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Original Article

McIsaac criteria for diagnosis of acute group-A β-hemolytic streptococcal pharyngitis

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Abstract

Background The early use of antibiotics for acute upper respiratory infections is controversial because most of these infections are caused by viruses. A strategy is needed to correctly identify the causitive agents of acute pharyngitis, so that antibiotics can be prescribed appropriately.

Objective To assess McIsaac criteria for diagnosing acute group-A β-hemolytic streptococcal (GABHS) pharyngitis in children.

Methods This diagnostic study was conducted from August 2011 to February 2012, to compare clinical criteria of McIsaac to throat swab culture results as the gold standard for diagnosis. Subjects were children aged 3-14 years who visited the pediatric outpatient clinic or emergency ward at Sanglah Hospital and the pediatric outpatient clinic at Wangaya Hospital.

Results There were 550 cases of acute pharyngitis during the study period, with 313 patients aged 3-14 years and 199 patients excluded due to a history of taking antibiotics in the two weeks prior to the hospital visit. Hence, 114 subjects were eligible for the study. GABHS prevalence in this study was 7.9%. McIsaac's area under the curve (AUC) from receiver operating characteristic (ROC) curve was 78.1%(95%CI 60.3 to 96%, P= 0.005). A McIsaac score ≥4 had a 66.7% (95%CI 49 to 97%) sensitivity, 87.6% (95% CI 81 to 94%) specificity, 31.6% (95 %CI 11 to 52%) positive predictive value (PPV), 96.8% (95%CI 93 to 100%) negative predictive value (NPV), 86.0% accuracy, 5.4 (95% CI 2.7 to 10.7) positive likelihood ratio (LR+) and 0.4 (95% CI 0.2 to 0.9) negative likelihood ratio (LR-).

Conclusion A McIsaac criteria total score of <4 is favorable for excluding a diagnosis of GABHS pharyngitis. A McIsaac total criteria score of ≥4 requires further examination to confirm a diagnosis of GABHS pharyngitis. **[Paediatr Indones. 2013;53:258-63.]**

Keywords: *diagnostic testing, pharyngitis, group-A β-hemolytic streptococcus (GABHS), McIsaac*

Acute respiratory infection (ARI) is a common medical problem for which patients seek a physician's care and are prescribed antibiotics.[1] Seventy-three percent of physicians prescribed antibiotics for acute pharyngitis, which is mostly caused by viruses.[2] In developing countries, antibiotics are prescribed for 44-97% of hospitalized patients, sometimes with inappropriate dosages.[3] Inappropriate usage of antibiotics (incorrect indications, selection, duration of administration, and dosage) may cause side effects, such as allergies or diarrhea, increase health care costs, and increase the possibility of selection for antibiotic-resistant bacterial strains.[2]

Group A β-hemolytic streptococcus (GABHS) or *Streptococcus pyogenes* is the most common cause of acute bacterial pharyngitis. Throat swab culture is the gold standard for diagnosing acute GABHS pharyngitis. However, in Indonesia, cultures take time, are not available in most health facilities and are expensive. A diagnostic tool that is fast, easy and inexpensive, with a value close to that of the gold standard, is needed to correctly diagnose acute

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GABHS pharyngitis. Practical diagnostic tools may comprise of clinical criteria and rapid lab tests. We hope that a feasible, less more affordable, yet accurate diagnostic tool will reduce unnecessary antibiotic usage.

The Centor Criteria have been widely accepted and validated as clinical criteria for diagnosis of GABHS bacterial pharyngitis in adults since1981.[4] This criteria was modified by McIsaac*et al.* in 1998, with the addition of age criteria. McIsaac criteria have a sensitivity and specificity of 70.6 % and 91.7%, respectively.[5]

A study on McIsaac criteria, particularly on acute GABHS pharyngitis in primary care in the tropics, is still limited while the incidence of acute pharyngitis is high. We aimed to compare the McIsaac diagnostic criteria to throat swab culture results for diagnosing acute GABHS pharyngitis in children.

Methods

This cross-sectional diagnostic study was performed to assess the McIsaac criteria for diagnosing acute GABH pharyngitis with throat swab cultur results as the gold standard. Subjects were children aged 3-14 years with symptoms of acute pharyngitis who visited the outpatient clinic or emergency ward of Sanglah Hospital and the outpatient clinic of Wangaya Hospital, Denpasar, from August 1, 2011 until February 6, 2012.

The inclusion criteria were clinical symptoms of acute pharyngitis in patients aged 3-14 years and parental agreement to participate in the study. We excluded patients with a history of antibiotic administration within the two weeks prior to enrollment. Subjects were collected by consecutive sampling.

Trained examiners who met the reliability test were hired for the study and blinded to the results from the trained laboratory officers at Prodia Labs who took throat swab specimens. Interobserver reliability tests were carried out on the trained examiners for ten subjects before the study began. Laboratory officers from Prodia Labs took throat swabs immediately after examiners evaluated subjects based on the McIsaac criteria. Researchers collected the questionnaires, McIsaac scores, and throat swab culture results at the end of the study. Subjects who scored ≥ 4 in the McIsaac criteria were treated with antibiotics. The McIsaac criteria are shown in **Table 1**.

The sample size was calculated with single sample proportion[6] each for sensitivity and specificity of McIsaac score ≥ 4, previously reported to be 70.6% and 91.7%,[5] respectively, with Z score for $\alpha = 0.05$ of 1.96 and 10% acceptable deviation of P value. The minimum required sample size was calculated to be 110 subjects.

This study was approved by the Research Ethics Committee of Udayana Medical School, Sanglah and Wangaya Hospitals, Denpasar, and Warren J. McIsaac.

Table 1. McIsaac criteria[5] (modified)

Determine the patient's total sore throat score by assigning points to the following:	
Criteria	Point
• Temperature > 38°C	1
• No cough	1
• Tender anterior cervical adenopathy	1
• Tonsillar swelling or exudate	1
• Age 3–14 years	1
• Age 15–44 years	0
• Age ≥45 years	-1
Total score	_____

Results

During the study period, there were 4,067 hospital visits, with 550 cases of acute pharyngitis (13.5%). Three hundred thirteen patients were children aged 3-14 years. We excluded 199 children due to their past history of antibiotic usage within the two weeks prior to the study. Hence, 114 patients were eligible for the study (**Figure 1**).

Characteristics of the study subjects are presented in **Table 2**. Most subjects were male (56.1%) and 6 years of age (18.4%). Fever (73.7%) was the most common clinical problem observed, followed by tonsillar swelling or exudates, anterior cervical lymph node swelling, and the absence of cough. The majority of subjects had total McIsaac scores of 3 (50%) ,followed by a score of 2 (33.3%). Acute pharyngitis is more frequent during the first 3-6 years of life.

Figure 2 shows the ROC curve of McIsaac scores. McIsaac criteria had an AUC value of 78.1%

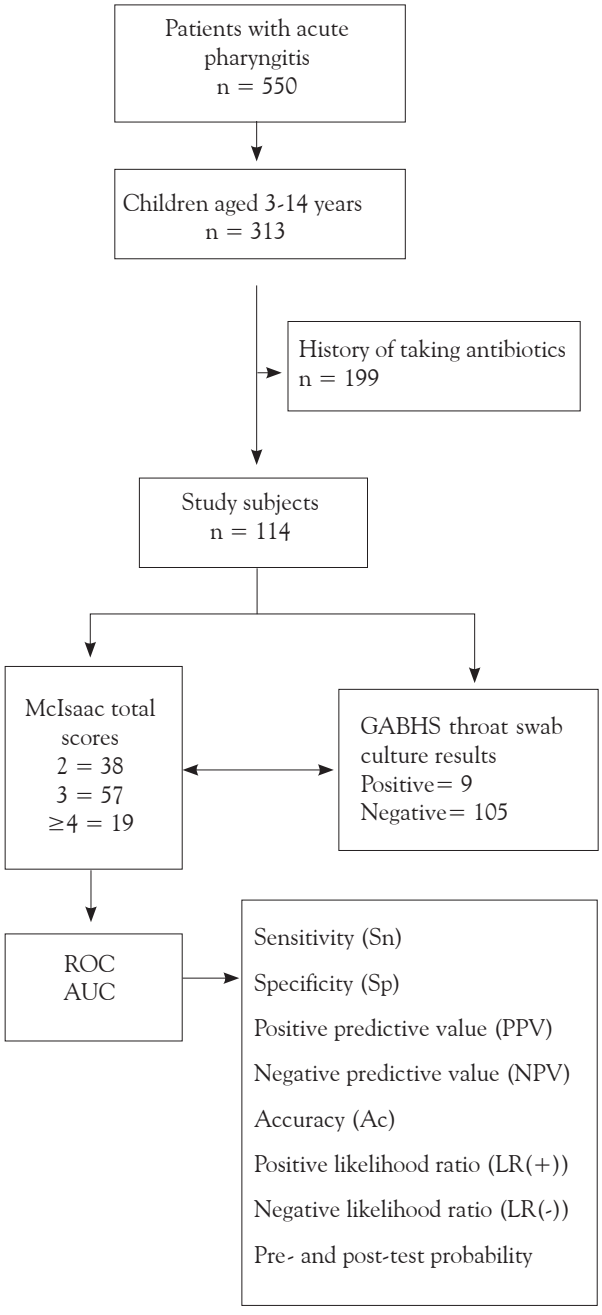

Figure 1. Study flow chart

Table 2. Baseline characteristics of subjects

Variables	n=114	%
Male gender, n	64	56.1
Age in years, n		
3	15	13.2
4	18	15.8
5	17	14.9
6	21	18.4
7	6	5.3
8	7	6.1
9	7	6.1
10	7	6.1
11	12	10.5
12	1	0.9
13	2	1.8
14	1	0.9
McIsaac's clinical criteria		
Temperature> 38ºC	84	73.7
No cough	23	20.2
Tender anterior cervical adenopathy	26	22.8
Tonsillar swelling or exudate	81	71.1
Total McIsaac criteria scores		
2	38	33.3
3	57	50.0
≥4	19	16.7

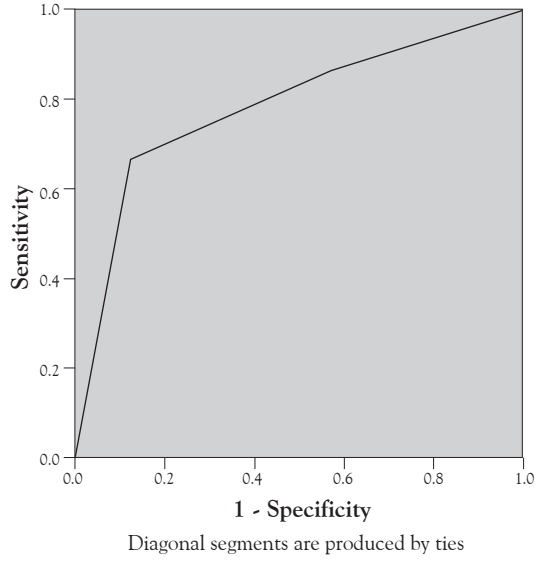

Figure 2. ROC curve of McIsaac criteria

Table 3. Diagnostic test of McIsaac scores confirmed with throat swab culture results

McIsaac's criteria total score	n	Positive culture results	Sn (%)	Sp (%)	PPV (%)	NPV (%)	Ac (%)	LR (+)	LR (-)
2	38	1	11.1	64.4	2.6	89.3	59.6	0.3	1.4
3	57	2	22.2	47.6	3.5	87.7	45.6	0.4	1.6
≥4	19	6	66.7	87.6	31.6	96.8	86.0	5.4	0.4

Sn=sensitivity; Sp=specificity; PPV=positive predictive value; NPV=negative predictive value; Ac=accuracy; LR=likelihood ratio

(95%CI 60.3 to 96%). We found that the prevalence of acute GABHS pharyngitis was 7.9%. **Table 3** shows the diagnostic test results of McIsaac criteria scoring, compared to the gold standard of throat swab culture results.

A total McIsaac score ≥4 had a sensitivity of 66.7% (95%CI 49to 97%), specificity 87.6% (95%CI 81 to 94%), positive predictive value 31.6% (95%CI 11 to 52%), negative predictive value 96.8% (95% CI 93% to 100%), accuracy 86.0%, positive likelihood ratio 5.4 (95%CI 2.7 to 10.7), negative likelihood ratio 0.4 (95 CI 0.2 to 0.9), pre-test odds 0.09, post-test odds 0.05, and post-test probability 0.32.

Discussion

We found that more boys suffered from acute pharyngitis than girls, similar to results of a previous Indonesian study.[7] However, two studies from other countries found that more females than males suffered from acute pharyngitis.[8,9] Some studies on acute GABHS pharyngitis did not display data on gender, possibly due to the lack of a significant difference in numbers of males and females.[10]

Acute pharyngitis was more common in subjects aged 3-6 years in our study. Similarly, an Indian study found that the highest incidence of GABHS pharyngitis was at 4-6 years (14.1%).[11] Tanz *et al*. reported that GABHS pharyngitis occurs in all age groups, but especially during school age,[12] 5-11 years, possibly due to high transmissibility from one child to another.[10]

Fever or a history of fever of>38°C in our study was the most common symptom accompanying pharyngitis, followed by tonsil swelling or exudates, enlarged lymph nodes, and absence of cough. Similarly, Tanz *et al*. found that 90% of GABHS pharyngitis was accompanied by fever.[12] In contrast, McIsaac *et al*. found the most common symptom occurring in acute GABHS pharyngitis to be enlarged lymph nodes with or without pain, followed by absence of cough, history of fever >38°C and tonsil enlargement or exudates.[5] Clinical manifestations of acute pharyngitis vary among studies. Steinhoff suggested that the classic pattern of acute GABHS pharyngitis, such as enlarged tonsils and/or exudates and tender lymphadenopathy are rare in some areas, such as Egypt.[10] As such, diagnostic tests to determine the validity of the clinical criteria in our setting must be undertaken.

We found that most of our subjects had total McIsaac criteria scores of 3. McIsaac[8] had similar findings, in contrast to another UK study that reported a total score of 2 as the most common, followed by 3 and 4.[9]

The area under curve (AUC) values were between 50% (no discriminative value) and 100% (best discriminative value). The ROC curves showed that the McIsaac score has good diagnostic value because the curve away from the line of 50% and nearly 100%.[14] McIsaac criteria has AUC value of 78.1% means that if the McIsaac score is used to diagnose GABHS in 100 children with acute pharyngitis, the correct conclusions that will be obtained in 78 patients. AUC value of 70-80% have moderate interpretation that tends to good.[14] The AUC value has statistically significant difference (P=0.005) to AUC value of 50%.

The prevalence of acute GABHS infections differs among regions and time periods. A longitudinal study in North America reported that the proportion of GABHS pharyngitis tended to not vary over the past 50 years, although the incidence of rheumatic fever and rheumatic heart disease in the US decreased.[10] In Edinburgh (Scotlandia), Ross *et al*. found an incidence of 30.0%,[17] but McIsaac *et al*. reported that an incidence of 17.0% in 2000 in Canada increased by 29.0% in 2004.[8] In addition, Jain *et al*. found an incidence of 12.6% in India in 2008.[11] The incidence of GABHS pharyngitis in Indonesia appears to be lower than that of other countries. A Central Jakarta study reported a prevalence of 6.1%,[16] while a Yogyakarta study found it was as high as 10.2%.[7] We found an incidence of 7.9% in our study.

McIsaac scores in our study and previous studies tended to have low sensitivity, but high specificity.[5,7,8] The sensitivity of a McIsaac score of ≥4 in our study was 66.7% (95%CI 49 to 97%), higher than that of Jurianti who reported a sensitivity of 56%.[7] However, the specificity was 87.6% (95%CI 81 to 94%), similar to that of Jurianti (87%).[7] This high specificity is more meaningful due to the low prevalence of acute GABHS pharyngitis in our population, indicating that in cases with McIsaac score of ≥4, there is higher likelihood that the acute pharyngitis is caused by GABHS, for which a selective antibiotic should be given.

For clinicians, PPV and NPV are more relevant than sensitivity and specificity.[13]The PPV of McIsaac criteria in our study was 31.6% (95%CI 11 to 52%), lower than that of a Yogyakarta study (33%).[7] However, the NPVs of our study and the Yogyakarta study were 96.8% (95%CI 93 to 100%) and 95%, respectively.[7] High NPV in our study indicates that for total McIsaac score of <4, then there is a 96.8% likelihood that the results are actually negative.[13] It means McIsaac score has a good role in excluding acute GABHS pharyngitis diagnosis.

Positive predictive value and NPV are influenced by disease prevalence that may vary among population settings. Therefore, LR(+) and LR(-) are useful as parameters unaffected by disease prevalence.[13] Higher and further LR(+) from one indicates a strong positive results of diagnostic tests and more likely confirm the presence of disease.[15] The LR(+) in our study was 5.4 (95%CI 2.7 to 10.7), indicating that for McIsaac score of ≥4, the ratio of positive results in the positive group compared with the positive results in the negative group was 5.4. There is a high likelihood of GABHS infection for LR(+) values between 5-10 for McIsaac score ≥4, hence McIsaac score can be used to contribute moderately to the acute GABHS pharyngitis diagnosis. Our results were lower than that of McIsaac (6.43),[5] but higher than that of Jurianti (4.39).[7]

Pretest probability (prevalence) of acute GABHS pharyngitis in children prior to diagnostic testing was 0.079. The possibility of a child with acute GABHS pharyngitis after McIsaac score (post-test probability) was 0.32. Post-test probability values within the range of 0.25-0.65 of test-treatment thresholds mean further tests are needed to determine therapy based on the post-test.[19] The low post-test probability may be the reason that McIsaac recommends throat swab cultures for all total scores, even though empirically antibiotics may be given for total scores ≥4.[5]

The combination of McIsaac clinical criteria and rapid detection tests improve sensitivity in diagnosing acute GABHS pharyngitis up to 100%.[8] This combination is greater than the sensitivity of rapid tests alone (85.8%) and expected to improve post-test probability, hence, the use of antibiotics can be decided empirically.[8] However, these rapid detection tests are not widely available in Indonesia.

A limitation of our study was that the subjects were within the age range of 3-14 years, while according to the McIsaac criteria, the scope of children's health extends to the age of 18 years. Studies with a wider age range, involving the ages of 0-3 years and 14-18 years are needed to improve the application of this study to the population. Another limitation was that the throat swab culture was performed only once. A second culture could be used to rule out the possibility of contaminants.

In conclusion, a total McIsaac criteria score of <4 may be useful for excluding a diagnosis of acute GABHS pharyngitis. Suspected cases of acute GABHS pharyngitis with total scores ≥4 require further investigation, such as a rapid strep detection test or throat swab culture as the gold standard, in order to confirm acute GABHS pharyngitis.

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