Detection of Occult Pneumonia in a Pediatric Emergency Department

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Background: Many children undergo chest radiography (CXR) in their evaluation of a febrile illness. Pneumonia without signs of respiratory distress or ausculatory findings has been previously described (termed *occult pneumonia* [OP]).

Objective: The objectives of this study were to determine the incidence of OP among children who have CXR performed and to identify clinical predictors of OP.

Methods: A prospective observational study of children undergoing CXR for possible pneumonia was conducted. Standardized data forms were completed before the CXR. Univariate analysis and recursive partitioning were used to identify predictors of OP.

Results: Of 1866 patients enrolled, 308 had no evidence of respiratory distress or lower respiratory tract findings and were studied for OP. Twenty-one patients had radiographic OP (6.8%; 95% confidence interval [CI], 4.0%–10.6%). Age, height of fever, duration or quality of cough, and pulse oximetry were not associated with OP. A decision rule based on fever for 1 day or longer or with a combination of fever for less than 1 day but worsening cough identifies patients at greater risk for OP (likelihood ratio, 1.47; 95% CI, 1.21–1.77). No patient with fever for less than 1 day and without any cough or without worsening cough had pneumonia (likelihood ratio, 0.40; 95% CI, 0.19–0.84).

Conclusions: Occult pneumonia was identified in 1 of 15 patients undergoing CXR without respiratory distress or ausculatory findings. Obtaining a CXR for the detection of OP in children without cough and with fever for less than 1 day in duration should be discouraged.

Key Words: pneumonia, *Streptococcus pneumoniae*, fever, chest radiograph, chest radiography, radiology, diagnostic testing

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The diagnosis of pneumonia in the pediatric population can be a challenge for clinicians. Clinical suspicion of pneumonia supported by radiographic findings has been the standard for the diagnosis of pneumonia. Several studies have attempted to identify clinical factors that predict which children with lower respiratory tract findings on physical examination will have radiographic pneumonia.[1–3] For patients who exhibit signs of respiratory distress or who have lower respiratory tract signs, the decision to obtain a radiograph is straightforward. However, many children have a radiograph obtained as part of their evaluation of a febrile illness; many of these patients have fever and cough but no specific findings of pneumonia by examination. Previous studies have investigated "occult" pneumonia, defined as radiographic pneumonia in children without signs of respiratory distress or lower respiratory tract findings. In the pre-heptavalent pneumococcal vaccine (PCV) era, the incidence of occult pneumonia was 25% (95% confidence interval [CI], 19%–34%) among highly febrile children with leukocytosis and no lower respiratory tract findings.[4] A recent retrospective study in the post–heptavalent PCV era estimated the incidence of occult pneumonia to be 5% (95% CI, 4.0%–6.8%) among febrile children who do not have examination findings of pneumonia.[5] In early 2009, Rutman et al[6] performed a retrospective analysis comparing the incidence of occult pneumonia in the pre– and post–heptavalent PCV eras. Children younger than 5 years with fever and leukocytosis were studied. The incidence of occult pneumonia was 9% after PCV compared with 15% before PCV, suggesting that occult pneumonia is still a viable entity in the post-PCV era.

For the pediatric clinician, the role of chest radiography (CXR) in common clinical scenarios remains uncertain. Is there any role for CXR in a child with high fever and cough? What if the patient is an infant? What if the fever persists for many days? What about the child with a worsening productive cough and persistent fever? For each of these questions, consider all the following variables in the decision to obtain a radiograph: overall appearance, findings on examination, pulse oximetry, and the quality of the examination. Herein, primarily, we will investigate the incidence of occult pneumonia among children undergoing CXR, and secondarily, we will identify clinical predictors of occult pneumonia in an effort to reduce radiography in low-risk children.

METHODS

Study Design

This was a prospective observational study conducted in an urban pediatric emergency department (ED) with approximately 56,000 visits annually.

Aims

The aims were to (1) determine the incidence of occult pneumonia among children undergoing CXR in a pediatric ED and (2) identify clinical predictors of occult pneumonia.

Participants and Enrollment

Patients 21 years or younger who underwent CXR for suspicion of pneumonia were enrolled in the study; those who have a CXR obtained for indications other than suspicion of pneumonia (eg, evaluation for cardiac disease, trauma, pneumothorax, foreign body aspiration) were excluded from this study. Patients were also excluded from the study if there was a previous medical history placing them at greater risk for pneumonia (sickle cell disease, cardiac disease, immunodeficiency, cystic fibrosis, chronic lung disease other than asthma, and severe neurologic disorder). The study was conducted during a 12-month period beginning November 2006.

Outcomes and Definitions

Occult pneumonia was defined as the presence of radiographic pneumonia in children who do not show signs of

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respiratory distress or lower respiratory tract findings on physical examination. Lower respiratory tract findings are defined as the presence of tachypnea or any adventitial breath sounds including wheeze, focal decreased breath sounds, rhonchi, rales, and/or crackles. Determination of pneumonia was based on the final reading (electronic medical record) by an attending pediatric radiologist. Definite pneumonia was defined by of the presence of any of the following radiographic descriptors: "consolidation," "infiltrate," or "pneumonia." A radiograph was classified as negative if read as "normal chest," "normal radiograph," "clear lungs," "no acute pulmonary findings," "atelectasis," or "peribronchial cuffing." A radiograph was considered equivocal for pneumonia if the summary report included ambivalent terminology such as "atelectasis versus infiltrate," "atelectasis versus pneumonia," or "likely atelectasis but cannot exclude (or rule out) pneumonia."

Study Protocol and Data Collection

Data collection consisted of a questionnaire completed before visualizing the radiograph or viewing the radiologist's report. Questionnaires were completed by the treating attending physician; in the case of trainees, forms were reviewed by the supervising attending physician. Completed questionnaires were placed into a locked drop box. The questionnaire included elements of the history and physical examination that led the physician to suspect pneumonia and asked the indication(s) for obtaining the radiograph: among the choices were height of fever, duration of fever, duration of cough, severity of cough, chest pain, elevated white blood cell (WBC) count, primary care physician request, and history of previous pneumonia. The questionnaire was designed in a check-box format, asking questions with predetermined answers, and no narrative or free text fields. Specific questions included the duration of fever, cough, difficulty breathing, chest pain, or abdominal pain. Duration for each item was selected on a fixed ordinal scale with choices of none, less than 24 hours, 1 to 3 days, 4 to 6 days, and 7 days or longer. General appearance and degree of respiratory distress were judged by the treating attending physician on a 5-point scale. The scale for general appearance was anchored by "well appearing" (value 1) and "toxic appearing" (value 5). The scale for respiratory distress was anchored by "no signs of distress" (value 1) to "severe respiratory distress" (value 5). Questions regarding physical examination included presence of tachypnea as assessed by the clinician and presence of any adventitial breath sounds (specifically wheeze, focal decreased breath sounds, rhonchi, rales, and crackles). Clinicians recorded the quality of the examination (quiet and cooperative, uncooperative, or crying), quality of cough during examination (productive or nonproductive), and trajectory of the cough in the past 24 hours (same, better, or worse). Electronic medical records were reviewed for a measured temperature at home, history of rhinorrhea or congestion, vital signs during the ED visit including maximum and triage temperature, triage respiratory rate, triage and minimum transcutaneous oxygen saturation, WBC count if collected, discharge diagnosis from the ED, and final CXR reading.

To estimate the enrollment rate, an automated electronic list was generated for any CXR ordered from the ED. We reviewed the ED record for all patients who had a CXR during the first 3 days of every month. Patients who presented with any respiratory complaints or signs were considered eligible; those who met the previously defined exclusion criteria were not considered eligible for estimating enrollment. The capture rate was calculated as the number of eligible patients who had a study questionnaire completed divided by the total number of eligible patients during the audit period.

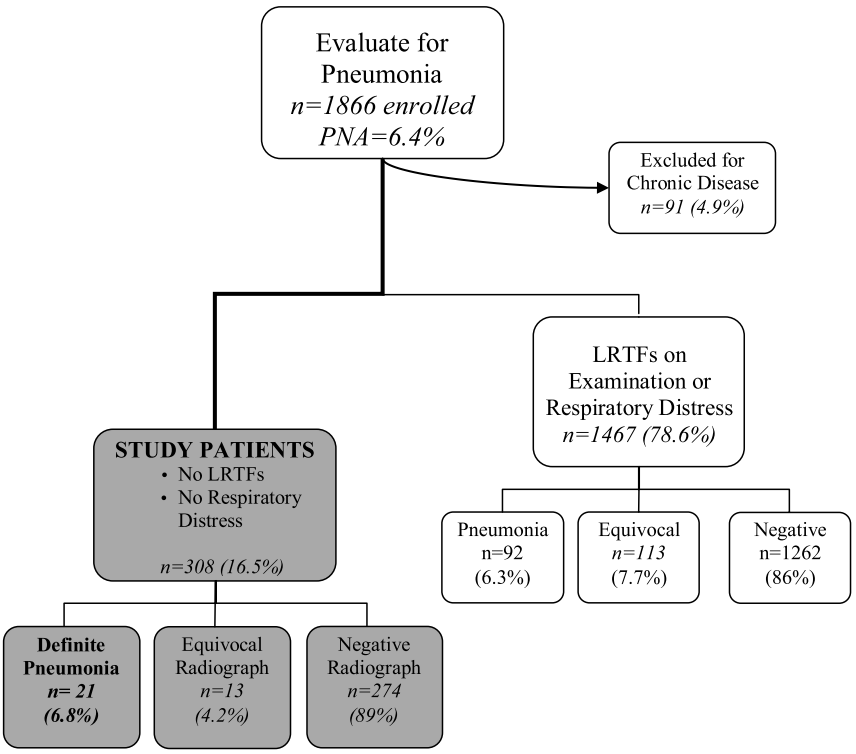

FIGURE 1. Schematic of study patients among patients who were enrolled. LRTFs indicates lower respiratory tract findings; PNA, pneumonia.

Data Analysis

All data were entered into a secure electronic database with data validation rules. Data analysis was performed with the Statistical Package for Social Sciences (SPSS Version 14; SPSS, Inc, Chicago, Ill). First, the univariate analysis of all history and physical examination elements was performed to identify possible predictors of occult pneumonia. The χ^2 analysis was performed for categorical variables, and the independent Student *t* test was used to compare means of continuous variables. For nonparametric data, the Mann-Whitney *U* test was performed. Statistical significance was considered at $P \leq 0.05$ without any correction for multiple analyses.

Chest radiographs with equivocal readings (previously defined) were analyzed in 2 different manners: (1) cases with equivocal radiographs were excluded from analysis and (2) cases with equivocal radiographs were treated as pneumonia. To provide a clinical context for the interpretation of the equivocal radiograph reading, the final ED diagnosis (as recorded in the medical record) was compared with the radiologist's final readings.

Multivariate Analysis

The tree-structured analysis by CART Version 6.0 (Salford Systems, San Diego, Calif) was used to develop the predictive model. The method of CART is binary recursive partitioning. To begin the process, a single outcome variable and all potential predictor variables are assigned. Splitting rules are developed in a stepwise fashion by analyzing each potential predictor and all possible cut points. Splits are made to minimize false-negative or false-positive assignments for the outcome variable at each step. Partitioning is repeated until either of the subgroups contains a homogeneous group or the subgroups are too small for further subdivision. A parameter representing the significance of misclassifications can be modified such that the model maximizes sensitivity or specificity.

For our model, pneumonia (definite or equivocal) versus no pneumonia was the dichotomous outcome variable, and all variables with $P < 0.5$ on univariate analysis were entered as candidate predictors. To maximize identification of pneumonia, we considered the misclassification of a patient with pneumonia into a low-risk (for pneumonia) node was twice as "costly" as misclassifying a patient without pneumonia into a high-risk node. CART determined the order and use of the variables as well as any cut points for any continuous variables. Finally, the model was tested by V-fold cross validation: the data set is divided into 10 equal parts with similar distribution of dependent variable, and then the model is derived with 9 parts (the learning set) and tested with 1 part (the validation set). This cross validation is repeated 10 times, and the results are combined to develop the predictive accuracy and error rates for the tree.

The study was approved by the institutional review board, including waiver of consent. Data collection was compliant with the Health Insurance Portability and Accountability Act of 1996.

RESULTS

Study Population and Enrollment

During the study period, 1866 children had questionnaires filled. On the basis of our audit (details provided previously), we estimate this number to represent 46% of all patients seen at our site who had qualifying respiratory symptoms and physician-ordered CXRs (Fig. 1). Of the 1866 children, 91 were subsequently excluded because of disqualifying medical conditions. Of the remaining 1775 patients, 1467 were considered to have had a CXR ordered for obvious signs of respiratory distress and/or of lower respiratory tract disease. Among this group, the fraction with definite pneumonia (CXR findings of pneumonia without equivocation) was 6.3% (95% CI, 5.1%–7.6%).

The remaining 308 (16.5%) were designated children for whom a CXR was ordered to exclude occult pneumonia and defined by the absence of respiratory distress, clinical signs of lower respiratory tract, and of disqualifying conditions; these patients constitute the study group. Among these children, the frequency of definite pneumonia was 6.8% (95% CI, 4.0%–10.6%).

Indications for CXR for the 308 study patients as recorded by physicians were as follows: duration of cough (38.3%), height of fever (30.8%), duration of fever (27.9%), severity of cough (14.9%), elevated WBC count (11.4%), history of previous pneumonia (7.5%), chest pain (6.2%), and primary care physician request (4.2%).

Assessment of Enrollment

For children with no disqualifying medical conditions who had a CXR performed to diagnose clinically suspected or clinically occult pneumonia, and for whom a questionnaire was completed (n = 1775), pneumonias were reported on chest radiographs in 6.4% (95% CI, 5.4%–7.6%). The frequency of pneumonias in previously healthy children for whom a questionnaire was not completed but for whom a CXR was obtained

TABLE 1. Clinical Characteristics of Study Population (n = 308)

Characteristics	
Enrolled during winter months, n (%)	200 (65)
Age, mean (SD), yr	5.2 (6.1)
Sex (% male)	46.6
History	
Presence of fever, %	72.1
Median duration of fever,* d	1–3
Median duration of cough,* d	4–6
Presence of cough, %	80.2
Productive	26.0
Worse in last 24 h	26.3
Better in last 24 h	3.6
Physical examination	
Triage temperature, median (IQR), °C	37.5 (36.8–38.5)
Triage O_2 saturation, median (IQR), %	99 (98–100)
General appearance,† median (IQR)	1 (1–2)
Ease of examination, %	
Cooperative	85
Crying, easy to assess	10
Difficult to assess	5
Assessment	
WBC performed, %	37.6
WBC count, mean (SD), $\times 10^9$/L	14.7 (7.9)
Blood culture obtained,‡ %	24.3
Admission rate, %	9.1

*On the basis of a predetermined scale: 1 = none, 2 = 24 hours or less, 3 = 1 to 3 days, 4 = 4 to 6 days, 5 = 7 days or longer.

†On the basis of a predetermined scale: 1 = well, 5 = toxic/ill.

‡Two patients had a positive blood culture (*Escherichia coli*, *Streptococcus pneumoniae*).

IQR indicates interquartile range; Winter months, December to March.

TABLE 2. Comparison of Clinical Characteristics Between Occult Pneumonia and No-Pneumonia Patients

	Occult Pneumonia, n = 34	No Pneumonia, n = 274	*P*
Age, mean (SD), yr	5.1 (4.2)	5.2 (6.3)	0.96
History			
Presence of fever, n (%)	27 (79)	195 (71)	0.42
Fever >1 d, n (%)	22 (65)	121 (44)	0.04
Presence of cough, n (%)	30 (88)	217 (79)	0.26
Duration of cough,* median, d	4–6	4–6	0.35
Productive cough, n (%)	11 (50)	69 (39)	0.36
Worsening cough, n (%)	12 (41)	69 (32)	0.40
Presence of chest pain, n (%)	6 (17)	25 (9)	0.13
Physical examination			
Triage temperature, mean (SD), °C	37.8 (1.2)	37.7 (1.1)	0.25
ED T_{max}, mean (SD), °C	38.1 (1.3)	38.0 (1.1)	0.50
$T > 39$°C, n (%)	7 (20)	48 (18)	0.81
Triage O_2 saturation, mean	99	99	0.89
Lowest O_2 saturation, mean	99	98	0.44
Appearance,† median (IQR)	1	1	0.80
Assessment			
WBC count obtained, n (%)	12 (35)	104 (38)	
WBC count, mean (SD), $\times 10^9$/L	15.4 (8.7)	17.6 (10.9)	0.74
WBC count >15 $\times$ 10^9/L, n (%)	7 (58)	47 (45)	0.54
Blood culture obtained, n (%)	8 (24)	66 (24)	1.0
Admission rate, n (%)	2 (6)	26 (9)	0.75

For this analysis, patients with equivocal chest radiographs are considered to have pneumonia.

*On the basis of a predetermined scale: 1 = none, 2 = 24 hours or less, 3 = 1 to 3 days, 4 = 4 to 6 days, 5 = 7 days or longer.

†On the basis of a predetermined scale: 1 = well appearing, 5 = toxic or ill appearing.

CP indicates chest pain.

to diagnose clinically suspect or clinically occult lower respiratory tract disease was 5.2% (95% CI, 2.9%–9.0%). Near parity of the frequency of pneumonia in these groups suggests that there was no marked bias toward systematic enrollment of children on the basis of disease severity.

Clinical Characteristics of the Study Group

The mean (SD) age of the 308 study patients was 5.2 (6.1) years, and 143 patients (46.6%) were males. Table 1 provides details of the study group including presenting symptoms and signs, vitals signs, and management.

Occult Pneumonia Versus No-Pneumonia Groups

Of the 308 patients studied for occult pneumonia, 21 (6.8%; 95% CI, 4.0%–10.6%) had definite pneumonia. Of these 308 patients, 13 (4.2%) had equivocal readings and 274 (89%) had negative radiographs. We compared the clinical characteristics of patients with radiographic evidence of pneumonia (by definition, these are occult pneumonias) to patients with negative radiographs. As noted in the Methods section, patients with equivocal CXR readings were analyzed in 2 manners, excluded from data analysis or treated as pneumonias.

Patients With Equivocal Radiographs Excluded

Twenty-one patients had definite pneumonia, and 274 patients had negative CXRs. There was no clinically significant difference in mean triage temperature, mean age, proportion with fever or cough, duration of fever or cough, mean temperature or oxygen saturation, or mean WBC count when obtained. Dichotomizing the cutoff value for duration of fever and duration of cutoff did not detect a significant difference in the rates of pneumonia between groups.

Patients With Equivocal Radiographs Treated as Pneumonia

Analyzing patients with equivocal radiographs as pneumonia results in 34 cases of pneumonia (34/308, 11%; 95% CI, 8%–15%; Table 2). Patients with pneumonia were more likely to have a fever duration greater than 1 day than patients without pneumonia (65% [95% CI, 48%–79%] vs 44% [95% CI, 38%–50%]). There were no differences in mean age, median duration of fever or cough, mean temperature or oxygen saturation, or mean WBC count when obtained.

Emergency Department Diagnosis of Pneumonia

Comparison between the ED attending physician diagnosis and radiologist's final reading of CXR is shown in Table 3. All patients with radiographic diagnosis of definite pneumonia were given a diagnosis of pneumonia by the treating ED physician.

TABLE 3. Comparison Between ED Diagnosis and Final Radiograph Result

	Attending Radiologist Reading		
ED Diagnosis	Definite Pneumonia	Equivocal	Negative
Pneumonia	21 (100%)	9 (69%)	5 (2%)
No pneumonia	0	4 (31%)	264 (98%)

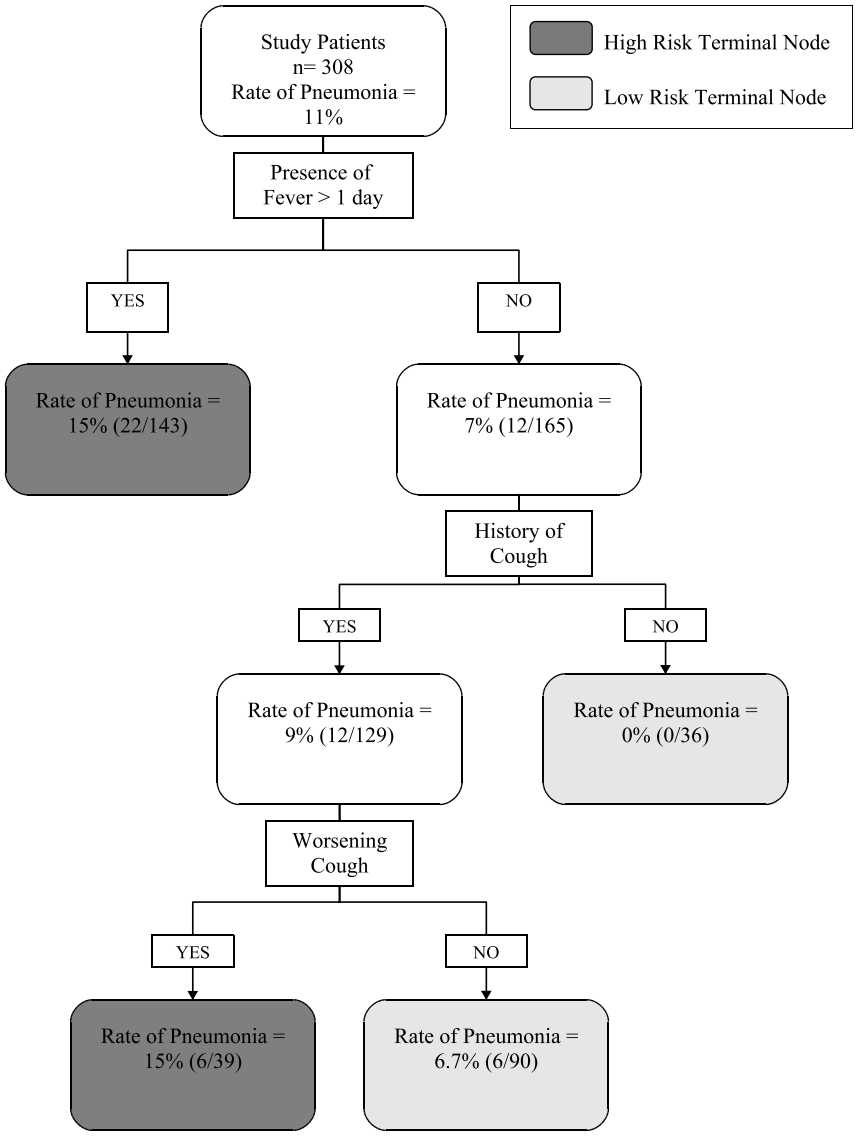

FIGURE 2. Decision tree for the identification of patients with occult pneumonia; for this analysis, patients with equivocal chest radiographs are considered to have pneumonia.

Of the 13 equivocal radiograph readings, 9 (69%) were treated as pneumonia by the ED clinicians, whereas 4 (31%) were not considered to have pneumonia by the ED clinicians.

Recursive Partitioning Analysis

As noted earlier, equivocal radiograph readings were treated as pneumonia in the recursive partitioning analysis (Fig. 2). The resulting decision tree included presence of fever for more than 1 day, presence of cough, and worsening cough during the last 24 hours (in a stepwise order). Among patients with fever for more than 1 day, the rate of occult pneumonia was 15% (95% CI, 10%–22%). Among those without fever, or in whom fever has persisted for less than 1 day, the rate of pneumonia was 7%; within this group, if there was no history of cough, none of the patients had pneumonia (0/36; 95% CI, 0–9.6). Among patients with fever for less than 1 day (or without fever) and a worsening cough (last 24 hours), the incidence of occult pneumonia was 15% (95% CI, 7%–30%). The performance of this model can be seen in Table 4. Overall, this decision tree correctly identifies 28 of the 34 patients with pneumonia, for a sensitivity of 82% (95% CI, 66%–91%). The specificity was 44% (95% CI,

TABLE 4. Performance of Recursive Partitioning Model

	Pneumonia	No Pneumonia	Total
High risk for pneumonia	28	154	182
Low risk for pneumonia	6	120	126
Total	34	274	308

Numbers were taken from terminal nodes of the decision tree in Figure 2.

Sensitivity = 82%; specificity = 44%; positive LR = 1.47 (95% CI, 1.21–1.77), and negative LR = 0.40 (95% CI, 0.19–0.84).

Positive predictive value 15.4%; Negative Predictive value 95.2%.

38%–50%). The decision tree predicts patients with pneumonia with a positive likelihood ratio (LR) of 1.47 (95% CI, 1.21–1.77) and a negative LR of 0.40 (95% CI, 0.19–0.84).

DISCUSSION

Fever is one of the most common reasons for presentation to an ED.[7] The evaluation of a child with a fever and no apparent source of infection on physical examination continues to present a diagnostic dilemma. The entity of "fever without a source" has been the subject of many studies and summarized in fever guidelines for children younger than 36 months.[8–11] The value of chest radiographs has been studied in these young children, with several studies suggesting that CXR has limited value in the absence of respiratory findings on physical examination especially in the youngest infants.[12–16] However, there are limited data on the utility of routine radiographs in older febrile children.

In addition to routine fever evaluation, there have also been studies that have focused on clinical predictors for a radiographic pneumonia. In 1982, Leventhal[3] prospectively identified tachypnea as a strong predictor of radiographic pneumonia. On the basis of his data, the sensitivity and specificity of tachypnea was 81% and 60%, respectively. More recently, Lynch et al[1] conducted a prospective study to derive a decision rule for pneumonia based on examination findings. The combination of fever and decreased breath sounds, tachypnea, or crackles yielded a sensitivity ranging from 93.1% to 96.1%; however, the specificity was low, ranging from 11.2% to 19.4%. Rothrock et al[14] evaluated the effectiveness of the evidence-based, Canadian guidelines for the detection of pneumonia. The guidelines suggested that the absence of respiratory distress, tachypnea, crackles, and decreased breath sounds accurately excludes pneumonia. Rothrock et al[14] found that these guidelines performed poorly, with a sensitivity of 45% (95% CI, 33%–58%) and specificity of 66% (95% CI, 60%–72%). In these studies, as well as several others, it has been shown that even when physical examination findings suggesting pneumonia are present, the ability of these findings to predict pneumonia are limited by their wide range of predictive values and overall poor specificity.[1–3,12,16–18] Furthermore, these values are limited to the subgroup of subjects who underwent CXR.

Beyond the poor correlation between physical examination findings and pneumonia, clinicians must also consider occult pneumonia, initially described in the pediatric literature in 1999.[4] In the original study, the investigators studied patients younger than 5 years, with a temperature higher than 39°C, and WBC count 20×10^9/L or greater. Among 278 patients, the incidence of occult pneumonia was 26% (95% CI, 19%–34%). In 2007, Murphy et al[5] conducted a retrospective study to determine the incidence of occult pneumonia in the post-pneumococcal conjugate vaccine era. One thousand eighty-four patients without signs of pneumonia on examination were studied, and 5.3% (95% CI, 4.0%–6.8%) had occult pneumonia. The investigators found presence and longer duration of cough (LRs of 1.24 [95% CI, 1.15–1.33] and 2.25 [95% CI, 1.40–2.22], respectively), increasing duration of fever (LR, 2.31; 95% CI, 1.21–4.20), and elevated WBC count greater than 15×10^9/L (LR, 1.76; 95% CI, 1.40–2.22) to be associated with radiographic pneumonia. However, this study was limited by its retrospective design because determination of "occult" was based solely on the documentation of the absence of respiratory distress or lower respiratory tract findings in the medical record.

Our prospective study shows the incidence of occult pneumonia to be 6.8% among patients who underwent CXR. Furthermore, occult pneumonia represented one sixth of the all pneumonias detected by radiography. When patients with equivocal radiographs were included as pneumonia, the incidence of occult pneumonia increased to 11%; this estimate is much more aligned with the actual management of such patients. Interestingly, the rate of occult pneumonia was nearly identical to the rate of pneumonia in patients with ausculatory findings or respiratory distress.

On the basis of our results, occult pneumonia must be considered in some children with fever even in the absence of ausculatory findings suggestive of pneumonia. Undoubtedly, for some children, the lack of ausculatory findings may be secondary to crying during the examination, and for younger children, the lack of examination findings may stem from the inability to take voluntary breaths for the examiner. Although the patients were considered to not have a clear source of infection, most patients had evidence of upper respiratory infection. Our study attempted to identify predictors to help guide the judicious use of CXR; however, we were unable to identify any strong clinical predictors. Recursive partitioning analysis showed that duration of fever, especially when dichotomized to greater or less than 1 day, may be a useful predictor of occult pneumonia when used in conjunction with the presence of worsening cough. Using this decision rule marginally improves the rate of detection of occult pneumonia from 11% to 15% over clinical practice alone. However, the rule identifies patients with fever for less than 1 day and without cough to be at low risk for pneumonia; we believe that CXR utilization for the detection of pneumonia in this population should be discouraged.

There are several limitations in this investigation. First, we only studied patients who were undergoing CXRs as determined by the treating physicians. Therefore, our study likely overestimated the incidence of occult pneumonia. Future studies may seek to better understand the factors that lead to a decision to obtain a radiograph in differing clinical scenarios. In addition, the limited number of patients with definite pneumonia made it difficult to perform any subgroup analyses. Although only 46% of eligible patients were enrolled, the rates of pneumonia did not differ between those enrolled and those not enrolled. The use of the radiologist's final reading poses a limitation to the study because the radiologist was not blinded to the patient's clinical information. Another pragmatic limitation is the lack of a standard for radiographic pneumonia and the related analysis of patients with equivocal chest radiographs. When clinicians ordered a radiograph to evaluate for pneumonia, the treating clinician declared pneumonia 69% of the time when the radiologist was uncertain. Accordingly, we performed the final, multivariate analysis with equivocal readings included as pneumonia to mirror clinical practice. A portion of the identified occult pneumonias in our study is likely to be viral in origin, but actual determination of the etiologic agent is difficult to determine.[19–22] Furthermore, clinical practice dictates that patients with clinical suspicion of pneumonia with radiographic findings are likely to be treated as bacterial pneumonia despite the possibility of a viral etiology. Finally, it is difficult to determine whether our findings can be generalized to other settings because the practice of ordering radiographs likely vary between institutions.

CONCLUSIONS

Occult pneumonias are frequently identified among patients without lower respiratory tract findings or respiratory distress. No strong clinical predictors of occult pneumonia were identified; however, this study confirms that patients with fever for less than 1 day and without cough are at low risk for pneumonia.

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