

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

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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 bronchiolitis 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). Xi-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 24months (38.4%) and between 25 to 60months (42.2%) of age. Only 19.4% of patients were over the age of 61months. The 3months 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% of the cases, 4.9% were just ill looking, 3.7% were irritable, 6.7% were lethargic, 13.8% had variable degrees of dehydration, and respiratory distress was present in 20.1%.

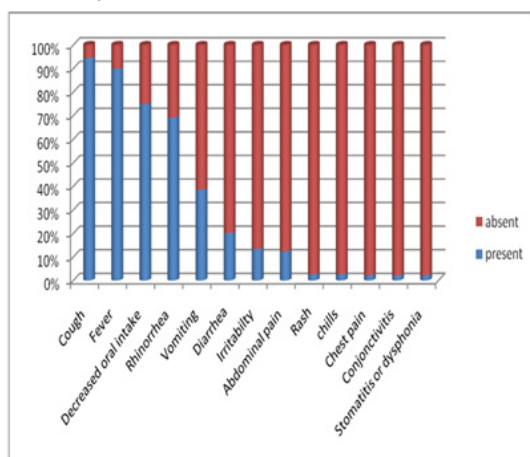


Figure 1 Recorded symptoms of community acquired pneumonia.

Physical exam findings

The most common clinical respiratory examination findings on admission were crackles (36.9%), decreased air entry (29.1%), and rhonchi (9.7%). The resident who first evaluated each patient mentioned tachypnea and concomitant OM in 25% and 9.7% of the cases respectively. The only significant variables related to age were the presence of decreased air entry that was noticed to be more

prevalent among children older than 2years of age (p=0.025) and the rhonchi that were noted among children under 5years of age (p=0.003).

Radiology results

Chest X-rays were performed during the first 24hours of hospitalization. Figure 2 shows the results classified into 4 categories: Presence of a focal consolidation (37.7%), focal infiltrates (25.7%), diffuse infiltrates (17.2%), and absence of these findings (19.4%). Of note, pleural effusion was found in 5.6% of the cases. Sex, age and the presence of fever were not statistically significant with respect to the presence of radiologic findings in this study.

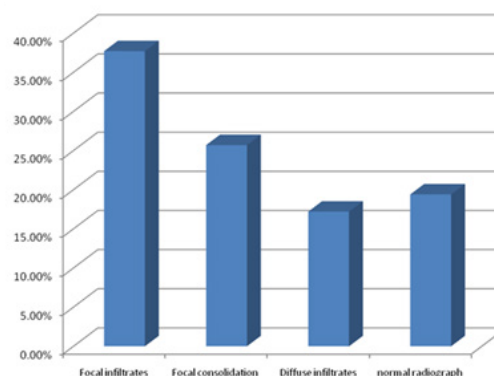


Figure 2 Radiologic findings of patients hospitalized for pneumonia.

Laboratory results

A CBC was performed on 267 patients. The mean WBC count was 15784/mm3. CBC differential was available for 266 patients and showed a mean ANC of 10886/mm3. CRP was measured on 215 patients (80.2%); it had a mean of 10.7 mg/dl.CRP increased with increasing duration of symptoms (p< 0.05). Blood cultures were performed in 173patients, and was positive in 9 cases; one case of Group A β hemolytic Streptococcus, 4 cases of Streptococcus pneumonia and 4 cases of Staphylococcus epidermidis considered as contamination.

Pleural fluid was cultured in 6 cases, and was positive in one case that grew staphylococcus aureus. Cold agglutinin was tested in 5.2% of cases on admission, and no repeated serologies were included in the patients’ medical records. Two patients tested positive. Mycoplasma IgM antibodies were searched for by enzyme-linked immunosorbent assay (ELISA) in 7.0% of the cases and only two cases were positive that were different from the cases with positive cold agglutinin test. Four cases tested positive for respiratory syncytial virus (RSV) by polymerase chain reaction (PCR) from nasal aspiration.

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 with 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.

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).

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 1 Radiologic findings in relation with patient(s) symptoms

	Radiologic Findings				χ^2 P value
	Normal CXR N=52	Focal Consolidation N=69	Focal Infiltrates N=101	Diffuse Infiltrates N=45	
Cough	50 -96.20%	67 -97.10%	92 -91.10%	43 -95.60%	0.327 a
Rhinorrhea	37 -71.20%	39 -58.20%	57 -56.40%	23 -51.10%	0.202
Diarrhea	8 -15.40%	14 -20.30%	19 -18.80%	13 -28.90%	0.396
Vomiting	25 -48.10%	23 -33.30%	39 -38.60%	16 -35.60%	0.399
Conjunctivitis	2 -3.80%	0 0.00%	3 -3.00%	1 -2.20%	0.488 a
Abdominal pain	2 -3.80%	16 -23.20%	11 -10.90%	4 -8.90%	0.009*
Decreased oral intake	39 -75.00%	48 -69.60%	77 -76.20%	35 -77.80%	0.727
Non pruritic rash	2 -3.80%	0 0.00%	5 -5.00%	0 0.00%	0.137 a
Stomatitis	1 -1.90%	1 -1.40%	3 -3.00%	1 -2.20%	0.926a
Irritability	7 -13.50%	5 -7.20%	15 -14.90%	9 -20.00%	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				χ^2 P value
		Normal CXR N=52	Focal Consolidation N=69	Focal Infiltrates N=101	Diffuse Infiltrates N=45	
Crackles	No crackles	33 -63.40%	39 -56.50%	65 -64.30%	31 -68.80%	0.536
	Presence of crackles	19 -36.50%	30 -43.50%	36 -35.60%	14 -45.10%	
Decreased air entry	yes	11 -21.20%	31 -44.90%	23 -22.80%	13 -28.90%	0.008*
	No	41 -78.80%	38 -55.10%	78 -77.20%	32 -71.10%	
Wheezing	Yes	41 -78.80%	66 -95.60%	81 -80.2	38 -84.40%	0.026*
	No	11 -21.20%	3 -4.40%	20 -19.80%	7 -15.60%	
Rhonchi	Yes	44 -84.60%	65 -94.20%	91 -90.10%	41 -91.10%	0.365
	No	8 -15.40%	4 -5.80%	10 -9.90%	4 -8.90%	

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

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	normal CXR	52	9387	6527	0.0001*
	Focal consolidation	69	14252	9129	
	Focal infiltrates	101	9239	7458	
	Diffuse infiltrates	45	10564	6984	
	Total	267	10786	7929	
CRP mg/dl	normal CXR	44	6.37	10.55	0.0001*
	Focal consolidation	56	18.27	14.87	
	Focal infiltrates	83	6.71	8.5	
	Diffuse infiltrates	34	12.99	14.41	
	Total	217	10.61	12.78	

*Means differences are statistically significant.

Table 4 Bonferroni multiple comparison test

White Blood Cells	Neutrophil count	CRP mg/dl
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.pneumoniaedetected		p value
	No N=261	Yes N=7	
Abdominal pain	31	2	>0.05 b
	-11.90%	-28.60%	
Decreased oral intake	193	6	>0.05 b
	-73.90%	-85.70%	
Non pruritic rash	7	0	>0.05 b
	-2.70%	0.00%	
Diarrhea	54	0	>0.05 b
	-20.70%	0.00%	
Vomiting	101	2	>0.05 b
	-38.70%	-28.60%	
Fever d	235	7	>0.05 b
	-90.00%	-100.00%	
Cough	247	6	>0.05 b
	-94.60%	-85.70%	
Rhinorrhea	152	5	>0.05 b
	-58.70%	-71.40%	
irritability	36	0	>0.05 b
	-13.80%	0.00%	
White Blood Cells	15694	16886	>0.05 a
Mean (standard deviation)	-8050	-8011	
Neutrophil count	10729	13078	>0.05 a
Mean (standard deviation)	-7896	-8899	
CRP mg/dl	10	31	<0.05* a
Mean (standard deviation)	-12	-17	

a independent samples t test.

b Fisher exact test.

*Mean difference is statistically significant.

Table 6 Difference between steacoustic findings in *S. pneumonia*

Crackles	No crackles	164	5	c
		-62.80%	-71.40%	
	Crackles on the right side	35	1	
		-13.40%	-14.30%	
	Crackles on the left side	33	0	
		-12.60%	0.00%	
	Crackles bilaterally	29	1	
		-11.10%	-14.30%	
Crackles	No	164	5	>0.05 b
	Yes	97	2	
Decreased air entry	Bilateral	21	0	c
		-8%	0.00%	
	GBAE	186	4	
		-71.30%	-57.10%	
	Left	30	1	
		-11.50%	-14.30%	
	Right	24	2	
		-9.20%	-28.60%	
	No	186	4	>0.05 b
	Yes	75	3	

b Fisher exact test.
c no parametric statistical test is feasible because the conditions are not present.
*Mean difference is statistically significant.

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 Bilkis 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 Virkki 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 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 antibiotic therapy. 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 antibiotics²² 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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Conflicts of interest

Author declares there are no conflicts of interest.

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