THE PATTERN OF RHEUMATIC HEART DISEASE IN THE URBANIZED BANTU OF JOHANNESBURG

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Rheumatic fever has been said to be commoner and more severe in temperate, than in tropical and sub-tropical climates.[1,2] It has also been stated that white-skinned races are more susceptible to rheumatic fever than dark-skinned ones.[3] A survey of the recent literature, however, shows that rheumatic fever is a major cause of organic heart disease in tropical and semi-tropical areas. Thus, Vakil[4] found rheumatic heart disease in 30·7% of 15,603 cardiac cases in India, and showed it to be second only in importance to hypertension. Other authors in India[5,6] have shown rheumatic heart disease to be the most frequent cause of organic heart disease in their particular series. Similarly, Alimurung[7] found rheumatic heart disease to be the most important cause of heart disease in the Philippines. The findings of Miller *et al.*[8] in their survey of cardiovascular disease among the Africans living in the vicinity of the Albert Schweitzer Hospital, Lamberene, are particularly relevant. In a population resident on the equator, rheumatic heart disease was the most frequent form of heart disease, with a prevalence of nearly 6% of mitral stenosis cases.

There have been remarkably few studies on rheumatic heart disease in the South African Bantu. Heiman *et al.*[9] found 64 in a total of 153 cases of organic heart disease and considered it to be the commonest cardiac disease among these people. Becker,[10] in 3,000 consecutive autopsies on Bantu and Coloured subjects during the period 1924 - 1938, showed that rheumatic heart disease comprised about 8% of all organic disease of the cardiovascular system and concluded that rheumatic heart disease occurs with a frequency equal to other racial groups throughout the world. Schwartz *et al.*,[11] in an analysis of the types of heart disease seen in Bantu patients admitted to one of the medical wards at Baragwanath Hospital, showed that acute and chronic rheumatic heart disease accounted for 23·3% of the cases and was second in frequency only to cryptogenic cardiomyopathy—a form of congestive cardiomyopathy found in the Bantu. More recently, Schrire,[12] surveying the incidence of rheumatic heart disease in 12,512 patients submitted for electrocardiographic examination at Groote Schuur Hospital, Cape Town, concluded that rheumatic heart disease is probably more common in the Bantu than the White population; and because of the infrequency of Bantu patients over the age of 40 years in this series, he suggested that the non-White races are more severely affected by rheumatic heart disease and thus die earlier.

The following study was undertaken to establish the pre-

vailing pattern of rheumatic heart disease among the Bantu in Johannesburg and to determine whether they are more severely affected by this disease than the White population.

MATERIALS AND METHODS

The material for study was obtained from patients with acute and chronic rheumatic heart disease admitted to Baragwanath Hospital, and from records obtained from the Department of Statistics, City Health Department, Johannesburg.

Baragwanath Hospital is the largest of the hospitals serving the Bantu population resident in the complex of townships surrounding Johannesburg. The hospital contains 2,300 beds and admits approximately 50,000 patients of all ages *per annum*.

1. *Acute Rheumatic Fever*

During the period January 1962 - December 1964, 12,000 patients under the age of 10 years were admitted to the paediatric wards. Of these patients, 127 satisfied the diagnostic criteria for acute rheumatic fever as defined by Jones[33] and are the subjects of the present analysis.* The investigations performed on these cases included chest radiography, 12-lead electrocardiograms, full blood counts, erythrocyte sedimentation rates (Westergren and Wintrobe), at least 1 estimation of the antistreptolysin titre, and, in many instances, estimation of the C-reactive protein. Throat swabs were examined for the presence of the haemolytic streptococcus. In addition to bed rest and penicillin, cases were treated with salicylates, but the more severe cases were given steroids. Wherever possible, follow-up study was maintained in the rheumatic fever clinic after discharge from hospital. The material studied in this section is compared chiefly with the large number of cases and information reflected in the Joint UK and US Report on the treatment of acute rheumatic fever.[34]

2. *Mitral Valve Disease*

A total of 208 consecutive patients at Baragwanath Hospital who had mitral valve surgery were selected for study: 181 had mitral stenosis, and 27 had mitral incompetence. The incidence of young patients requiring surgery for mitral valve disease has been compared with the incidence reported elsewhere. In addition, an analysis of the clinical, radiological, electrocardiographic and operative findings in all patients under the age of 20 years was made to determine the severity of the disease in the young Bantu.

3. *Mortality from Rheumatic Heart Disease in Johannesburg*

Mortality figures are not available for the Bantu population of the whole country. The over-all death rate for both the White and Bantu groups is therefore only compared for the City of Johannesburg. From the available statistics it is not possible to express the actual death rate for various age-groups. Thus, only the percentages of the total deaths below the age of 20 years are compared in the White and non-White groups.

RESULTS

1. Acute Rheumatic Fever

Hospital incidence. There were 127 cases of acute rheumatic fever, representing a hospital admission rate of 10·6 cases per 1,000 medical admissions below the age of 10 years.

This is a very high admission rate for a disease which is becoming progressively less frequent in most Western countries. Thus, the admission rate to the Hospital for Sick Children in Toronto for 1925 was 12/1,000, and this had declined to 2·5 cases/1,000 admissions by 1953.[35]

Age incidence. Of the 127 patients, 17 (13·4%) were below the age of 5 years and 110 (86·6%) were aged 5 - 10 years. This incidence is in marked contrast to the infrequency with which rheumatic fever occurs below the age of 5 years in Western European countries.[36] Of the 497 cases studied in the Joint UK and US Report on rheumatic fever, 57% were aged 10 - 15 years, 40% were aged 5 - 9 years and only 3% were aged 3 - 4 years. For the purposes of comparison with this study, of the 214 cases below the age of 10 years, 200 (93·5%) were aged 5 - 10 years and 14 (6·5%) were aged 3 - 4 years.

This predilection for the younger age-group shown in the present study has also been reported from countries with poor socio-economic circumstances. Thus, in India, Vaishnava *et al.*[37] have shown that of 166 cases of rheumatic heart disease below the age of 12 years, 14% were aged 5 years or less at the onset of the disease. Similarly, Borman *et al.*[38] found that 20% of paediatric cases of acute rheumatic fever in Jerusalem were younger than 5 years of age.

Sex incidence. There were 86 females (68%) and 41 males (32%). This marked preponderance of females is unexplained and is at variance with most series which usually report only a slightly higher incidence in females.[39] We have however found exactly the same bias in an analysis of patients submitted for mitral valvotomy who were under the age of 20 years (see below).

Acute carditis. The heart was involved in 101 cases (87%). The diagnosis of carditis was usually established clinically by the murmurs of mitral and/or aortic valvulitis. The murmur of mitral incompetence was present in 64% of cases and mid-diastolic murmurs were audible in 37%. Congestive cardiac failure occurred in 29 of the 101 cases of carditis (23% of the whole group) and was present in 5 of the 17 children who were under the age of 5 years.

This incidence of carditis is higher than is usually reported. Thus, Coburn[20] reported an incidence of 65%, Coombs[21] 72·5% and Poynton[22] 61% in their cases of acute rheumatic fever. It is also noteworthy that congestive cardiac failure occurred with unusual frequency among the Bantu children. This feature was present in only 9·7% of the cases in the Joint UK and US Report on acute rheumatic fever.[34] The severity of the cardiac involvement in the Bantu child is undoubtedly related to the young age at which the acute attack of rheumatic fever occurs.[23]

Extracardiac manifestations. The relatively low incidence of chorea, nodules, arthritis and erythema marginatum are shown in Table I. It is evident from a comparison with the findings of the Joint UK and US Report on acute rheumatic fever[34] that these manifestations are infrequent in the Bantu child. This difference is particularly marked with regard to erythema marginatum; this is not due to difficulty

TABLE I. EXTRACARDIAC MANIFESTATIONS OF ACUTE RHEUMATIC FEVER IN PRESENT SERIES COMPARED WITH FINDINGS OF JOINT UK AND US REPORT[34]

	Present series	*Joint UK and US report*
Chorea	4·8%	10·9%
Arthritis	36·0%	43·3%
Nodules	1·0%	14·0%
E. marginatum	Nil	5·8%

*Cases of acute rheumatic fever occurring above the age of 10 years were not included in this study because a cross-reference system does not exist for this section of the hospital population and because they are not followed up in a special rheumatic fever clinic.

in recognizing the lesion in a dark skin, as the occasional case seen at this hospital has been promptly diagnosed. The disparity in the incidence of extracardiac manifestations of rheumatic fever between the Bantu and the White is difficult to explain. Similar findings have however been reported from India[4,24] and from the Philippines.[25]

Mortality. Five of the 127 patients (3·9%) died during the acute attack; 2 patients were under the age of 5 years and 3 were between 5 and 10 years. All the deaths were due to severe carditis with valvular damage and irreversible heart failure. One case showed histological evidence of severe necrotizing visceral arteritis.

This high mortality is not unexpected in a group of cases where carditis and heart failure are so prevalent, and contrasts strongly with the mortality reported elsewhere. Thus, Atwater[26] in a group of 20,000 cases of acute rheumatic fever found a mortality of 1·7%. In the Joint UK and US Report the mortality was 1·2% within the first year and 2·8% at 5 years.

Recurrence rate. Nineteen of the 127 patients (15%) had a second attack of rheumatic fever within a 3-year period. In the Joint UK and US Report on acute rheumatic fever,[14] 64 of the 497 cases (12·8%) suffered a recurrence within 5 years of the original attack. This high recurrence rate in the Bantu children was due in many instances to failure to continue penicillin prophylaxis. However, this is not the only factor, for it has been shown that the recurrence rate is higher than when the initial attack of rheumatic fever occurs below the age of 10 years.[27]

2. Mitral Valve Disease

(a) *Mitral Stenosis*

There were 181 patients who were submitted to closed mitral valvotomy. Of these, 39 (21·6%) were below the age of 20 years; 2 cases were under 9 years of age, 11 were aged 10 - 14, and 26 were aged 15 - 20 years. The frequency with which young patients required valvotomy is noteworthy and contrasts markedly with the age incidence reported in most other series (Table II). The only other series in which such a high incidence in young patients is reported is from India,[28] where it was noted that a high proportion of their patients were of poor economic and nutritional status.

TABLE II. COMPARISON OF FREQUENCY WITH WHICH MITRAL VALVOTOMY IS PERFORMED IN YOUNG PATIENTS

Author	*Year and country*	*Total valvotomies (all ages)*	*% young patients*
Logan and Turner[44]	(1953) UK	100	Less than 19 years 1%
Goodwin *et al.*[30]	(1955) UK	75	Less than 20 years 3%
Bailey and Bolton[45]	(1956) USA	1,000	Less than 20 years 1%
Angelino *et al.*[46]	(1956) Italy	600	Less than 16 years 2%
Glover[47]	(1959) USA	1,500	Less than 18 years 1%
Borman *et al.*[18]	(1961) Israel	173	Less than 16 years 8%
Cherian *et al.*[28]	(1963) India	373	Less than 20 years 34%
Present series	(1965) S. Africa	180	Less than 20 years 21%

Sex incidence. Of the 39 patients 26 were females (66·7%) and 13 were males (33·3%).

Symptomatology. The functional grade before operation in the majority of patients (92%) was grade III or IV; none were asymptomatic (Table III).

Haemoptysis was present in 50% and in many cases was a recurrent feature. This is the same incidence reported by Wood.[29] The haemoptysis in the majority of patients was thought to be due to rupture of a small intrapulmonary vein. Pulmonary infarction was responsible for the haemoptysis in only 1 case.

TABLE III. MITRAL VALVOTOMY—FUNCTIONAL GRADE BEFORE OPERATION

Grade	*Percentage of patients*
I	Nil
II	8%
III	47%
IV	45%

Systemic embolization was present in 2 of the 39 cases (5%) and resulted in hemiplegia in both instances. This is a low incidence as compared to other series (Goodwin *et al.*[30] 16%) and is undoubtedly related to the fact that there were no examples of atrial fibrillation, in contrast to the usually reported figure of 40% for this complication in older patients.[29]

Pulmonary oedema occurred in 5 cases (12·6%). In 1 case the pulmonary oedema would not respond to medical management; emergency valvotomy was performed but the patient died in the immediate postoperative period. The incidence is similar to that reported by Wood[29] (10%).

Other valve lesions, e.g. trivial mitral incompetence as indicated by the presence of a grade I pansystolic murmur, was present in 5 cases (12·6%); functional tricuspid incompetence was present in 4 cases (10·5%) who also had evidence of severe pulmonary hypertension; aortic incompetence was present in a further 4 cases (10·5%). One case had coarctation of the aorta which was resected at the time of valvotomy.

ECG examination showed all of the cases to be in sinus rhythm with evidence of left atrial enlargement (Table IV). The radiological features were essentially the same as usually observed in adults with mitral stenosis and are summarized in Table V.

TABLE IV. ELECTROCARDIOGRAM IN MITRAL STENOSIS

Right axis deviation	80%
Right ventricular dominance	88%
Left atrial enlargement	100%
Right atrial enlargement	56%
Sinus rhythm	100%

TABLE V. OPERATIVE FINDINGS IN MITRAL STENOSIS, COMPARED WITH THE FINDINGS OF GOODWIN *et al.*[30]

	Baragwanath	*Other series*[30]
Orifice less than 1 cm.	42%	56%
Orifice 1·0–1·5 cm.	58%	37%
Orifice 1·5–2·0 cm.	0	5%
Calcification	2·6%	40%
Left atrial thrombus	5·2%	19%
Mobile leaflets	50%	
Markedly fibrotic leaflets	50%	

Operative findings. The size of the mitral orifice estimated at the time of surgery was always less than 2 cm. in diameter. Left atrial thrombus was present in only 5% of cases. In 50% of cases the valve leaflets were markedly fibrotic; calcification, however, was present in only 2·5% of

the cases. The operative findings are compared to those of Goodwin *et al.*[30] in Table VI.

TABLE VI. RADIOLOGICAL FEATURES IN 39 PATIENTS (UNDER 20 YEARS) SUBMITTED TO CLOSED MITRAL VALVOTOMY

Cardio-thoracic ratio	*Under 50%* 36·6%	*Over 50%* 63·4%	*Over 60%* 6·6%
RV enlargement		100%	
LV enlargement		13·3%	
LA enlargement		100%	
RA enlargement		23·3%	
Main pulmonary artery	Slight enlargement 60%	Moderate—marked enlargement 40%	
Kerley 'B' lines		58·9%	
Pulmonary arterial hypertension		20·5%	
Pulmonary infarction		5·1%	
Haemosiderosis		10·2%	
Pulmonary ossifications		Nil	
Calcified mitral valve		Nil	

The rarity of thrombus within the left atrium is in accord with the low incidence of systemic emboli and the fact that none of the cases had atrial fibrillation. The incidence of calcification is lower than usually reported and is presumably related to the fact that the disease in this young age-group was not of a sufficiently long-standing nature. The high incidence of markedly fibrotic valves is noteworthy.

(b) *Mitral Incompetence*

Twenty-seven cases of mitral incompetence have been operated upon since the inception of cardiopulmonary bypass at this hospital. Thirteen patients were under the age of 19 years; 2 were aged 7 - 9, 9 were aged 10 - 14, and 2 were aged 14 - 19 years.

Sex incidence. Eight were females and 5 were males.

Symptomatology. The functional grade before operation was grade IV in all 13 patients, and all had been in congestive cardiac failure. Haemoptysis was present in only 1 of the cases and this was a patient with predominant mitral stenosis, but with significant incompetence and a heavily calcified valve. Pulmonary emboli, systemic emboli and subacute bacterial endocarditis were not present in any of the 13 patients. Functional tricuspid incompetence was found in 3 patients and a further 3 had mild aortic incompetence.

ECG examination showed atrial fibrillation in 1 case, the remainder being in sinus rhythm. Left ventricular dominance was present in 12 of the 13 cases. The remaining case was the patient with predominant stenosis and a heavily calcified valve. Left atrial enlargement was present in every case.

The radiological and angiographic findings are summarized in Table VII. It is worthy of note that marked cardiomegaly (CTR more than 60%) was present in over 60% of the cases. All the patients were submitted to left and right heart catheterization and left ventricular cine-angiography. Pulmonary hypertension (pulmonary artery pressure greater than 30/15 mm.Hg) was present in every case. The pulmonary vascular resistance was greater than 2 units in 10 of the 13 cases. The mean left atrial pressure exceeded 14 mm.Hg in 10 of the 13 cases.

TABLE VII. RADIOLOGICAL FEATURES IN 13 PATIENTS (UNDER 19 YEARS) WITH MITRAL INCOMPETENCE SUBMITTED TO OPEN HEART SURGERY

Cardio-thoracic ratio	*Under 50%* Nil	*Over 50%* 13 cases (100%)	*Over 60%* 8 cases (61·5%)
RV enlargement		13 cases (100%)	
LV enlargement		12 cases (92·3%)	
LA enlargement		13 cases (100%)	
RA enlargement		7 cases (53·8%)	
Main pulmonary artery	Slight enlargement 6 cases (46·1%)	Moderate—marked enlargement 7 cases (63·9%)	
Kerley 'B' lines		1 case (7·6%)	
Pulmonary arterial hypertension		5 cases (41·6%)	
Pulmonary infarction		Nil	
Haemosiderosis		Nil	
Pulmonary ossifications		Nil	
Retrograde left ventricular cine–angiography	*Slight MI* Nil	*Moderate MI* 5 cases (38%)	*Severe MI* 8 cases (61·5%)
Aortography	*Slight AI* 36 cases (23%)	*Moderate AI* Nil	*Severe AI* Nil

Operative findings. In 12 of the cases the valve was grossly incompetent with a large orifice. Marked shortening and fibrosis of the leaflets, especially the posterior, was present in all of these cases. The remaining case was the one with stenosis and incompetence and a heavily calcified valve. In most cases there was marked dilatation of the mitral annulus.

Type of operation. Eight of the cases were treated with the insertion of a Starr-Edwards mitral valve prosthesis and the remaining 5 were treated by cusp extension (using a pericardial graft) combined with annuloplasty. The severity of the disease in these patients is in marked contrast with the pattern usually reported for this lesion. Thus, patients with mild to moderate degrees of mitral insufficiency may have survival patterns similar to that of the general population.[31-34] Patients with more severe mitral insufficiency may progress to cardiomegaly, pulmonary hypertension and congestive cardiac failure, but this is uncommon in childhood and adolescence, and in Wood's

TABLE VIII. DEATH RATES FROM RHEUMATIC HEART DISEASE IN BANTU AND WHITE POPULATIONS OF JOHANNESBURG FOR THE PERIOD 1960–1963

	Population	*2–4 years*	*5–9 years*	*10–14 years*	*15–19 years*	*20–24 years*	*25–34 years*	*35–44 years*	*45–54 years*	*55–64 years*	*65–74 years*	*75 + years*	*Total*	*Death rate per 1,000*
							Bantu							
1960	493,650	Nil	1	6	4	6	12	10	7	3	Nil	1	50	0·10
1961	505,677	Nil	3	5	7	6	17	10	7	5	6	1	67	0·13
1962	490,004	Nil	1	5	6	3	22	14	12	8	1	Nil	72	0·14
1963	492,179	Nil	3	9	3	3	20	16	13	6	2	Nil	76	0·15
							White							
1960	368,277	Nil	Nil	2	3	Nil	3	9	8	7	7	2	41	0·11
1961	370,000	Nil	Nil	1	1	1	5	9	10	10	4	3	44	0·11
1962	372,400	Nil	Nil	1	Nil	1	4	4	10	10	7	4	41	0·11
1963	374,800	Nil	Nil	Nil	2	Nil	3	9	10	9	13	7	53	0·14

TABLE IX. DEATH RATES FROM MITRAL VALVE DISEASE IN BANTU AND WHITE POPULATIONS OF JOHANNESBURG FOR THE PERIOD 1960–1963

	Population	5–9 years	10–14 years	15–19 years	20–24 years	25–34 years	35–44 years	45–54 years	55–64 years	65–74 years	75 + years	Total	Death rate per 1,000
						Bantu							
1960	493,650	Nil	4	2	3	6	5	7	3	Nil	Nil	30	0·060
1961	505,677	1	3	1	4	10	5	5	3	2	Nil	34	0·052
1962	490,004	1	1	4	2	11	8	8	4	1	Nil	40	0·077
1963	492,179	1	5	Nil	2	10	7	6	1	Nil	Nil	32	0·064
						White							
1960	368,277	Nil	1	Nil	Nil	3	6	2	5	2	Nil	19	0·059
1961	370,000	Nil	Nil	Nil	1	2	2	4	6	2	Nil	17	0·042
1962	372,400	Nil	Nil	Nil	Nil	2	2	4	6	3	4	21	0·055
1963	374,800	Nil	Nil	1	Nil	1	3	6	7	8	4	30	0·079

series occurred in the third decade.[35] Similarly, surgery for mitral insufficiency is rarely performed in the younger age-groups; Linde *et al.*[36] reported the use of the Starr-Edwards prosthesis in a 10-year-old child with rheumatic mitral incompetence and was able to find only 4 previous reports of total mitral valve replacements in children.[37–40]

3. Comparison of Mortality Rates from Rheumatic Heart Disease in the Bantu and White Population of Johannesburg

The over-all death rate for both racial groups of all ages and the absolute number of deaths in the various age-groups for the period 1960 - 1963 is shown in Table VIII. It is evident that the over-all death rate is slightly higher in the Bantu. In the Whites, the total number of deaths for the 4-year period was 179, and of these 10 (5·6%) occurred below the age of 20 years. The pattern in the Bantu, however, was completely different. Thus, of the 265 deaths in the same period, 53 (20·0%) occurred below the age of 20 years.

The findings are similar with regard to the death rates for mitral valve disease (Table IX). Thus, the mean annual death rate for Whites was 0·055/1,000, while the corresponding figure for the Bantu was 0·067/1,000. An analysis of the ages at which these deaths occurred, shows that of the 87 White deaths, 2 (2·3%) occurred below the age of 20 years; however, of the 156 Bantu deaths in the same period, 23 (14·7%) occurred below the age of 20 years.

DISCUSSION

Despite the recent decline in mortality observed in several countries, rheumatic fever and rheumatic heart disease are still a major problem throughout the world. Stamler[41] has shown that in the USA the mortality rate from acute rheumatic fever and rheumatic heart disease in children and young adults has shown a continuous decline in the 20th century. The American Negro has shown a less significant decline in mortality in these age-groups than his white counterpart. Surveying the data on the mortality from this disease in Chicago, Stamler[42] has shown that deaths from rheumatic fever and rheumatic heart disease, below the age of 24 years, are 3·3 times more common in Negroes than in Whites. In his monograph on the epidemiology of acute rheumatic fever, Paul[43] has demonstrated that the urbanization of the American Negro under poor socio-economic circumstances has increased the risk and mortality of acute rheumatic fever and rheumatic heart disease. It seems likely, therefore, that racial predisposition is not as important as exposure to the haemolytic streptococcus in overcrowded urban slums. Thus, Paul has shown that irrespective of race, the death rate for rheumatic fever and rheumatic heart disease is higher for urban children and adolescents than for children resident in rural areas.

Until very recently the Bantu population of Johannesburg was largely engaged in unskilled manual labour and was resident in extremely poor and overcrowded housing conditions. It would not be surprising, therefore, to find that rheumatic fever and rheumatic heart disease exist in both more frequent and more severe form than in the Whites. The data presented in this study support this contention.

Acute rheumatic fever is a disease frequently encountered at Baragwanath Hospital. The high mortality rate of 3·9% is related to the youth of the patients and the high incidence of carditis and congestive cardiac failure. The severity of the disease in Bantu children and adolescents is further illustrated by the remarkable frequency with which these patients require surgical treatment for advanced mitral valve disease. The data on the mortality rates for rheumatic heart disease presented in this paper show similar trends to the pattern prevalent in the USA. Thus, although the over-all mortality rate is only slightly higher in the Bantu than in the White, there is a strikingly higher proportion of deaths among the Bantu below the age of 20 years compared with Whites.

SUMMARY

1. The pattern of acute rheumatic fever and rheumatic heart disease in the urbanized Bantu of Johannesburg is described.
2. Acute rheumatic fever was found to have a high hospital incidence at Baragwanath Hospital (10·6/1,000 admissions below the age of 10 years) and to exist in virulent form because of the youth of the patients and the frequency of carditis and congestive cardiac failure.
3. An analysis of patients submitted for surgical relief of mitral valve disease showed a remarkable predilection for young patients.
4. A comparison of the mortality figures for rheumatic heart disease in Johannesburg shows that the Bantu are more severely affected than the Whites, because of the high proportion of deaths in the younger age-groups.

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