Original Article

The echocardiographic prevalence of rheumatic heart disease in North Kordofan and initiation of a control program

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Abstract Background: Rheumatic heart disease (RHD) is an important public health problem in Sudan and the most common cause of heart disease in the young in developing countries. Echocardiography (echo) can be done to detect early RHD using small hand held echo (HHE) machines.

This study aims to measure the echo prevalence of RHD, initiate treatment and prophylaxis, conduct health awareness and training of health personnel in North Kordofan.

Methods: A medical campaign was conducted in North Kordofan (Umbadir and Sodari localities) in the period February 14-24/2017. Subjects 5-40 years of age were invited to come for screening which was done using HHE. Echo diagnosis of RHD was based on modified World Heart Federation criteria. Simultaneously, health awareness sessions and training workshops for health personnel were carried out.

Results: In the study period, 3315 people were screened by HHE, 204 subjects were found to have RHD giving a prevalence of 61.5/1000. Definite RHD was found in 133 and borderline RHD in 71 subjects. Female to male ratio was 1.2:1, the most common age group was 11-30 years (63%). Fourteen
patients had severe disease. All definite cases were started on prophylactic penicillin and referred for follow-up. Training of 81 health care providers was conducted using posters and manuals. Health awareness sessions were carried out covering about 30 000 people.

**Conclusion:** The prevalence of RHD in North Kordofan is very high compared to other areas in Sudan and nearby countries. Special attention should be paid to girls and women as RHD is one of the leading causes of maternal mortality. Control measures need to be consolidated and integrated in maternal health programs in this area.

**Keywords:** Rheumatic heart disease, echocardiography, North Kordofan, Sudan.

**Introduction**

Worldwide, rheumatic heart disease (RHD) affects 15.6–19.6 million people and in Sudan, it is the most common cause of acquired heart disease in children and young adults.\(^1\,^2\) In Sudan, patients with RHD present with severe lesions needing surgical intervention in 82% of cases. Surgery is considered palliative as its long term results are suboptimal, moreover, operations costs about 4000 US dollars and only 7% of patients who need surgery had access to it.\(^3\) In recent years echocardiographic (echo) screening documented a prevalence that is several folds higher than that detected clinically.\(^4\,^5\) Availability of defined echo criteria for subclinical RHD from the World Heart Federation (WHF) and small hand held echo (HHE) machines enabled many investigators to objectively study subclinical carditis in different settings.\(^6\) These machines proved to have a sensitivity for definite RHD up to 97%, therefore, it can be utilized in resource limited settings as a tool for surveillance.\(^7\) Kordofan region was identified to bear a large burden of RHD,\(^8\) therefore, a medical campaign was conducted and the results are detailed in this paper.

**Methodology**

A medical campaign that aimed to measure the echo prevalence of RHD, to increase the public awareness and help training of health workers was conducted in North Kordofan in the period February 14-24/2017. The campaign consisted of mobile clinics that travelled from Khartoum to Umbadir and Sodari localities where 13 villages were visited. The area selection was based on the local statistics which suggested that these areas are highly endemic for RHD. In each area, a mobile clinic was located for general medical checkup and treatment of patients and in a separate site, 4 doctors were conducting HHE screening. All the subjects in the target age 5-40 years were invited to come for screening through announcements in the schools and public gatherings.

The study was approved by the Ethics Committee at the Faculty of Medicine, University of Khartoum. Administrative approval from the Ministry of Health of North Kordofan and the locality of Sodari and Umbadir were obtained. The participants or their guardians agreed to participate in the study after full explanation by the research team.

The calculated sample size was 2500 based on an echo prevalence of 30 per 1000 detected in South Darfur.\(^9\)

Three HHE machines (V Scan – General Electric) were used. This machine has a single probe with a frequency 1.7-3.4 mega hertz. It has storage capacity and a battery that lasts about 2.5 hours which was recharged using solar energy from the mobile clinic van. Three pediatric residents were trained on using the HHE supervised by a pediatric cardiology fellow. We utilized a simplified “one view” protocol of the parasternal long axis.\(^10\) Four images were recorded, 2 without and 2 with color Doppler. All the studies were recorded and stored to be reviewed later by 2 pediatric cardiologists. Abnormal echo studies were defined by the modified WHF criteria\(^6\) as follows:

- **Pathological regurgitation** is defined as mitral regurgitation (MR) jet equals to or >2 cm; aortic regurgitation (AR) jet equals to or >1cm.

- **Morphological criteria** are defined as follows:
  - For the mitral valve: anterior mitral valve leaflet >3mm, chordate tendenae thickening, restricted leaflet motion and excessive mitral valve leaflet tip motion in systole.
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- For the aortic valve the morphological criteria include irregular thickening, coaptation defect, restricted leaflet motion and leaflet prolapse.

1. Definite RHD:
   I: If there is pathological valve regurgitation plus 2 morphologic valve criteria.
   II. If there is borderline disease of both mitral and aortic valves.

2. Borderline RHD:
   I. Pathological regurgitation without morphologic criteria.
   II. Two of the above morphologic criteria without pathologic regurgitation.

Clearly definite cases were started on treatment on site and referred for further evaluation while other individuals were told that they will be contacted if an abnormality is detected in their echo after being reviewed by a second cardiologist. The name, age, residence and phone number of the participants were recorded for further contact.

**Results**

Echo screening was performed for 3315 candidates. As shown in Table 1, RHD was diagnosed in 204 subjects giving a prevalence of 61.5/1000. The definite/borderline cases ratio was 1.9:1. Out of the definite cases, 14 (10%) had severe disease. In addition, 14 patients with non rheumatic heart lesions were detected and referred for further management. The most common age group was 11-30 years constituting 63% of definite cases. Females represent 53% of all positive cases and 56% of definite cases.

**Table 1: Results of echo screening**

<table>
<thead>
<tr>
<th>No of Cases (prevalence of RHD)</th>
<th>Age in Years (mean)</th>
<th>Female to Male Ratio</th>
<th>Definite Cases (%)</th>
<th>Borderline Cases (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>204 (61.5 /1000)</td>
<td>5-40 (15)</td>
<td>1.2:1</td>
<td>133 (65)</td>
<td>71 (35)</td>
</tr>
</tbody>
</table>

The types of RHD are shown in Table 2. The most common valve lesion was isolated MR (Fig. 1) which was present in 102 patients (80%) followed by combined mitral and aortic regurgitation in 15 patients (12%). Mitral stenosis was seen in 2 patients (Fig. 2). One patient had 3 affected valves.

**Table 2: Type of RHD in definite cases.**

<table>
<thead>
<tr>
<th>Type of RHD</th>
<th>No of Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitral Regurgitation</td>
<td>106 (79.8)</td>
</tr>
<tr>
<td>Combined Mitral and Aortic Regurgitation</td>
<td>16 (12)</td>
</tr>
<tr>
<td>Aortic regurgitation</td>
<td>5 (3.8)</td>
</tr>
<tr>
<td>Combine Mitral stenosis and Regurgitation</td>
<td>4 (2.1)</td>
</tr>
<tr>
<td>Mitral Stenosis</td>
<td>2 (1.6)</td>
</tr>
<tr>
<td>Combined mitral regurgitation and stenosis and aortic regurgitation</td>
<td>1 (0.7)</td>
</tr>
<tr>
<td>Total</td>
<td>133 (100%)</td>
</tr>
</tbody>
</table>

**Figure 1:** Parasternal long axis view with color Doppler showing moderate mitral regurgitation.

**Figure 2:** Parasternal long axis view showing thickened fused mitral valve leaflets (mitral stenosis) with dilated left atrium (LA).
Kajmar and Hofra villages were found to have the highest burden of RHD as shown in Table 3.

Table 3: Areas with high burden of RHD.

<table>
<thead>
<tr>
<th>Area</th>
<th>No of cases</th>
<th>No of Screened Subjects</th>
<th>Cases per screened subjects (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kajmar</td>
<td>26</td>
<td>297</td>
<td>8.7</td>
</tr>
<tr>
<td>Hofra</td>
<td>14</td>
<td>211</td>
<td>6.6</td>
</tr>
<tr>
<td>Altileih</td>
<td>14</td>
<td>263</td>
<td>5.3</td>
</tr>
<tr>
<td>Hamrat Elsheikh</td>
<td>13</td>
<td>259</td>
<td>5</td>
</tr>
<tr>
<td>Umbadir</td>
<td>19</td>
<td>511</td>
<td>3.7</td>
</tr>
<tr>
<td>Al mashroa</td>
<td>10</td>
<td>281</td>
<td>3.5</td>
</tr>
<tr>
<td>Others</td>
<td>&lt;3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All patients with RHD were contacted by phone after the final revision of HHE and the condition was fully explained to the adults and to the children’s guardians. Patients with severe RHD were started on medical treatment and penicillin prophylaxis and were referred to the cardiac center in Khartoum for possible cardiac surgery or transcatheter balloon dilatation. Patients with definite disease were started on penicillin prophylaxis and asked to come for regular follow-up in Al Obeid cardiology clinic or in Khartoum. Regular phone calls were planned to ensure patients’ compliance with prophylaxis and follow-up. Patients labeled as borderline RHD were asked to come for regular follow-up by echo every 6 months.

Training sessions on ARF and RHD were delivered to 81 medical assistants (Photo 1) using the National Protocol which includes sore throat diagnosis and treatment (primary prevention), ARF diagnosis and treatment (secondary prevention) as well as the protocol for Benzathine penicillin administration.

Two health promoters were trained and they conducted health education sessions using posters, pamphlets and a video clip. They covered about 30,000 people in schools and public areas.

Discussion

This study confirmed the hospital data that pointed to Kordofan and Darfur as high burden areas for RHD. The prevalence in North Kordofan was found to be double that were detected in Niyala camps of internally displaced people which was found to be 33 per 1000 in 2016. The same study revealed an echo prevalence in Khartoum inner city population of only 0.3 per 1000. (9)

Although late diagnosis and treatment of bacterial pharyngitis and ARF are responsible for RHD, it is well known that genetic factors play a role. (11) This was clearly shown in this study by finding clusters of cases in certain areas such as in Kajmar. Further studies are needed in order to define the genetic characteristics of these patients in order to better understand this geographical variation.

Screening projects like the current one have dual utility, first, they help to map the epidemiology of RHD in Sudan and at the same time they provide early detection of cases and implementation of penicillin prophylaxis which will prevent recurrence of ARF, therefore, halts the progression of RHD. However, we need to have necessary resources to manage patients detected on screening as most of them come from poor socio-economic backgrounds. While most experts agree on using secondary prophylaxis to those with definite RHD detected by screening, larger scale randomized trials are needed to confirm the value of this treatment. (12) The use of secondary prophylaxis in those above 30 years of age with mild disease needs to be further studied as recurrence rates are low at this age. Most previous screening studies were conducted on school children age 5–18 years and to our knowledge, no previous such study was performed for older patients. (13)

The age distribution of subjects with RHD detected in this study highlights the impact of RHD on young people who will have a
debilitating disease with a poor prognosis as well as adversely affect their quality of life and economic productivity. Female predominance of RHD noted in this study is well known and has also been reported in Kordofan by Elfaki.(14) This stresses the need for special care to these girls and women as RHD in pregnancy constitutes one of the important preventable causes of maternal mortality in countries where RHD is common.(15) In Sudan, RHD constitutes 60% of heart diseases in pregnancy and has been associated with poor fetal and maternal outcomes.(16) The management of pregnant women with prosthetic valves is complex and needs specialized centers in order to monitor anticoagulation treatment. Therefore, integration of RHD management in maternal health programs is highly recommended in order to counsel these ladies prior to conception.

We initiated a control program in the area with health education sessions and training of medical assistants in all the villages that were visited using manuals and poster. These training tools are planned to be integrated into the non communicable disease programs of the Ministry of Health to guarantee its sustainability.

In conclusion, we measured the echo prevalence of RHD in North Kordofan which proved to be extremely high and affecting mainly women in reproductive age. Efforts should be directed to implement a comprehensive program for RHD control Kordofan and similarly affected areas.

Acknowledgement
We would like to acknowledge the valuable support of the Governor of North Kordofan State, Ahmed Haroun and The Minister of Health, Dr Abdullah Faki and his team. We also like to acknowledge the support of Al Masar Organization for Rural Development who owns the mobile clinics, particularly to Mr Ahmed Bilal Koko and his team.

Funding: This study was funded by the Government of North Kordofan.

Conflict of Interest: None

Ethical clearance: obtained

Informed consent form: obtained

References


