cough and chest pain were also correlated with pneumonia, however, patients younger than 1 year of age or who were treated with “more than one bronchodilator treatment in the emergency unit” were excluded from the study. This can explain the variation in the results, as children younger than 12 months of age are more prone to having a viral respiratory infection specifically bronchiolitis than a pneumonia [11]. Vinkki et al. showed that nasal congestion was significantly more prevalent among RSV positive patients; our study didn’t find such results, the difference in the study designs might be the cause [12].

Among the physical exam findings, tachypnea, the most sensitive sign in several studies [13, 14] was not predominant in our study (25%). This is most likely due to the lack of objective measurement and documentation. In addition, it was not adjusted to temperature and irritability. The symptom of tachypnea was more commonly seen in patients with wheezing. In contrary to Shah et al. [15], who found tachypnea useful in distinguishing children with and without pneumonia only in patients without wheezing? Our study did not show the same results as it wasn’t helpful in distinguishing pneumonia even in patients without wheezing. This is likely due to the differences in study design.

Decreased air entry was shown to be helpful clinical exam finding in detecting the presence of pneumonia, while crackles were not. Most of the literature has shown that both were significantly associated with pneumonia. A prospective cohort study demonstrated that patients with radiographic pneumonia were more likely than patients with normal chest radiographs to have among other clinical features crackles (p=0.001) and decreased breath sounds (p=0.034) [11]. Recall bias may be responsible for that divergence since crackles were considered absent if not mentioned to be present.

Three laboratory findings were most frequently studied in correlation to radiographic pneumonia. WBC and ANC showed no definite difference when comparison between known and unknown etiology, based on blood culture, pleural culture and pleural PCR, was done. These results resemble those of previous studies showing that WBC and ANC are poor predictors of pneumonia’s etiology [2,6,16]. A study done by Korppi et al. showed no association between WBC and ANC with the radiographic alveolar versus interstitial infiltrates but it showed only significant difference in the evaluation of ANC and not WBC between bacterial pneumonia and viral pneumonia as well as mixed infections [17].

CRP was significantly more prevalent in the consolidation group than all the three other radiological categories and it was shown to be more elevated in cases with positive blood culture, pleural culture or PCR with a significant p value. The Korppi et al. prospective study showed the similar results where CRP was significantly higher in alveolar infiltrates versus interstitial infiltrates but was not variable among the different etiological categories. The sensitivity was too low (26%) when CRP>60 mg/l in spite of a relatively acceptable specificity [15]. On the contrary, a more recent meta-analysis concluded that serum CRP concentrations exceeding 40–60 mg/L weakly predict bacterial pneumonia in children with a positive predictive value of 64% [2].

Furthermore, Cohen et al. recently published a study that evaluated the laboratory tests and their predictive value of rapid response to beta lactam antibiotics that they considered to be significant of bacterial etiology. They only found a significant correlation between procalcitonin and rapid response to beta lactam ant biotherapy. Among the limitations of that study is that the antibiotic therapy was given empirically so the bacterial etiology wasn’t objectively confirmed [18].

Conclusion

Community acquired pneumonia is a very common diagnosis in children that, even though studied thoroughly, still presents major diagnostic, etiologic and therapeutic deficiencies. In this study, no clinical or laboratory findings could be sufficient for the diagnosis and therapeutic decision. In fact, decreased air entry reached a prevalence of 44.9% and elevated CRP could suggest a bacterial process, in contrast a low CRP couldn’t rule it out. Our study has several limitations; it’s a retrospective study, involving only hospitalized patients so it can’t be extrapolated to every pneumonia case in the Lebanese population. There is still a considerable deficit in the etiologic diagnosis of community acquired pneumonia. Till now, there is no criterion standard for the diagnosis of pneumonia in children. [19,20] The chest radiograph remains the diagnostic test of choice in tertiary care centers [11,21]. Several studies tried to generate a clinical prediction algorithm for bacterial pneumonia [11,19] but no one succeeded [5].

More than 50% of cases remain without an etiologic diagnosis resulting in the unnecessary or inappropriate prescription of antibiotics [22] and thus making the threat of antibiotic resistance closer.

A high clinical index of suspicion, following the WHO recommendation can be useful in our developing country until new laboratory tests viral and bacterial PCR, and specific bacterial serologies could be made more available.

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