



## Predictive value of clinical features in differentiating group A $\beta$ -hemolytic streptococcal pharyngitis in children

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Identifying children with acute pharyngitis caused by group A  $\beta$ -hemolytic *Streptococcus* (GABHS) is an important task for pediatricians. This study examined the value of certain clinical symptoms and signs in predicting a positive culture result. A total of 442 children who presented at the outpatient department with pharyngeal erythema were enrolled. The clinical features of patients with positive throat cultures for GABHS were compared to those with negative culture results. Throat cultures were positive for GABHS in 120 (27%) patients. Patients aged between 5 and 10 years had a higher prevalence of GABHS pharyngitis. Significant differences between the groups with and without GABHS pharyngitis were noted for the presence of sore throat ( $p < 0.001$ ), tonsillar swelling ( $p < 0.001$ ), anterior cervical adenopathy ( $p = 0.004$ ), and scarlatiniform rash ( $p < 0.001$ ), but not for the presence of fever, cough, rhinorrhea, abdominal pain, headache, tonsillar exudate, or palatal petechiae. Despite these strong associations, none of these symptoms or signs had both high sensitivity and specificity, and the positive predictive values of these individual findings were never greater than 50%. The results indicate that diagnosis based on clinical grounds alone is unreliable although there are certain individual symptoms and signs that are associated with GABHS pharyngitis. These symptoms and signs may be helpful in modifying estimates of probability of infection with GABHS. Throat cultures in suspected patients remain mandatory.

**Key words:** Group A  $\beta$ -hemolytic *Streptococcus*, pharyngitis, throat culture

Acute pharyngitis is one of the most common illnesses for which children visit primary care physicians [1]. Group A  $\beta$ -hemolytic *Streptococcus* (GABHS) is by far the most common bacterial cause of acute pharyngitis in children [1,2]. When a pediatrician evaluates a child with acute pharyngitis, the most important clinical task is to decide whether the pharyngitis is attributable to this organism [3]. Rapid and accurate diagnosis of GABHS pharyngitis is critical to prevent acute rheumatic fever, acute glomerulonephritis, and other suppurative complications [4-6]. Because GABHS pharyngitis shares symptoms with other upper respiratory infections of nonstreptococcal origin, numerous attempts have been made to distinguish it from viral pharyngitis based on clinical features [7-12]. It is uncertain whether a careful examination for clinical findings could allow a pediatrician to distinguish accurately between streptococcal and non-streptococcal infection. This study investigated the feasibility of clinical differentiation between patients with GABHS

pharyngitis and those with pharyngitis caused by other agents based on the patients' clinical symptoms and signs.

### Patients and Methods

#### Study sample

This study was conducted at the outpatient department of Cathay General Hospital-Neihu between January and December 2001. Children aged between 1 and 15 years who presented with pharyngeal erythema and received a throat culture were enrolled in the study. Children who had received any antibiotic therapy within the previous 5 days of presentation and who had otitis media and diseases of the lower respiratory tract (eg, pneumonia) were excluded.

#### Study protocol

At the time of patient assessment the treating physicians completed a standard encounter form and a single throat swab was obtained to culture GABHS from each patient. The encounter form was used to document the patient's age, sex, number of days of illness before the visit, and presence of sore throat, cough, rhinorrhea, headache, abdominal pain, and history of a temperature higher

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than 38°C. Physicians examined patients for the presence of tonsillar swelling, tonsillar exudate, palatal petechiae, anterior cervical adenopathy, and scarlatiniform rash (red, papular, and sandpaper-like rash). Demographic and clinical features of patients with positive throat cultures were compared with the features of patients with negative throat cultures.

### Bacterial culture

A pharyngeal specimen was obtained by swabbing the tonsillar surface and the posterior pharynx with a rayon-tipped throat swab (Culturette, Becton Dickson Microbiology Systems, Sparks, MD, US). The swabs were inoculated on 5% sheep blood agar. A bacitracin disc was placed on the inoculum, and the agar was stabbed in several areas. Plates were incubated at 35°C aerobically for 48 h and examined for the presence of  $\beta$ -hemolytic streptococci. Isolates with typical streptococcal colony morphology that were sensitive to bacitracin were classified as belonging to group A. Negative cultures and cultures positive for any other organisms were considered not infected with *Streptococcus*.

### Statistical analysis

Data were analyzed using SPSS for Windows 8.0.1 (SPSS Inc., Chicago, IL, US). Chi-square test was used to determine the association between the presence of each of the clinical findings and the presence of GABHS on the culture. The sensitivity, specificity, and positive predictive values of each of the clinical features were calculated.

## Results

### Clinical characteristics and culture results

A total of 442 children met criteria for inclusion over 1 calendar year. The mean age of these patients was  $7.1 \pm 3.1$  years (median, 7 years). There were 225 boys and 217 girls with a male/female ratio of 1.04:1.0. When these patients visited our outpatient department, they had been ill for 1 to 4 days (mean duration of illness,  $1.4 \pm 1.1$  days). Most (84%) of the children were examined during the first 2 days of illness. According to the culture results,  $\beta$ -hemolytic streptococci were found in 136 (31%) cases. Of these cases, 120 (88%) belonged to group A.

Respective mean ages of patients with GABHS culture-positive and -negative results were  $8 \pm 2.5$  years and  $6.8 \pm 3.2$  years. When patients were stratified by age, GABHS was more prevalent in children aged between 5 and 10 years (Fig. 1). Episodes of GABHS

pharyngitis occurred in 66 boys and in 54 girls. Although there was a slight preponderance of boys with streptococcal throat infection, the difference in sex was not significant ( $p=0.29$ ).

### Clinical assessment

We examined whether children with pharyngitis with a positive culture for GABHS could be distinguished clinically from children with pharyngitis negative for GABHS. The clinical features in children with and without GABHS pharyngitis are summarized in Table 1. Fever was commonly associated with pharyngitis regardless of culture results. No difference was noted between the patients with and without GABHS pharyngitis for the presence of fever, cough, rhinorrhea, abdominal pain, headache, tonsillar exudate, or palatal petechiae. Patients with GABHS pharyngitis were significantly more likely than those without GABHS pharyngitis to have sore throat ( $p<0.001$ ), tonsillar swelling ( $p<0.001$ ), anterior cervical adenopathy ( $p=0.004$ ), and scarlatiniform rash ( $p<0.001$ ). Despite these strong associations, none of these findings had both high sensitivity and specificity (Table 2). The positive predictive values of these individual findings were never greater than 50%. Some combinations of 2 or 3 of these significant features had positive predictive values between 70% and 90% and had negative predictive values between 85% and 95%. However, these combinations were present in less than 20% of the children with GABHS pharyngitis. Thus findings on clinical examination did not sufficiently distinguish those children who were culture positive for GABHS.

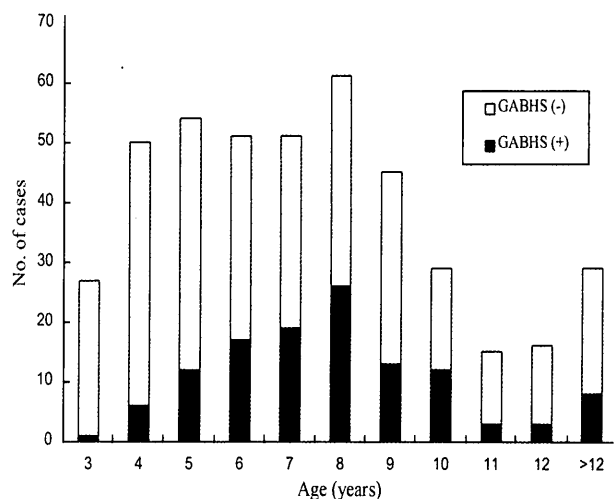


Fig. 1. Age distribution of patients with group A  $\beta$ -hemolytic streptococcal (GABHS) pharyngitis.

**Table 1.** Characteristics of patients with positive and negative cultures for group A  $\beta$ -hemolytic *Streptococcus*

Characteristic	GABHS (+) n = 120 (%)	GABHS (-) n = 322 (%)	<i>p</i>
<b>Symptom</b>			
Temperature >38°C	94 (78)	262 (81)	0.47
Sore throat	92 (77)	146 (45)	<0.001
Cough	38 (32)	129 (40)	0.11
Rhinorrhea	54 (45)	169 (52)	0.16
Abdominal pain	29 (24)	63 (20)	0.29
Headache	18 (15)	38 (12)	0.37
<b>Sign</b>			
Tonsillar swelling	86 (72)	129 (40)	<0.001
Tonsillar exudate	47 (39)	97 (30)	0.07
Palatal petechiae	18 (15)	38 (12)	0.37
Anterior cervical adenopathy	42 (35)	70 (22)	0.004
Scarlatiniform rash	31 (26)	32 (10)	<0.001

Abbreviation: GABHS = group A  $\beta$ -hemolytic *Streptococcus*

## Discussion

Certain clinical features have been reported in association with a higher likelihood of GABHS pharyngitis [7-12]. Breese and Disney [13] first commented that exudate covering the pharynx and tonsils, and a very red throat were associated with GABHS pharyngitis. Kaplan *et al* [14] concluded that patients with cough or rhinorrhea, despite other findings, had 50% fewer positive throat cultures. Meland *et al* [9] suggested that GABHS pharyngitis should be ruled in by the simultaneous presence of age over 5 years, swollen lymph nodes, and no cough. Attia *et al* [11] created a multivariate predictive model for GABHS pharyngitis in children, which included scarlatiniform rash, tonsillar swelling, tender and enlarged cervical nodes, and absence of coryza. Nawaz *et al* [12] found that a strong clinical impression of GABHS pharyngitis was associated with tonsillar exudate and hypertrophy, tender nodes, and pharyngeal erythema. Although these studies have demonstrated that some symptoms and signs are predictive of GABHS pharyngitis, the predictive value of these findings for a positive culture is low.

In this study, the probability of GABHS pharyngitis was not related to the presence of fever, cough, rhi-

norhea, abdominal pain, headache, tonsillar exudate, or palatal petechiae, indicating that these widely cited clinical features of GABHS pharyngitis in children do not discriminate GABHS pharyngitis from other causes. This result is similar to the findings of previous studies [11,12]. On the other hand, although this study found evidence that several clinical findings (sore throat, tonsillar swelling, anterior cervical adenopathy, and scarlatiniform rash) were significantly correlated with positive throat cultures for GABHS, none of these features has both high sensitivity and specificity. These organisms were found in less than half of the patients who had these clinical manifestations. The results confirm previous findings that GABHS pharyngitis cannot be diagnosed reliably on clinical grounds alone [12,15]. Disease could be ruled in by the simultaneous presence of some combinations of 2 or 3 of these significant features and be ruled out when absent. These findings may indicate the importance for pediatricians to consider the possibility of infection with GABHS based on the findings for symptoms and signs rather than to use these findings as a basis for avoiding specific diagnostic testing [8,12,15].

Since individual symptoms and signs are not accurate enough to make a diagnosis, several scoring

**Table 2.** Value of clinical findings in the prediction of group A  $\beta$ -hemolytic *Streptococcus*

Clinical predictor	Sensitivity	Specificity	PPV	NPV
Sore throat	0.77	0.45	0.39	0.84
Tonsillar swelling	0.72	0.60	0.40	0.85
Anterior cervical adenopathy	0.35	0.78	0.38	0.76
Scarlatiniform rash	0.26	0.90	0.49	0.77

Abbreviations: PPV = positive predictive value; NPV = negative predictive value

systems have been developed to predict the probability of GABHS pharyngitis [16-20]. One of the simplest scoring systems validated in adults is a 4-item clinical prediction rule developed by Centor *et al* [16], but it has not been validated in pediatric patients. The most successful scoring system for prediction of GABHS was developed by Breese [17], who demonstrated that the combination of acute onset of fever and sore throat with tonsillar exudate, palatal petechiae, and tender cervical nodes was highly suggestive of GABHS pharyngitis in school-aged children [17]. However, these diagnostic systems have not transferred well from one area to another because of their inability to allow for changing prevalence of *Streptococcus* [18,19].

Whether antibiotic treatment is indicated in children who have GABHS detected is not entirely clear. The clinical difficulty in separating the symptomatic patients with a positive culture into those who have true infection and into those who have pharyngitis due to some other agent (streptococcal carriers) leads most physicians to treat such patients with appropriate doses of antibiotics [14,21]. It appears to be a rational approach that symptomatic individuals with positive cultures should be treated with appropriate antibiotics [21]. Individuals with properly obtained and processed but negative throat cultures do not require therapy [21]. It is inappropriate to treat acute pharyngitis routinely with antibiotics because only a minority of patients with pharyngitis are infected by GABHS.

This study had several limitations. Because a rapid test for the streptococcal antigen was not available at our hospital, a single throat culture was used as a criterion standard for diagnosis. Although a single throat culture has a relatively high sensitivity in detecting the presence of GABHS, there are still 3% to 10% of individuals who may still be missed by this test [22, 23]. In addition, the test for antistreptococcal antibody (antistreptolysin O) was not performed in the initial visit. Although elevated or rising titers of antistreptolysin O provide reliable confirmation of a recent GABHS infection, this test can only confirm diagnosis several weeks to months after the pharyngitis [24]. Thus, this test was not used in the initial diagnosis of GABHS pharyngitis in this study.

In conclusion, some of the clinical findings associated with GABHS pharyngitis did not distinguish between patients with positive cultures and patients with negative cultures for GABHS. While certain individual symptoms and signs were associated with GABHS pharyngitis in this study, diagnosis based on clinical findings alone was unreliable. Specific symptoms and signs should be used to alert pediatrician to consider

the possibility of infection with GABHS rather than serving as justification for avoiding specific diagnostic testing.

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