**Introduction**

Paediatric cardiology is a sophisticated highly technical discipline in industrialized countries. It deals mainly with congenital malformations that are often diagnosed in the foetus and treated in the neonatal period. Research often focuses on the origin and the physiopathological mechanisms of cardiac malformations, myocardial diseases and rhythm disorders. In developing countries acquired cardiac diseases are frequent and affect mainly children. Thus paediatric cardiology often is confronted with “conventional” medical strategies and extremely difficult therapeutic and preventive challenges. Congenital malformations usually are not treated in infancy and present later with serious complications such as myocardial and/or pulmonary arterial damage.

This paper is focused on the poorest countries where rheumatic fever and/or other specific acquired diseases are still endemic. Its aims are to: i) present general data that are common to the poorest developing countries; ii) specifically analyse the situation in Sub-Saharan Africa (that includes 31 of the 40 poorest countries of the world) to define the best strategies for treatment in those and other similar situations; and iii) determine how to help through governmental and non-governmental organizations (NGO).

**Heart diseases in developing countries**

The high prevalence of acquired “infectious” cardiac diseases in children and the increase in the number of adults with hypertension and coronary heart disease prompted the WHO in 1998 to declare cardiovascular diseases a priority for health care and prevention in developing countries.

**Epidemiology**

Relevant health statistics usually are imprecise and often simply do not exist. Therefore, estimates of the number of patients who are affected by acquired or congenital heart disease are either very approximate or impossible to obtain. The majority of data come from hospitals that introduce biases since the population is mainly rural, the density of medical networks is low, the cost of hospitalization is high; and diverse cultural factors peculiar to each country play a role. For example, according to Lopez of the World Health Organization (WHO), statistical data on cardiac mortality (including adults) are only available on 68% of the population in Latin America, 16% in Eastern Mediterranean area, 4% in South-East Asia and 0.25% in Sub-Saharan Africa [1].

Although acquired diseases are the most frequent, cardiac problems encountered in those settings, the prevalence and the types of diseases are very variable in the different regions, i.e. Sub-Saharan Africa, Mediterranean, South and Central American, and Far-Eastern developing countries. The main differences relate to diverse prevalences of rheumatic heart disease (from 0.1% to 2%), tuberculosis and specific parasitic and/or nutritional diseases (Chagas’ disease in South America, endomyocardial fibrosis in Sub-Saharan Africa, hydatidosis in North Africa, etc) [2-5].

Cardiac malformations apparently occur with similar frequency in developed and developing countries.
countries (0.8%). Their presentation, however, differs in those settings because of the absence of early diagnosis and the lack of interventions in infancy in developing countries [6]. The presentations of cardiac malformations thus are influenced by their natural history. Malformations that do not adapt to the perinatal circulatory changes are lethal in the neonatal period and usually are not diagnosed. This is why transposition of the great arteries, pulmonary atresia, severe coarctation of the aorta or other critical left ventricular obstructions are extremely rare in these countries. The surviving patients often complain of extracardiac manifestations, e.g. neurological in case of cyanotic malformations, nutritional in case of congestive heart failure, and pulmonary problems due to bronchial compression or frequent infectious diseases. Alterations of the pulmonary arterial bed also occur in patients with pulmonary artery hypertension and myocardial damage is a common consequence of a chronic pressure or volume overload or of a chronic hypoxemia. There are some ethnic specificities in cardiac malformation. The most common concerns the infundibular septum that is frequently lacking in cardiac malformations of the asiatic population. This explains the high frequency of aortic valve prolapsus and regurgitation associated with ventricular septal defects and the special kinds of tetralogy of Fallot (without infundibular stenosis) in these populations.

Systemic hypertension is the major cardiovascular disease in black populations and is recognized as the primary cause of mortality in Sub-Saharan Africa [7]. It apparently occurs frequently in children, although it is rarely diagnosed. It may be due to specific arterial wall characteristics or secondary to dietary habits. Atherosclerosis that was said to be very rare in adult Africans is in fact quite frequent among higher socio-economic groups because of the changes in diet and life style [8].

Management of heart diseases in developing countries

Diagnosis

The precise diagnosis of cardiac diseases depends on the availability and accessibility of reliable echocardiographies. Echocardiographs are increasingly less expensive. Moreover, they often are offered by NGO’s or governmental agencies. One or several echo machines thus are available in most urban centers. However, the presence of a machine is not sufficient. It is crucial that it be maintained. Thus after-sales services and the availability of consumables are also essential. Competent health professionals also are necessary to perform and correctly interpret echocardiographic results. Unfortunately, the local cardiologists, who may be well trained to evaluate rheumatic heart diseases or other specific acquired heart diseases, are too often not trained to manage cardiac malformations competently. In addition, diagnosis is possible only if affected children are referred and primary screening is usually lacking. Primary referral too often depends on the patient’s socio-economic status. In rural regions, primary and secondary school educators should be trained to recognize children with symptoms (oedema, dyspnea, cyanosis) of potential heart disease. Health professionals should be able to perform adequate physical examinations and perform and interpret simple examinations such as chest X-rays or electrocardiograms. In any case the motivation for referring patients is extremely dependent on the therapeutic possibilities. The lack of treatment possibilities serves as a significant disincentive at all levels of the medical chain.

Treatment

Medical therapy when any is available generally is not very efficient. It usually is only palliative. Medical treatment with diuretics, digoxin, vasodilators, etc., are available in most places but are expensive and not always reliable. Available drugs are not well controlled and thus may have variable amounts of the active component. The prescription of these drugs is often inappropriate because a precise diagnosis is not made and/or an adequate medical culture is not available. Some medication, such as anticoagulants, are available but dangerous because the treatment cannot be followed up properly.

Surgery is rarely available even in hospitals that provide care of other paediatric specialties (e.g. urology or orthopaedic surgery). There is usually no thoracic surgeon and when one is available,
anaesthesiology or post-operative care is often not adequate to support any thoracic surgery, even closed-heart surgery. Only a few centers in selected large cities have facilities that include those needed for open-heart surgery, but rarely are these available for children and only exceptionally for infants. The only possibilities for treatment are transfer to cardiology hospitals in developed countries or local surgical missions by surgeons, anaesthesiologists and paediatric cardiologists.

Catheterization has become a powerful tool for the treatment of some congenital or acquired heart diseases (e.g. mitral stenosis in rheumatic disease, aortic or pulmonary valve stenosis in congenital malformations and coronary disease in adults). This technique is rarely available and nearly never for children. This is due to the high cost of the X-ray installation and of the material (e.g. wires, guides, catheters, stents or other prothesis). Also difficulties to maintain a reliable installation often prove overwhelming. There are also very few doctors locally able to perform catheterization. However, this situation should improve in the near future since new mobile X-ray facilities are now available at a reasonable cost (1/3 of the usual catheterization laboratory cost) and new catheters have been designed at a low cost for dilating valves (e.g. for the treatment of rheumatic mitral stenosis). Additionally, the increasing frequency of coronary disease stimulates the creation of private cardiology units in urban centers.

**Prevention**

Rheumatic heart disease is the most typical example of preventable heart disease. It’s prevalence is high in many developing countries even though its prevention (antibiotic treatment of streptococcal angina) is easy, inexpensive and effective [9-12]. The same applies to other acquired disease of an infectious, parasitic or nutritional aetiology. Why is prevention so seldom achieved? Different reasons have been put forward in India [9]. These can be extended to many other developing countries and should be addressed: priority should be given to the prevention of infectious and nutritional diseases. Unfortunately, the available resources are used preferably for diagnosis and treatment – can we choose not to treat? – rather than for prevention strategies that provide the medical staff with less gratification because prevention is anonymous and has no immediate results. Another reason for the lack of attention given to prevention strategies is that epidemiologic data are incomplete and not sufficient to guide the design and implementation of an effective prevention program. Finally, prevention clashes sometimes with short-term economic interests and with cultural, social, and dietary habits that are difficult to change. Prevention, thus, requires consistent methodology, pluri-annual grants and the mobilization of the entire community.

**Contribution of humanitarian organizations**

Apart from prevention policies that should be a priority and involve large co-operative programmes, the only way to treat children with heart diseases in developing countries that lack surgical or catheterization possibilities is through humanitarian help. Three levels of help can be offered.

**Transfer to a developed country**

This type of acute care benefits only a few families. It has the merit of showing results and thus motivates medical teams and politicians. It is therefore a good way to raise awareness. The first step is the availability of at least one reliable and motivated cardiologist and/or paediatrician acting as a referral source for the NGO in the country. A rational protocol for selecting patients, an adequate organization for patient transfer and a requirement for minimal follow-up when the child returns are the keys necessary to this strategy. The choice of the patients is particularly difficult since the local demand is far greater than can be met. Priority is usually given to very symptomatic patients with a high short-term morbidity and mortality who can be cured completely through surgical interventions that require minimal further medication (prophylaxis) and follow-up. Regular forms of tetralogy of Fallot and mitral valve regurgitation that respond to valvoplasty are the best candidates for this strategy.
Local missions

Surgery and therapeutic catheterizations can be performed in reasonably well-equipped hospitals. For open-heart surgery, a stable electrical system (e.g. reliable generator), and the availability of oxygen, a vacuum, anaesthetic ventilator and minimal conditions for postoperative intensive care are required. A complete team is necessary for the first missions (Fig. 1). The requirements for therapeutic catheterization teams are less, since general anaesthesia and post-catheterization intensive care are not necessary. Catheterization however requires an acceptable X-ray table and a pressure monitor scope. For closed-heart surgery, a conventional clean operating room with minimal postoperative conditions are sufficient. Surgical and catheterization missions give the opportunity to treat selected patients, but more importantly they prepare for the creation of a local autonomous structure and self-perpetuating infrastructure.

Local autonomous structure

This is obviously the ultimate goal. The demand should come from medical and political local authorities. Plans must be prepared after a careful study of population needs and of the local capacity and motivation to sustain the effort. The effort’s institutionalization should be defined clearly (public, private, subsidized, etc.) and the financial and economic aspects should be analyzed carefully and addressed. The administrative organization is essential to the success of the programme. It needs careful planning over several years to train medical doctors (cardiologists, paediatricians and intensivists), surgeons, anaesthesiologists, nurses, biologists and administrators. The first two steps may be medical transfer and local missions. With time local medical training improves, a local administration is set-up and the external missions are multiplied with the increasing participation of the local team.

One example of this strategy’s implementation is the Ho-Chi-Minh-Ville Cardiac Institute (Fondation Alain Carpentier). This effort required five years of close collaboration between the Vietnamese government and the French institution (Assistance Publique-Hôpitaux de Paris). Presently over 1500 patients/year (50% children) are operated in this institute by the Vietnamese team. It uses only echocardiography without catheterization and the vast majority of the patients are evaluated properly without any apparent adverse consequences on mortality (3.6%). About 40% of the children are operated free of charge, the cost of open-heart surgery is about US$ 1800 (1/10 of the usual price in Europe) and their budget is not subsidized. They thus demonstrated that very high quality surgery can be done at low cost with good organization.

NGO’s like “Chaîne de l’Espoir” have other activities in Cambodia and in Mozambique, with the goal of creating other cardiac institutes. The philosophy is to treat free of charge the sick children of poor families (almost all patients with rheumatic heart disease are indigent). Funds come in part from various subsidies. They also may come from adult cardiology consultations and interventions, especially in patients with coronary artery diseases that affect predominantly higher socio-economic groups who previously went abroad at very high cost to be treated. This explains why it seems justified to include catheterization laboratories in such cardiology centres. This provides the capability to diagnose and treat adult patients who suffer from treatable vascular and coronary artery diseases. These non-lucrative institutions could work in the future on the basis
of “rich adults paying for poor children”. Last but not least, the institutes also must have academic missions that include teaching, research (epidemiology and/or basic research) and primary prevention. This is the goal in Mozambique where “Chaîne de l’Espoir”, together with other NGO’s from Portugal, England and Switzerland, intend to create a research center on African endocardial fibrosis.

Specific problems in developing countries

Sub-Saharan common cardiovascular disorders

Rheumatic heart diseases

After high blood pressure, rheumatic heart disease is the second most important cause of hospitalization for adult cardiovascular disease in Africa, and by far the first for paediatric patients (3 patients with rheumatic heart disease for 1 congenital malformation) [11-13]. The prevalence among school children is globally about 3 per 1000/year but may be as high as 1% in Guinea. These figures have not fallen in recent years because of the absence or insufficient nature of preventive treatment.

The first episode may occur as early as 3 years of age and new crises may recur in adult life. The most common anomaly is by far mitral valve regurgitation, followed by aortic regurgitation that is usually associated with mitral regurgitation. Tricuspid valve regurgitation is common but more often benign. Mitral stenosis is usually only symptomatic in young adults or adolescents; however, in some African regions with very inflammatory rheumatic disease, it can be seen in children before puberty. Aortic stenosis occurs in adult life.

Mild mitral or aortic regurgitation that occurs after a first episode of rheumatic fever may regress after anti-inflammatory treatment. Usually, several inflammatory episodes are necessary to damage valves. Therefore, it is crucial to avoid new episodes of rheumatic fever by active prophylaxis (e.g. secondary prophylaxis by exten-cillin every 2 weeks). Once the inflammatory process is controlled, the consequences of the valvar lesions should be evaluated and treatment initiated. Diuretics, digoxin and vasodilators are only helpful to improve symptoms. The only non-symptomatic treatment available is surgery. Isolated or predominant mitral regurgitation is the most common condition. The efficiency of mitral valvoplasty (applicable in more than 90% of the cases) has been a fantastic improvement in the treatment of these patients. If possible, valvoplasty must be indicated for all symptomatic children. When they really need therapy, they need surgery. They should be operated before the occurrence of atrial fibrillation (from dilated left atrium), severe pulmonary artery hypertension with eventual right ventricular failure or left ventricular dysfunction. The long-term results are good if the valvoplasty is performed in time and is followed by good prophylaxis. Unfortunately, these conditions are not often fulfilled and a deterioration of the plasty is common. The situation becomes critical since artificial valve replacement is then the only possibility, which requires adequate anticoagulant therapy that is rarely possible in these countries.

Children with severe aortic regurgitation are more difficult to handle since aortic valvoplasty is less reliable than mitral valvoplasty. Valve replacement is often necessary but not satisfactory. Mechanical aortic valves are a possibility since the need for anticoagulant therapy is not as crucial as it is for mitral valve replacement. A modern alternative may be the Ross operation. This technique uses the pulmonary artery valve as an aortic valve, i.e. an autograft. However, this type of operation usually involves a homograft tube being used to replace the pulmonary artery valve, that must be replaced after 5 to 20 years.

Mitril stenosis may occur early in children and may benefit from a catheter dilatation. This gives excellent results if the stenosis is due mainly to fusion of the commissures without too much val-var regurgitation. In any case, the follow-up of all rheumatic fever patients is mandatory with a strict secondary prophylaxis of rheumatic disease and bacterial endocarditis [14-19].

Pericardial disease

Acute pericarditis also is frequent in Sub-Saharan Africa. In many countries the main cause is tuberculosis. This situation is now worse because of the frequency of AIDS. In the absence of early treatment, its natural evolution results in constricive
pericarditis. Purulent pericarditis is also frequent and may lead to constrictive pericarditis if adequate drainage and antibiotic therapy is not performed. The main cause is staphylococcus secondary infection, but amoebic pericarditis also is encountered after rupture of a liver abscess into the pericardium. Viral pericarditis also is more common than it is in developed countries; the evolution of these conditions generally is favourable unless myocardial infection also occurs (specially frequent in AIDS). Rheumatic pericarditis can be observed during the inflammatory phases of the disease. Chronic effusive pericarditis often is observed in endomyocardial fibrosis and in other kinds of restrictive cardiomyopathies. Chronic constrictive pericarditis, mainly due to tuberculosis or purulent pericarditis, is a life-threatening condition that requires closed-heart surgery.

Arteritis
Arteritis is not uncommon in the course of rickettsial or typhoid fever. Kawasaki disease is present but appears relatively uncommon. Conversely, Takayashu disease is relatively frequent and often is localized to the descending aorta. Thus it simulates the classical isthmic coarctation of the aorta.

Cardiomyopathies
Myocarditis is much more common in developing countries than it is in developed countries. It is the consequence of the high frequency of all infections (bacterial, parasitic and viral) common to these countries although particular emphasis is merited by typhoid fever and AIDS. Other viruses, rickettsiae, rabies and tuberculosis should not be ignored. Human African trypanosomiasis cardiomyopathy is observed in a third of the cases at the generalized blood stage. It gives mainly electrocardiographic T and ST anomalies, and sometimes conduction disorders lead to complete heart block that may regress with corticoids [20, 21].

Bilharziasis (schistosomiasis) can affect the liver, lungs and the myocardium. Its most common cardiovascular manifestation is pulmonary arterial hypertension. It usually is reversible after antiparasitic treatment. However, in 2 to 3% of the patients, the lesions are severe (disseminated) and irreversible (fibrosis with endothelial destruction). The patient develops right heart failure, and cyanosis with a very poor short-term prognosis [22, 23]. Myocardial infection is less common, but the myocardium may be affected through indirect mechanisms such as hypereosinophilia, severe anaemia or myocardial toxicity secondary to the antiparasitic treatment.

Myocardial reactions occur sometimes in acute falciparum malaria. This condition may be associated eventually with relative bradycardia and dissociation between pulse and temperature; the prognosis is not influenced by the cardiac signs. Conversely intoxication with quinolinic drugs can lead to QT lengthening and death by “torsade de pointe”.

Metabolic cardiomyopathies (carnitine and thiamine deficiencies) are also more frequent in developing countries. Nutritional deficiencies (primary and conditional) and the high frequency of consanguinity are the main reasons for the higher prevalence of these abnormalities.

Drepanocytic cardiomyopathy is very rare in childhood. It results from the combination of chronic anaemia, myocardial or pulmonary infarction and secondary pulmonary artery hypertension [24]. The difficulties in performing cardio-pulmonary bypass in this condition were outlined in the 1970’s. These are due to the decrease in oxygenation and acidosis that occur during the procedure. These may precipitate the sickling phenomenon [25, 26]. Mild hypothermia and haemodilution seem to solve these difficulties [27].

Submitral aneurysm of the left ventricle has been reported quite frequently in Nigeria and Congo Democratic Republic (3% of autopsia) [28]. Their aetiology is understood incompletely, but they are considered by most authors as sequelae of a primary condition (e.g. tuberculosis). The mitral valve often is involved and thromboembolic complications may occur. Calcification of the aneurysm may suggest the diagnosis from a simple chest X-ray. Surgical resection of the aneurysm with eventual mitral valvoplasty can be considered in symptomatic patients.

Endomyocardial fibrosis
This condition is especially frequent in Africa. It also presents in India and South America. Endomyocardial fibrosis deserves special considera-
tion since it is a specific and intriguing disease of developing countries [29]. Its very severe prognosis can be improved by surgery [30, 31].

This condition was described in developed countries by Löffler in 1936 under the name of fibroplastic endocarditis and later in Uganda by Davies in 1948 under the name of endomyocardial fibrosis [32, 33]. These descriptions probably represent two aspects of the same disease. It is observed in Europe in an early inflammatory stage and in Africa in later stages [34]. The lesion begins in the endocardium and usually stays in the sub-endocardial layers where necrosis, thrombosis and fibrosis appear. Fibrosis eventually may affect the myocardium.

The disease starts in children usually after the age of 3 years. Symptoms of congestion are more common after 10 years of age. Fibrosis usually predominates in the right ventricle and right heart failure with liver congestion, ascitis, pericardial and pleural effusion occur but never with limb oedema. Fibrosis also can affect the left ventricle with pulmonary oedema. Atrial rhythmic disturbances are frequent, secondary to atrial dilatation, and thromboembolism complications may occur. Prognosis is poor. Death occurs a few years after the onset of the symptoms, but long periods of stabilization are possible (Fig. 2).

The diagnosis is confirmed by echocardiography with Doppler signs of restrictive cardiomyopathy. Because of the fibrosis and retraction of the tricuspid papillary muscles and mitral valves, regurgitation is common. Spontaneous microcavitations are present in the inferior vena cava and subhepatic vein. These conditions explain stagnation of blood. Calcification of the endomyocardial fibrosis may be seen on chest X-ray and the electrocardiogram shows atrial hypertrophy when the patient is in sinus rhythm.

Medical treatment is based on anticongestive therapy with diuretics and draining of pleural and pericardial effusions and ascitis fluid. Atrial dysrhythmia should be controlled and anticoagulant drugs also may be useful. Surgery at times is an option. Its aim is to remove the endocardial fibrosis and calcifications and to liberate the papillary muscle thus recovering satisfactory atrioventricular valve function. Valve replacement should be avoided. The treatment is effective in improving the diastolic compliance of the ventricles. If done properly, it can stop the worsening of the disease [31].

The condition’s aetiology is understood incompletely. Eosinophils have been implicated as co-factors in the aetiology [35-37]. Epidemiological studies have assessed the disease’s geographical distribution and the dietary practices of the populations it affects [38-40]. It is striking to observe the associations between the prevalence of the disease and the consumption of cassava. In Mozambique, 98% of patients with endomyocardial fibrosis have...
a nearly exclusive cassava diet. In monkeys, a protein deficient cassava diet can provoke an endomyocardial fibrosis whereas a banana diet does not [41-42]. Epidemiological and experimental studies have also been performed in India. Roles for magnesium deficient and cerium adulterated diets also have been postulated [43, 44].

**Mediterranean developing countries**

Rheumatic heart disease is the main concern in this region. It is particularly prevalent in Algeria and Morocco. Nonetheless progress has been made. Its prevalence apparently has decreased from 15 per 1000 to 3.5 per 1000 in the last twenty years [15]. Hydatid cysts are still observed currently in Maghreb, with intramyocardial or pericardial cystic formations.

**South and Central America**

Rheumatic heart diseases remain an important cause of morbidity in these regions. It occurs principally in adults since primary prevention campaigns have been very efficient in many countries of these regions. In Costa Rica, the number of hospitalized rheumatic fever cases has decreased by 90% following a primary prevention campaign [16].

Trypanosomiasis (*T.cruzi*) or Chagas’ disease threatens 90 million people in 17 countries of South America [45-49]. The infection often starts in children. It usually presents as a mildly symptomatic acute myocarditis. At this stage of the disease, the parasite may be detected in the blood, sometimes in the pericardium, or even in the myocardium (for the rare mortal cases). After 5 to 20 years, approximately 50% of the patients may present with a chronic cardiomyopathy with myocardial fibrosis and common rhythmic and conduction disturbances. The parasites are no longer present in the myocardium and the cardiomyopathy appears to be the long-term consequence of an auto-immune disease triggered by the parasitic infection. The exact mechanism of the fibrosis is unknown, although some authors have postulated that eosinophils play a role [46]. Eosinophils and neutrophils may be involved in a vicious cycle that follows the disappearance of the parasite. These cells likely are recruited to clear the tissues that their activity builds. Some have suggested that the disease process is triggered by the cleaning of the necrotic tissue. This possible aetiology, however, does not exclude an auto-immunity process as a starter of the disease [47-49].

**Conclusions**

Acquired heart diseases are a major public health problem in developing countries. They present one of the more difficult challenges from preventive and therapeutic points of view. Prevention requires the mobilization of the entire community and the setting up of an efficient health system. Treatment, often surgical, relies on advanced technology and expensive tools and requires well-trained health professionals. Its successful implementation depends on a long step-by-step
co-operative plan with governmental and non-
governmental organisations that has as a final 
goal, the creation of autonomous cardiology cen-
tres. These institutes’ missions include diagnostic 
and therapeutic services and preventive, educative 
and research tasks.

Acknowledgments

We would like to thank “Chaîne de l’Espoir” and 
“Fondation Alain Carpentier” who allowed us to 
co-operate with Vietnam, Cambodia and Mozam-
bique, to set up local missions, contribute to the 
formation of health professionals and create local 
heart centers able to diagnose, treat and follow 
children suffering from congenital and acquired 
heart diseases.

References

1. Lopez AD. Assessing the burden of mortality from car-
dio-vascular diseases. World Health Stat Q 1993;46:91-
6.
2. Alwan AA. Cardiovascular diseases in the eastern Mediterra-
3. Boedhi-Darmojo R. The pattern of cardiovascular dis-
4. Muna WFT. Cardiovascular disorders in Africa. World 
5. Yao C, Wu Z, Wu Y. The changing cardiovascular pat-
6. Maron BJ, Applefeld JM, Krovetz L. Racial frequencies 
7. Pobee JO. Community-based high blood pressure pro-
Gambiense (a propos de 194 malades). Acta Cardiol 
1974;29:363-81.
9. Lindsay J, Meshel JC, Patterson RH. The cardiovascular mani-
festations of sickle cell disease. Arch Intern Med 
1974;133:643-51.
10. de Leval M, Tashwell HF, Bowie EJW, Danielson GK. Open 
heart surgery in patients with inherited haemoglo-
binopathies, red cell dyscrasias and coagulopathies. 
11. Leachman RD, Millet WT, Atias IM. Sickle cell trait com-
plicated by sickle cell thrombi after open heart surgery. 
heart surgery in sickle cell haemoglobinopathies: a report 
matic fever. A statement for health professionals by the 
Committee on Rheumatic Fever and Infective Endo-
carditis of the Council on Cardiovascular Disease in the 
Young. Circulation 1984;70:1118-22A.
14. Vyse T. Rheumatic fever: changes in its incidence and 
42. Sezi CL. Effects of cassava diet on Cercopithecus aethiops livers; a case for cassava as the cause of both tropical splenomegalgy syndrome (TSS) and endomyocardial fibrosis (EMF). *East Afr Med J* 1996;73:S24-8.