Tachypnea is a useful predictor of pneumonia in children with acute respiratory infection

Palafox M, Guiscafré H, Reyes H, Muñoz O, Martínez H. **Diagnostic value of tachypnoea in pneumonia defined radiologically.** Arch Dis Child. 2000 Jan;82:41-5.

QUESTIONS

In children with acute respiratory infection, is tachypnea accurate for detecting pneumonia? Does disease duration, age of the child, or presence of malnutrition influence sensitivity and specificity?

DESIGN

Blinded comparison of respiratory rate with findings on chest radiography.

SETTING

A state referral hospital in Tlaxcala, Mexico.

PARTICIPANTS

110 children who were 3 days to 5 years of age (55% were ≥ 1 y of age) and had acute respiratory infection. Children who were clinically diagnosed with pneumonia were matched to control children with acute respiratory infection. 30% of children were underweight. Exclusion criteria were chronic diseases, genetic abnormalities, neurologic diseases, bronchial asthma, or septicemia.

DESCRIPTION OF TEST AND DIAGNOSTIC STANDARD

A pediatrician measured the respiratory rate by observing the child's chest movements for 1 minute while the child rested with no crying or fever. Tachypnea was defined as a respiratory rate > 60 breaths per minute in children < 2 months of age, > 50 breaths per minute in children 2 to 12 months of age, and > 40 breaths per minute in children ≥ 1 year of age. The diagnostic standard was chest radiography (not clinical diagnosis).

MAIN OUTCOME MEASURES

Sensitivity and specificity for detecting pneumonia.

MAIN RESULTS

59 children (54%) had a clinical diagnosis of pneumonia, but only 35 children (32%) had findings on radiology. The sensitivity, specificity, and likelihood ratios are shown in the Table. Sensitivity and specificity were lowest in children with a disease duration of < 3 days ($P < 0.01$) (Table); age or presence of malnutrition did not influence results.

CONCLUSIONS

In children with acute respiratory infection, tachypnea had a sensitivity of 74% and specificity of 67% for detecting pneumonia but did not perform as well when disease duration was < 3 days. Age or presence of malnutrition did not influence results.

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Test characteristics of tachypnea for detecting pneumonia in children with acute respiratory infection*

Test	Patient group	Sensitivity (95% CI)	Specificity (CI)	+LR	–LR
Tachypnea	All children	74% (60 to 88)	67% (56 to 77)	2.2	0.4
	Disease duration < 3 d	55% (40 to 72)	64% (49 to 80)	1.5	0.7
	Disease duration 3 to 5 d	64% (49 to 78)	66% (51 to 80)	1.9	0.5
	Disease duration ≥ 6 d	93% (84 to 102)	73% (57 to 89)	3.4	0.1
Clinical judgment	All children	74% (61 to 88)	56% (48 to 69)	1.7	0.5

*Abbreviations defined in Glossary; LRs calculated from data in article.

COMMENTARY

Many clinicians currently consider pulse oximetry to be a vital sign. In contrast, the studies by Palafox and Rajesh and their colleagues from developing nations emphasize the importance of an accurately measured respiratory rate. Palafox and colleagues studied young children in Mexico. They selected children with clinically diagnosed pneumonia and an equal number of children with other acute respiratory illnesses, ensuring a sample with a high prevalence of radiographically proven pneumonia (32%). The radiographic determination of pneumonia was the reference standard to which the finding of tachypnea was compared.

Tachypnea, defined according to World Health Organization (WHO) recommendations, was present in 74% of children with pneumonia and in 33% of those without pneumonia. The presence of tachypnea approximately doubled the odds of pneumonia, and its absence decreased the odds by about half. These findings are similar to those of a systematic literature review on the diagnosis of pneumonia in infants in which the authors concluded that tachypnea was the best single finding for ruling out pneumonia (1). In that review, likelihood ratios for pneumonia in the presence of tachypnea (+LR) ranged from 1.6 to 3.2 with the exception of infants < 2 months of age. Likelihood ratios for pneumonia when tachypnea was not present (–LR) ranged from 0.3 to 0.8. The unique finding of Palafox and colleagues was that, as hypothesized, the finding of tachypnea was less sensitive and less specific in infants and children who had been sick for < 3 days.

Rajesh and colleagues in India found tachypnea to be a similarly useful marker for hypoxia in sick infants < 2 months of age. A cutoff point of 60 breaths per minute had the best combination of sensitivity and specificity in this age group (in agreement with the WHO recommendations). Tachypnea was present in 81% of hypoxic infants and in 32% of those who were not hypoxic. Thus, tachypnea is sensitive for ruling out hypoxia in young infants, although approximately 1 in 5 hypoxic infants will be missed using tachypnea alone.

The study sample included many severely ill infants; 16% died. In addition to pneumonia (present in 34%), septicemia (12%), and meningitis (14%), several less frequent conditions were found.

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A respiratory rate of ≥ 60 breaths per minute had high sensitivity for detecting hypoxia in infants

Rajesh VT, Singhi S, Kataria S. **Tachypnoea is a good predictor of hypoxia in acutely ill infants under 2 months.** Arch Dis Child. 2000 Jan;82:46-9.

QUESTION

In ill infants < 2 months of age, can the respiratory rate be used as an indicator of hypoxia?

DESIGN

Blinded comparison of respiratory rate with oxygen saturation level.

SETTING

A hospital pediatric emergency service in Chandigarh, India.

PARTICIPANTS

200 infants who were < 2 months of age (mean age 28 d) and had symptoms of any acute illness. Exclusion criteria were age < 24 hours, major congenital malformations, previous hospitalization, or active cardiopulmonary resuscitation.

DESCRIPTION OF TEST AND DIAGNOSTIC STANDARD

The respiratory rate was counted for 1 minute while observing the infant's chest and abdominal movements when the infant was quiet. If the respiratory rate was ≥ 50 breaths per minute, the rate was counted again after 30 minutes. The diagnostic standard was the assessment of oxygen saturation, which was measured at the finger or toe with a pulse oximeter (BCI, Waukesha, WI, USA). Hypoxia was defined as an oxygen saturation level ≤ 90%.

MAIN OUTCOME MEASURES

Sensitivity and specificity for detecting hypoxia.

MAIN RESULTS

77 infants (39%) had hypoxia. Sensitivities, specificities, and likelihood ratios are shown in the Table. The cutoff point of ≥ 60 breaths per minute provided the best balance of sensitivity (81%) and specificity (68%).

CONCLUSION

In infants who were < 2 months of age and had an acute illness, a respiratory rate of ≥ 60 breaths per minute had a sensitivity of 81% and a specificity of 68% for detecting hypoxia.

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Test characteristics for detecting hypoxia in infants with acute illnesses*

Respiratory rate	Sensitivity (95% CI)	Specificity (CI)	+LR	-LR
≥ 40 breaths/min	96% (89 to 99)	37% (28 to 46)	1.5	0.1
≥ 50 breaths/min	91% (82 to 96)	59% (50 to 68)	2.2	0.2
≥ 60 breaths/min	81% (70 to 89)	68% (59 to 76)	2.5	0.3
≥ 70 breaths/min	51% (39 to 62)	85% (77 to 90)	3.3	0.6
≥ 80 breaths/min	22% (13 to 33)	93% (88 to 97)	3.4	0.8

*Abbreviations defined in Glossary; CIs and LRs calculated from data in article.

COMMENTARY

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Therefore, many of the "false positives" who were tachypneic but not hypoxic probably had serious illness. Indeed, tachypnea identified 72% of infants who died, whereas hypoxia identified only 53%.

Both studies used the proper method for determining respiratory rate, as emphasized by others (1, 2). The child should be observed in a quiet state, ideally when not febrile, and the respirations counted for a full 60 seconds by observing chest movement. In young children, the presence of fever and cough (without pneumonia) increases respiratory rate by approximately 10 breaths per minute (2). A similar difference is found between wakeful (but quiet) and sleeping children (3). Respiratory rates obtained by auscultation are on average 2 to 3 breaths per minute higher than those obtained by observation, with greater differences (occasionally ≥ 10) seen in wakeful children (3).

These studies support the use of tachypnea as a diagnostic test to identify pneumonia and hypoxia in areas where radiography and pulse oximetry are not widely available. In areas with better access to these technologies, confirmatory tests should be used to guide therapy in order to avoid unnecessary treatment. This is especially true when patient populations have lower rates of serious illness, as is often the case in developed countries. Regardless of practice setting, all clinicians will improve their care of sick children by remembering to carefully assess respiratory status.

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