Clinical Indicators of Radiographic Findings in Patients With Suspected Community-Acquired Pneumonia: Who Needs a Chest X-Ray?

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Purpose: To develop a prediction rule for the use of chest radiographs in evaluating for community-acquired pneumonia (CAP) based on presenting signs and symptoms.

Patients and Methods: Adult patients with acute respiratory symptoms and positive chest radiographic results from October 2004 through April 2005 were enrolled as positive cases (n = 350). An equal number of age-matched controls with acute respiratory symptoms but negative radiographic results were included. Data analyses were performed on the 6 most common individual clinical indicators (cough, sputum production, fever, tachycardia, tachypnea, and abnormal physical examination results). Additional analyses were performed for any vital sign abnormality and for the presence of vital sign or physical examination abnormalities.

Results: The data show that vital sign and physical examination findings are useful screening parameters for CAP, demonstrating a sensitivity of 95%, a specificity of 56%, and an odds ratio of 24:9 in the presence of vital sign or physical examination abnormalities. In light of these results, the authors developed a prediction rule for low-risk patients with reliable follow-up, which states that chest radiographs are unnecessary in the presence of normal vital signs and physical examination findings.

Conclusion: The data suggest that chest radiographs are unnecessary in patients with acute respiratory symptoms who present with normal vital signs and physical examination findings. Because approximately 5% of cases would be missed, however, these criteria are useful only for patients with reliable follow-up and a low likelihood of morbidity if CAP is not detected initially.

Key Words: Pneumonia, respiratory infection, prediction rule, chest x-ray, thoracic imaging

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INTRODUCTION

Decision rules for diagnostic procedures have helped revolutionize health care by decreasing the costs associated with unnecessary diagnostic studies and providing algorithms to increase physicians' efficiency. Perhaps the most noteworthy of these are the Ottawa ankle rules, which assist physicians in determining which patients require radiographs in the setting of acute ankle injuries. We set out to develop a similar prediction rule for the use of chest radiographs in evaluating for community-acquired pneumonia (CAP) on the basis of presenting signs and symptoms.

A recent meta-analysis reviewed more than 30 years of data and highlighted 4 studies that evaluated clinical indicators of CAP [1]. The studies had similar method-

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Table 1. Clinical indicators of community-aquired pneumonia

- Cough
- Sputum production
- Fever (temperature ≥100.5°F)
- Tachycardia (heart rate ≥100 beats/min)
- Tachypnea (respiratory rate >20 breaths/min)
- Abnormal physical examination findings
  - Crackles
  - Decreased breath sounds
  - Dullness to percussion
  - Rhonchi

ologies but different conclusions regarding the best clinical indicators [1-5]. Additionally, these studies were based primarily in emergency departments, limiting generalizability to the outpatient setting.

Our study evaluated the 6 most common clinical indicators from prior studies in both outpatient and emergency settings. Additionally, we included a significantly larger number of positive cases (n = 350) than any of the seminal studies (n = 40 to 139).

PATIENTS AND METHODS

This study was approved by the institutional review board with a waiver of the requirement for informed consent. The setting was outpatient clinics and the emergency department of a tertiary care facility. All adult patients (18 years or older) with acute respiratory symptoms and positive chest radiographic results from October 2004 through April 2005 were enrolled as positive cases (n = 350). An equal number of controls with acute respiratory symptoms but negative radiographic results were included; controls were matched by age and date of radiography. Patients were excluded in cases of suspected hospital-acquired (positive radiographic results within 10 days of hospital discharge) or aspiration pneumonia.

Outpatient and emergency room physicians recorded data regarding the clinical indicators before obtaining chest radiographs; thus, they were blinded to the radiographic findings. All chest radiographs were subsequently interpreted by a board-certified radiologist blinded to the clinical findings. Positive radiographic findings were defined as the presence of new air-space opacities in the setting of acute respiratory symptoms. Patients with equivocal radiographic findings interpreted as "possible pneumonia" were considered positive cases. For each positive case, a single control was randomly selected from a list of eligible controls with acute respiratory symptoms, negative chest radiographic results, and a date of birth within 5 years of that of the positive case. Once patients were appropriately identified as cases or controls, outpatient charts were reviewed to gather data regarding the clinical indicators.

The 6 clinical indicators were selected on the basis of the cumulative results of the seminal studies and included cough, sputum production, fever (temperature = 100.5°F), tachycardia (heart rate = 100 beats/min), tachypnea (respiratory rate >20 breaths/min), and physical examination abnormalities (Table 1). Physical examination abnormalities consisted of crackles, decreased breath sounds, dullness to percussion, and rhonchi [1-5].

Sensitivities and specificities were calculated for each of the 6 clinical indicators using STAT/SE 9.0 for Windows (STATA Corp LP, College Station, Tex). Odds ratios (ORs) were also calculated for each of the 6 clinical indicators. Additional analyses were performed for any vital sign findings (positive test result = fever, tachycardia, and/or tachypnea) and for the presence of any vital sign or physical examination findings (positive test result = abnormal vital signs, abnormal physical examination, or both). On the basis of the above analyses, a prediction rule was then developed to determine which patients require chest radiographs in the setting of suspected CAP. The diagnostic accuracy of the prediction rule was determined by the area under the receiver-operating characteristic curve.

FINDINGS

Three hundred fifty consecutive adult patients with acute respiratory symptoms and positive chest radiographic results were enrolled as positive cases, with an equal number of age-matched controls. The demographics of cases and controls were similar (see Table 2). Data analyses are listed in Table 3.

Table 2. Demographic data for patients with suspected community-acquired pneumonia

Variable	Cases (n = 350)	Controls (n = 350)
Average age in years	65	66
Age range in years	19 to 91	20 to 91
Men	197 (56.3%)	180 (51.4%)
Women	153 (43.7%)	170 (48.6%)
Preexisting pulmonary disease cases[a]	106 (30.3%)	82 (23.4%)

[a]Pre-existing pulmonary disease defined as chronic obstructive pulmonary disease, interstitial lung disease, or cancer.