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Revision of the Jones Criteria for the Diagnosis of Acute Rheumatic Fever at Jiblah University Hospital, Yemen

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ABSTRACT

Background: Acute Rheumatic Fever (ARF) is an important and preventable cause of morbidity and mortality in developing countries including Yemen. Jones criteria provided a standardized approach for the identification of Acute Rheumatic Fever and facilitated an improvement in early case detection.

Aims: To determine the extent to which physicians rely on Jones criteria to diagnose acute rheumatic fever in patients attending Jiblah University Hospital, Yemen.

Materials and Methods: A hospital-based cross-sectional study was carried out at Jiblah University Hospital in Jiblah town, Yemen. Data of 71 convenience samples were collected through an open-ended questionnaire and analyzed using SPSS version 26.

Results: Of 71 clinically diagnosed cases of ARF who tested high ASO titer, only 10 (14.1%) met the revised Jones criteria.

Conclusions: The financial inability of patients to undergo Doppler echocardiography coupled with physician's negligence about the importance of Jones criteria for diagnosing rheumatic fever and their reliance on high ASO titers for diagnosing rheumatic fever could lead to misdiagnosis of rheumatic fever in the study area.

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Introduction

Acute Rheumatic Fever (ARF) is an autoimmune disease that is a post-streptococcal infection due to group Aβ hemolytic streptococcal pharyngitis [1,2]. Joints, skin, subcutaneous tissue, heart and brain are affected by ARF [3]. ARF is considered as one of the most important etiological causes of cardiovascular morbidity and mortality especially in the low-income countries [4]. Recurrent episodes of ARF lead to Rheumatic Heart Disease (RHD). Patients with RHD are highly risk for infective endocarditis, stroke and death [3,5]. In 2004, WHO stated that ARF and RFD diseases are directly related to socio-economic risks and diseases of poverty, driven by malnutrition, poor sanitation, overcrowding, and limited access to medical and health care [5]. Globally, the mortality rate of RHD ranges from1-10% and affects approximately 40 million people, with 300,000 directly attributable deaths each year [1,6]. About 25-40% of all cardiovascular disease and 25-50% of all cardiac admissions are due to complications of rheumatic fever [2]. The prevalence of ARF is approximately 19 per 100,000 population and ranges from 5-51 per 100,000 people worldwide in the age group of 5 to 15 years [7]. Although the incidence of ARF has decreased in high income countries over the past decades with increasing standards of hygiene and access to medical care and health facilities being the major determinants of this change, ARF remains one of the most important causes of heart disease in low income and middle-income countries [5]. Rheumatic fever remains a major global health problem, especially in low-income countries, where the incidence is 100 to 200 times greater than that in high income countries [8]. RHD is preventable cause of mortality and morbidity among young adults and children in developing countries and at-risk populations living

in developed countries [9]. In 2025, The World Heart Federation (WHF) aims to reduce mortality rate due to ARF and RHD by 25% [10]. Early diagnosis of ARF is needed to initiate treatment with benzyl benzathine penicillin G that can prevent recurrent ARF and worsening of RHD [11]. The diagnosis of ARF is complex and there is no single diagnostic test for ARF. The Jones criteria have been the gold standard for ARF diagnosis since 1944 and reconfirmed in principle at an AHA-sponsored workshop in 2000 [12,13]. Jones criteria consisting major and minor criteria. Supporting evidence of streptococcus infection becomes one of the diagnostic criteria used [14]. Major criteria such as chorea, erythema marginatum, subcutaneous nodules, polyarthritis, and carditis, while minor criteria involve polyarthralgia, fever, sedimentation rate at or more than 60 mm and/or C-Reactive Protein (CRP) at or more than 3.0 mg/dl, and prolonged PR interval [15]. Laboratory criteria and echocardiography are essential part of the evaluation of major and minor manifestations in the Jones criteria. In many low-income countries, these tests are simply not available at the community level, and the ability to detect ARF without them is not known [1].

Yemen is one of the poorest countries in the Middle East and North Africa. Since 2014, Yemen has been suffering from war and political conflict and is facing one of the worst humanitarian crises in the world, causing enormous economic and social costs to the country and its people. Instability in the country has made access to health care and medical services in Yemen very challenging. ARF and its sequelae RHD are a major public health concern and burden in Yemen. RHD remains a major public health issue and is still the most common cardiovascular cause of death among children and young adults [16]. Many studies conducted in Yemen reveled that incidence of ARF were 33.7% in Sana'a, 11.9% in Thamar and 8.5% in Aden [6]. Despite the acute rheumatic fever and its sequelae are the most important cardiovascular diseases seen in medical practice in Yemen, the diagnosis of ARF using Jones criteria as a guideline in diagnosing ARF represents a challenge for physicians in Yemen. Most physicians in Yemen depends on serological test as ASO test to diagnosis of ARF and neglect Jones criteria as a guideline in diagnosing ARF. Although a high ASO titer indicates group A streptococcal infection rather than ARF. According to the "Modified Jones Criteria", the diagnosis of ARF does not require serological evidence of recent group A strep infection, but streptococcal infection documented by a positive throat culture and a high ASO titer are considered secondary criteria. According to WHO report 2003, ASO titer is more an evidence of group A streptococcal infection and is becoming a weak indicator to confirm ARF [17]. However, most physicians in Yemen rely on a high ASO titer to diagnose ARF. They neglect the Jones criteria as a guideline in the diagnosis of ARF [8]. To the best of our knowledge, there is a scarcity of information about the use of Jones criteria as a guideline in diagnosing ARF in Yemen. Therefore, this study aims to determine the extent to which physicians rely on Jones criteria to diagnose acute rheumatic fever in patients attending Jiblah University Hospital, Yemen.

Materials and Methods

A hospital-based cross-sectional study. A total of 71 convenience samples were collected from patients diagnosed with acute rheumatic fever based on clinical manifestations and ASO titer test positivity (lack of fulfillment to revised Jones criteria) at Jiblah University Hospital in Jiblah city, Yemen. Informed verbal consent from subjects was obtained before collection of data. Participants were interviewed through an open-ended questionnaire by the researchers. Clinical reasons and lab results are evaluated and discussed in target patients to identify the significance of each criterion to diagnose ARF that coincide with revised Jones criteria.

Statistical Analysis

Data will be analyzed using the Statistical Package for the Social Sciences (SPSS) V26. To assess the association between qualitative variables, the Chi-squared test was used. *P* values less than or equal 0.05 are statistically significant.

Results

The 71 subjects are included in this study. Of these, 50 (70.4%) were females and males represented 21 (29.6%). The mean age was19 ±8.6 and the age group of 14-27 years represented 24 (33.8%); however, patients aged 35 years or more represented only 4 (5.56%). Patients from rural areas represented 37 (52.1%) and urban areas 34 (47.9%). The majority of the study population 42 (59.2%) were given penicillin G (BPG) as prophylaxis for six months and only 1 (1.4%) of them were given the medication for more than one year. Patients mainly suffered from arthralgia accounting for 71 (100%), fever in 55 (77.5%), carditis in 7 (9.9%), major polyarthritis 7 (9.9%). Regarding laboratory results, 10 (14.1%) were positive for CRP, 9 (12.7%) were leukocytosis and a high ESR test value accounted for only 3 (2.70%).

Table 1: Frequency and Percentage of Patients Population

	Frequency	Percentage
Gender		
Male	21	29.6
Female	50	70.4
Age (years)		
7-13	23	32.40
14-20	24	33.80
21-27	15	21.10
28-34	4	
≥ 35	5	5.60
Residence		
Urban	34	47.9
Rural	37	52.1
Duration of use of BPG drug		
3 Months	17	23.90%
6 Months	42	59.20%
1 year	11	15.5%
>1 year	1	1.4%
Clinical Characteristics		
Arthralagia	71	100%
Fever	55	77.50%
Carditis	7	9.90%
Majratory polyarthritis	7	9.90%
Carditis and Majratory polyarthritis	4	5.60%
Laboratories Findings		
CRP	10	14.10%
Leukocytosis	9	12.70%
High ESR value	3	2.70%

In this study, it was noted that about 18 (23%) of the patients participating in this study met some of the major Jones criteria, distributed among 7 (9.9%) patients with carditis, 7 (9.9%) with migratory polyarthritis, and 4 (5.6%) had carditis with migrating polyarthritis. Regarding the relationship between these criteria and the age and gender of the participants, it was noted that most of the participating patients were between the ages of 14-20 years, of whom 4 (16.7%) suffered from carditis, while those over the age of 27 years did not suffer from carditis. There was no statistical association between age and carditis ($P \geq 0.655$). Although 4 (19.4%) male patients had carditis, there was no significant association between gender and carditis ($P \geq 0.09$) of the patients. Of the 23 (32.4%) subjects aged 7-13 years, 20 (87%) had fever, while only 1 (1.8%) of the subjects aged 28-34 years had fever. There is a marginal statistical relationship between fever and age ($P \geq 0.057$). Of the 50 (70.4%) females, 12 (24%) had fever and there was no association between gender and fever ($P \geq 0.649$). Although there was no statistical association between them ($P \geq 0.14$), the ASO titer test result in 40 (80%) of the female participants and more than half of the male participants was 400 IU/mL ($P \geq 0.14$). Regardless, the ASO test titer in more than half of the 14–20-year-old was 400 IU/ml, there was no statistically significant relationship between them ($P \geq 0.18$).

Table 2: Clinical and Laboratory Findings Regarding Gender and Age (in Years) among Study Patients

Variable	Gender		*P* value*						*P value
	Female	Male		7-13	14-20	21-27	28-34	≥35	
	NO. (%)	NO. (%)		NO. (%)	NO. (%)	NO. (%)	NO. (%)	NO. (%)	
Major Jones criteria									
Carditis			0.09						0.66
Yes	4 (19.04)	3 (6)		2 (8.7)	4 (16.7)	1 (6.7)	0 (00)	0 (00)	
No	17 (80.96)	47 (94)		21 (91.3)	20 (83.3)	14 (93.3)	4 (100)	5 (100)	
Majratory polyarthritis			0.95						
Yes	2 (9.5)	5 (10)		2 (8.7)	4 (16.7)	1 (6.7)	0 (00)	0 (00)	0.66
No	19 (90.5)	45 (90)		21(91.3)	20 (83.3)	14 (93.3)	4 (100)	5 (100)	
Carditis and Majratory polyarthritis			0.84						0.46
Yes	1 (4.8)	3 (6)		1 (4.4)	3 (12.5)	0 (00)	0 (00)	0 (00)	
No	20 (95.2)	47 (94)		22 (95.6)	21 (87.5)	15 (100)	4 (100)	5 (100)	
Minor Jones criteria									
Arthralagia									
Yes	21 (100)	50 (100)		23 (100)	24 (100)	15 (100)	4 (100)	5 (100)	
No	0 (00)	0 (00)		0 (00)	0 (00)	0 (00)	0 (00)	0 (00)	
Fever			0.65						0.057
Yes	4 (19.1)	12 (24)		20 (87)	18 (75)	13 (86.7)	1 (25)	3 (60)	
No	17 (80.9)	38 (76)		3 (13)	6 (25)	2 (13.3)	3 (75)	2 (40)	
ASO titer			0.14						0.18
200 IU/ml	4 (19.1)	6 (12)		3 (13)	3 (12.5)	1 (6.7)	1 (25)	2 (40)	
400 IU/ml	12 (57.14)	40 (80)		18 (78.3)	16 (66.7)	13 (86.7)	2 (50)	3 (60)	
600 IU/ml	4 (19.1)	2 (4)		0 (00)	5 (20.8)	0 (00)	1 (25)	0 (00)	
800 IU/ml	1 (4.76)	2 (4)		2 (8.7)	0 (00)	1 (6.7)	0 (00)	0 (00)	
CRP ≥30 mg/l			0.98						0.77
Yes	3 (14.3)	7 (14)		4 (17.4)	4 (16.7)	1 (6.7)	0 (00)	1 (20)	
No	18 (85.7)	43 (86)		19 (82.6)	20 (83.3)	14 (93.3)	4 (100)	4 (80)	
ESR ≥30 mm/h			0.15						0.21
Yes	2 (9.5)	1 (2)		0 (00)	2 (8.3)	0 (00)	0 (00)	1 (20)	
No	49 (98)	49 (98)		23 (100)	22 (91.67)	15 (100)	4 (100)	4 (80)	

**P*-value of < 0.05 was considered statistically significant.

This study showed that most of the patients participating in the current study 61 (85.9%) who were diagnosed with rheumatic fever did not meet the Jones criteria for diagnosing rheumatic fever, but only 10 (14.1%) of the study population who were diagnosed with acute rheumatic fever met the Jones criteria.

Table 3: Distribution of Patients' Diagnoses with respect to Fulfillment of Jones Criteria

	Approved diagnosis of ARF					Unapproved diagnosis of ARF					
Number of revised Jones criteria	1 Major and 2 Minor	2 Major and 2 Minor	2 Major and 3 Minor	2 Major and 4 Minor	NO. (%)	1 Minor	2 Minor	3 Minor	4 Minor	5 Minor	NO. (%)
Frequency of criteria	6	1	2	1	10 (14.1)	14	35	9	2	1	61 (85.9)

Discussion

ARF is still a major public health problem issue in developing nations. ARF can lead to RHD and it is a preventable disease [18]. The most risk factors of ARF are poverty, undernutrition, overcrowding, and limited access to health-care facilities and its burden represents a major challenge in undeveloped countries [19,20]. Early diagnosis of ARF leads to treatment of the disease and reduce its complication. The diagnosis of ARF is based on fulfillment to modified Jones criteria complemented by Doppler echocardiography. A major impediment in the diagnosis of AFR in developing countries is the lack of modern diagnostic tools, such as Doppler echocardiography, which represents economic burden on patients leading physicians to rely on serological tests and clinical features regardless of using Jones criteria to confirm the diagnosis of ARF. In the 1992, AHA revised Jones criteria reveled that, carditis is considered as a major manifestation of ARF. Doppler echocardiography has been reported to be far more sensitive than cardiac auscultation in screening for RHD [5].

Yemen is a developing country and has been suffering from war since 2014. As a result, the country's health system has been destroyed and unable to cope with the major health problems in Yemen, including ARF and its consequences. The diagnostic tools and techniques needed to diagnose AFR are not available for poor patients, especially in rural areas. Therefore, physicians in Yemen do not use the Jones criteria for guidance in diagnosing acute rheumatic fever. They rely on diagnosing the clinical characteristics of rheumatic fever and the high titer of the ASO test, which leads to inaccurate diagnosis of rheumatic fever and the use of incorrect medications which may affect patients' health, as well as, over-diagnosis results in the individual receiving BPG injections unnecessarily and an increased use of health system resources. This study showed that most cases diagnosed as rheumatic fever were misdiagnosed. Of 71 clinically diagnosed cases of ARF who tested high ASO titer, only 10 (14.1%) met the revised Jones criteria. Several studies conducted in Lebanon, Egypt and the Netherland, which stated that the Jones criteria are the gold standard for diagnosing Acute Rheumatic Fever (ARF) and that the ASO titer test has a weak predictive value for suspicion of acute rheumatic fever [2,8,17]. Misdiagnosis of ARF may be due to the lack of diagnostic facilities in the study area as well as the need for Yemeni physicians to have additional awareness regarding the importance of Jones criteria for the diagnosis and management of primary ARF. The current study showed that rheumatic fever disease is more common among females 50% (70.4%), which is consistent with other studies conducted in Ukraine [19]. The same results were also discovered in different regions in Yemen [16,18,21]. However, the results of this study differ from the study conducted in Lebanon [8]. Perhaps the reason for infection in females is greater than in males, because females are more sensitive to infection with Streptococcus A, or because females are responsible for caring for children, reside more in crowded homes, and are less likely to seek health care due to customs and traditions in some countries. The reason may be genetic predisposition. This study reported that ARF is a disease of young adults where the mean age of the target patients was 14±8.6. The majority of target patients are in the age group of 14-20 years 24 (33.8%). The result of the present study is consistent with recently published results in Nepal and Yemen [16,18,21,22]. These studies showed that the majority of patients were poor and belonged to the productive age group in their communities.

Limitation of the Study

The duration of the study and the sample collected were small and the study was limited to one hospital. Therefore, the results of this study cannot accurately reflect the general situation in Yemen. This study highlights how physicians diagnose acute rheumatic fever and it is necessary to follow the Jones criteria as the gold standard for diagnosing acute rheumatic fever.

Conclusion

The incidence of misdiagnosis and mismanagement of patients with acute rheumatic fever, overreliance on high ASO titers, and neglect of the use of Jones criteria in diagnosing acute rheumatic fever may indicate the financial inability of patients to undergo Doppler echocardiography as well as perhaps the need for physician awareness and education. The importance of Jones criteria for diagnosing rheumatic fever and not relying on the ASO test result to diagnose rheumatic fever.

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Data Availability: Data will be made available on request.

Conflict of Interest: No conflict of interest is associated with this work.

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