

Differentiating bacterial from viral pneumonias in children

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Abstract. 58 paediatric patients with pneumonia, in whom an etiological agent had been isolated, were reviewed. The patients were designated to have either viral or bacterial pneumonia on the basis of proposed clinical and radiological criteria. These presumed diagnoses were then compared to the microbiologically proven diagnosis. When clinical features suggested a bacterial infection the chance of isolating a bacteria as opposed to a virus was 18%. When radiological features suggested a bacterial infection the chance of isolating a bacteria as opposed to a virus was 30%. Thus the commonest cause of "bacterial" clinical and radiological features is a viral infection and the proposed criteria do not allow differentiation of bacterial from viral pneumonia.

Most childhood pneumonias are caused by viral agents or *Mycoplasma pneumoniae* [1]. Management decision are made at presentation based on clinical and radiological features that suggest a bacterial infection rather than awaiting isolation of the causative organisms. Swischuk and Hayden [2] reported an accuracy of over 90% in differentiating bacterial and viral chest infections on radiological grounds. However, the etiological agent was surmised on clinical grounds rather than being microbiologically proven. Our retrospective study was undertaken to assess the accuracy of Swischuk's clinical and radiological criteria in differentiating proven bacterial and viral pneumonias.

Material and methods

107 patients have been previously collected by Dr D. McCrossin (unpublished data). All were previously healthy children aged greater than 100 days, in whom there was strong clinical evidence of pneumonia. Data was collected between March and November 1985 inclusive; and inpatients and outpatients were studied. An etiological agent was isolated in 66 patients and complete information was available in 58 patients who formed the study group.

The patients clinical data was reviewed and the patient was assigned a clinical diagnosis, either viral or bacterial, according

to guidelines of Swischuk and Hayden [2] (Table 1). Chest x-rays in the 58 patients were reviewed by 2 radiologists using the schema of Swischuk and Hayden [2] and each patient was assigned a radiological diagnosis, either viral or bacterial (Table 2). In patients with indeterminate infiltrates, or films not codeable using these criteria the radiological diagnosis was recorded as unhelpful.

The following investigations were performed: full blood picture and C reactive protein (58 patients); blood cultures including anaerobic and aerobic cultures (58 patients); nasopharyngeal aspirates for immunofluorescent staining and cultures for viruses; *Mycoplasma pneumoniae*; *Chlamydia trachomatis* and *Bordetella pertussis* (55 patients); urine on the day of admission and for the next 2 days for *Haemophilus influenzae* type b and *Streptococcus pneumoniae* antigens by latex agglutination (42 patients); paired sera for antibodies to Respiratory Syncytial Virus, influenza A and B viruses and adenoviruses (14 patients). Infection with a potential agent was assumed if the following criteria were met: (A) for viruses, *C. trachomatis*, *M. pneumoniae* and *B. pertussis*; positive immunofluorescence or isolation from nasopharyngeal aspirates, detection of specific IgM in a single serum or a 4 fold or greater rise in antibody titre in paired sera. (B) for bacteria - isolation from blood, pleural fluid or detection of specific antigens in urine. For the purpose of this study, patients with mixed viral and bacterial infections were classed as having bacterial illnesses.

Results

The clinical diagnoses, radiological diagnoses and microbiological diagnoses are given in Table 3. The clinical and radiological diagnoses were then reviewed in patients with proven viral and bacterial illnesses (Table 4). The clinical and radiological di-

Table 1. Clinical criteria for distinguishing bacterial and viral pneumonias proposed by Swischuk + Hayden [2].

	Bacterial		Viral
Duration of Symptoms	<2 days	(Score + 1/2)	>3 days
Fever	39.5°C	(Score + 1/2)	38.8°C
^a Total WBCC	>15,000	(Score + 1)	<15,000
Response to Antibiotics	Response with 24 hours	(Score + 1)	No response within 24 hours

Score of 2 or more = Bacterial

^a Ref. [3]

Table 2. Proposed radiological criteria for distinguishing bacterial and viral pneumonias (after Swischuk and Hayden [2])

X-ray appearance	Radiological diagnosis	Number of patients
1 Parahilar, peribronchial infiltrates + atelectasis	Viral	26
2 Lobar consolidation homogenous or fluffy	Bacterial	17
3 Reticulonodular infiltrate in one lobe	Mycoplasma	-
4 Diffuse bilateral fluffy infiltrates extending peripherally	Bacterial	-
5 Parahilar, peribronchial infiltrates with superimposed consolidation	Viral with superimposed bacterial (= Bacterial)	3
6 Indeterminate infiltrates	Unhelpful	4
7 Uncodeable	Unhelpful	8

Table 3. Diagnoses in 58 patients

	Clinical diagnosis	Radiological diagnosis	Microbiological diagnoses
Viral	41	26	47
Bacterial	17	20	11
Unhelpful	-	12	-

Table 4. Accuracy of criteria in predicting etiology

	Clinical diagnosis	Radiological diagnosis	Combined diagnosis
Prediction			
Viral; correct	33	24	16
Viral incorrect	8	2	2
Bacterial; correct	3	6	3
Bacterial; incorrect	14	14	4
Unhelpful		12	12
Discordant information			21

agnoses were then combined (combined diagnosis) to see if error could be minimised (Table 4).

In terms of *Clinical criteria*, the predictive value of a positive test [4] for bacterial infection is 18%; and the predictive value of a negative test is 81%.

In terms of *Radiological criteria*, the predictive value of a positive test for bacterial infection is 30% and the predictive value of a negative test is 92%.

Discussion

Because of difficulty in distinguishing viral and bacterial infections in the majority of childhood pneumonias, antibiotics are often commenced while awaiting results of microbiological investigations. Swischuk and Hayden [2] claimed an accuracy of over 90% in differentiating bacterial and viral pneumonias on radiological grounds, but we found their

method inaccurate. Their use of clinical criteria, rather than microbiological criteria, to establish their diagnosis is suspect. We have shown that clinical criteria and radiological criteria do not accurately reflect the etiology of childhood pneumonias. When the criteria are combined there are a large number of discordant diagnoses and the specificity and sensitivity are not increased.

The proposed clinical and radiological criteria overdiagnosed bacterial illness. A lobar pattern of consolidation was more than twice as likely to be associated with a viral illness, and clinical symptoms suggesting a bacterial infection were four times as likely to be caused by a virus. Even when clinical and radiological features both suggested bacterial infection the patient was as likely to have a viral etiology for their pneumonia.

The proposed criteria are of more value in excluding bacterial pneumonia. A small number of patients with bacterial pneumonia do present with "viral" features. When clinical criteria, radiological criteria or both combined, suggested a viral illness an unsuspected bacterial infection was present in 20%, 8% and 12% respectively ("viral incorrect" Table 4).

It could be argued that a bacterial agent could be implicated in some instances when only a virus was isolated. However, the predominance of viral agents is in keeping with previous published reports on the causative organisms in childhood pneumonias in developed countries [1, 5]. We conclude that proposed clinical and radiological criteria either alone or in combination are of little value in differentiating bacterial from viral pneumonias.

References

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Received: 15 October 1987; accepted: 20 December 1987

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