Perspective

African experiences of humanitarian cardiovascular medicine: the Mozambican experience

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Introduction

Independent from Portugal since 1975, Mozambique covers 800,000 km^2 and has 2,470 km of coast line. With the Indian Ocean on the East, it shares borders of 4,571 km in total with the following countries: South Africa (491 km) and Swaziland (105 km) in the South; Zimbabwe (1,231 km), Zambia (419 km), Malawi (1,569 km) in the West; and Tanzania (756 km) in the North. The estimation of Mozambique population for 2012 is 23.5M inhabitants; the population density was last reported at 29.74 per sq. km. Two thirds of the population is under 25 and around 46% are under 14 years (median age is 16.8 years). The life expectancy is below 50 years old and infant mortality rate is around 130 per 1,000 live births. Total fertility rate is 5.4 children born/woman. The prevalence of children underweight under the age of 5 years was 21.2% in 2003, and that of HIV/AIDS is 11.5% in the adult population (1,2).

According to the World Bank report from 2011 (3), the income per capita is only $1,400, and around 5% of the GDP is allocated to health expenditures. The physicians density is 0.027/1,000 habitants and hospital bed density is 0.8 beds/1,000 population (3).

The heart diseases situation

The epidemiological profile of Mozambique is dominated by infectious endemic diseases such as Malaria, Schistosomiasis, Tuberculosis and water born diseases, but heart diseases also rank high and affect particularly young people. The cardiovascular diseases which threaten the children of Mozambique are mostly Congenital Heart Disease, Rheumatic Heart Disease and Endomyocardial Fibrosis (EMF). EMF affects 19.8% of the population in some coastal regions (4); its only active treatment is surgery. Regarding adults Systemic Hypertension, Stroke and Dilated Cardiomyopathy are the most important conditions (5-7). Complications of endemic infectious diseases such as Tuberculosis and HIV represent a burden at all ages.

There are currently 13 cardiologists working in the country (4 expatriates working under bilateral agreements between Mozambique and Cuba governments) and 3 cardiac surgeons. While echocardiography is available on a routine basis in the referral hospitals (two for the southern, one for the central and one for the northern regions of the country), cardiac catheterization is only available in the capital city (*Figure 1*). These invasive procedures have been performed mainly by visiting teams from overseas, but routine exams by local cardiologists are due to start in one of the referral centers. Regarding surgery, from 2001 to 2010 it was performed exclusively by teams from overseas that visited the country periodically, sponsored by humanitarian organizations; this has changed in the last two years, with local teams at the Central Hospital in Maputo and Instituto do Coração performing open heart surgery.

Humanitarian efforts in cardiovascular medicine in Mozambique

The humanitarian efforts in the area of cardiovascular diseases are done mainly by local and foreign non-governmental organizations (NGO's). The first initiative originates from the Instituto do Coração and started in the last decade. A second, more recent international partnership with the main referral hospital in the country, provides the framework for regular sessions of open-heart surgery.

Figure 1 Map of Mozambique showing the 11 provinces of the country, one of which is the City of Maputo (location 11). Maputo City is the place where the two major referral units are located (Hospital Central de Maputo and Instituto do Coração). Together these institutions have 9 of the 13 cardiologists working in the country and are the only having availability of cardiac catheterization and open heart surgery. Only other two of the remaining 10 provinces of Mozambique have cardiologists (locations 3 and 7). The hospitals in these locations serve as referral points for all patients of the central and northern regions

Instituto do Coração (ICOR)

ICOR is a private non-profit organization located in the capital of Mozambique, which is devoted to service provision, training, research & prevention in the area of cardiovascular medicine. It represents a collaborative effort between a Mozambican non-government organization (*Amigos do Coração*) and four humanitarian organizations from Europe: *Chaine de L'Éspoir* in France, *Chain of Hope* in England, *Cadeia da Esperança* in Portugal and *Couer pour Tous* in Switzerland (8). All founder organizations are orientated mainly towards the management of cardiovascular disease in children. The Mozambican government supported this initiative and the Ministry of Health (MoH) designated a group of doctors and nurses from public hospitals to initiate the project. After an agreement was signed between the ICOR and MoH local professionals were trained and the first open heart surgery was performed in 2001 by a visiting team from Europe.

Training: Mozambican doctors and nurses have been trained through join programs including local training, stays in European hospitals and mentorship programs involving senior specialists collaborating with the above mentioned humanitarian organizations in France, England, Portugal and Switzerland. This was important to create local capacity for diagnosis, management and research into cardiovascular diseases. Under this program several Mozambican doctors underwent post-graduate training to become cardiologists, cardiac surgeons, anesthetists; simultaneously, local technicians and nursing staff were trained to insure cardiac surgery through programs that included usually 6-12 months stays abroad. The financial support for this program has been obtained from international organizations such as *Cooperation Française* and *Cooperação Portuguesa*, which made scholarships available and contributed with transport of equipment and consumables donated from hospitals in Europe.

Service provision: cardiac catheterization and open heart surgery have been made available for the first time to the Mozambican population through joined efforts of ICOR and its partners. The procedures have been performed free of charge to children from underprivileged families, while adults and patients from affluent backgrounds benefit from subsidized prices. Initially, the local cardiologists selected the patients that would be treated by the visiting international teams periodically. With progressive training of the local team low and medium risk surgical procedures are performed on a continuous basis by the local surgeons, while cardiac catheterization continues to be performed by visiting teams.

Research: the ICOR has put neglected cardiovascular diseases such as Rheumatic Heart Disease (RHD) and Endomyocardial Fibrosis (EMF) at the top of its research agenda.

Figure 2 Research projects implemented in the rural area with high prevalence for endomyocardial fibrois involved local health professionals. In this picture the laboratory technician from the local Health Centre obtains a blood sample from a child participating in the epidemiological study

Epidemiological research on RHD was implemented through an exchange program of doctors between France and Mozambique. The main focus of the studies was gathering epidemiological data as well as comparing echocardiographic screening and clinical diagnosis of rheumatic heart valve disease. The results of these studies favored the use of echocardiography for early diagnosis and showed a prevalence higher than that estimated by the world health organization, at 30 per 1,000 in schoolchildren (9). Moreover, this work fueled studies from other endemic regions for RHD using portable echocardiography for early diagnosis and follow-up; this resulted in increased awareness about the disease and advocacy towards its prevention in countries where it had not been recognized as a public health issue.

Another condition targeted by the ICOR's research program was EMF, a restrictive cardiomyopathy with high morbidity and mortality that is endemic in certain regions of Mozambique, being a leading cardiovascular cause of admission to hospital in young people. Community research was coordinated at the ICOR Research Centre built in a remote rural area known for its high incidence of the disease (10), and has benefited from support of the surrounding communities and local health professionals (*Figure 2*). Echocardiographic screening using battery-powered ultrasound machines was used to determine the prevalence of EMF in this population and to refine criteria for diagnosis of the disease. These efforts driven by local cardiologists and financially supported mainly by the Harefield Research Foundation (UK), have resulted in joined publications showing that EMF is a public health problem in that region (prevalence of 18.9% in the general population) and describing some aspects of its pathophysiologic mechanisms and natural history (7,11).

One particular aspect of research was the description of the profile of congenital heart disease in Mozambique, by studying the 534 patients with congenital heart disease assisted at ICOR during the first 6 years (12). A pattern of late presentation with severe complications emerged. The median age at diagnosis was 4 years (range, 0-79) and only 282 (52.8%) patients were diagnosed before the age of two years. High rate of complications was found at first presentation, leading to high rates of refusal of surgery; less than half the patients being operated (196 patients; mean age of 8±10 years). The profile of congenital heart defects was similar to that of other areas of the world with left-to-right shunts corresponding to 2/3 of the cases, caused mainly by ventricular septal defect (32.0%), atrial septal defect (14.4%) and persistence of ductus arteriosus (4.8%). Fallot´s tetralogy was the most common cyanotic defect present in 85 patients (15.9%). Patients with indication for surgery would be operated within a mean period of 3-6 months after the diagnosis; patients less than 6 kg who needed urgent surgery were submitted to closed-heart surgery (usually systemic-pulmonary shunt or pulmonary banding) as a first step of a two-staged procedure. In this resource-deprived setting the approach to management of CHD emphasized the treatment of "curable" malformations, and neonatal surgery was not performed.

Of interest is also the description of the unique clinical and demographic profile of patients with rheumatic mitral stenosis submitted to percutaneous valve dilatation in Mozambique, compared to that of patients from developed countries. It has shown that Mozambican patients have earlier and more severe disease, but similarly good immediate results are obtained after of the procedure (13).

Humanitarian initiatives in the public sector

The *Hospital Central de Maputo (HCM)* is the main referral unit in the country, and like the ICOR is located in the capital city, Maputo. It is a 2,000 bed public hospital managed by the Ministry of Health, and constitutes the main teaching hospital for the Faculty of Medicine of the

major public university and the institutions responsible for training other health professionals. Visiting teams from Valencia (Spain) started open-heart surgery at this hospital 4 years ago. Although a local team is now able to operate continuously for the past three years, the humanitarian missions from Spain continue to occur periodically to provide both support for selected surgical procedures and continuous medical education for the local team. Surgery is mainly for treatment of adults and adolescents with acquired heart disease (personal communication Dr A Morais).

Other key-players

A major challenge faced by the health authorities is to insure continuity and guaranty sustainability in a foreseeable future. Supply of consumables needs to be improved, maintenance of equipment acquired through these humanitarian projects is a problem and the cost recovery system in weak. The rate of unemployment in Mozambique is 21% (3), and private health insurance systems only cover a minority of the citizens.

Public enterprises: the costs of cardiovascular medicine in general, and of cardiac catheterization and surgery in particular, cannot be afforded by the average Mozambican citizen. Even the subsidized prices charged by the ICOR to those patients considered affluent, are still unaffordable to the majority of the population. In the public sector these high costs are permanently questioned, due to the competing needs inside the health system, namely prevention of endemic infectious diseases, as well as maternal and child care. To face this situation some local enterprises have been supporting financially their employees in need of catheterization or surgery, while others donate money to support activities of these health institutions. These efforts of local partners are contributing for the sustainability of these projects.

Professional organizations: local efforts to increase the quality and quantity of training activities in the area of cardiovascular diseases have been undertaken locally. The College of Cardiology of the Medical Council of Mozambique, which congregates all cardiologists practicing in the country, has taken the leadership of this process raising awareness about the burden of cardiovascular diseases in the country. Acknowledging the scarcity of cardiologists in the country the members of the College organize and deliver free of charge educational activities targeting general practitioners, physicians, pediatricians and other health professionals involved in the care of cardiac patients. These activities aim at improving the referrals, making correct use of the available diagnostic and therapeutic resources, and updating all professionals on the new developments in cardiovascular medicine as well as promoting research that is relevant for the Mozambican context (*Figure 3*).

Figure 3 Picture showing a continuing medical education session to an audience of cardiologists, general practitioners and medical students, as part of the humanitarian work organized by members of the Mozambican College of Cardiology

Lessons learned, challenges and opportunities

Humanitarian efforts in cardiovascular medicine in Mozambique have been complementing the services provided by the government in an innovative way. They have pioneered the introduction of invasive diagnosis and cardiac surgery in the country, and have been key in promoting research. Training of cardiologists has been done locally with the candidates spending a variable amount of time overseas to acquire competences for which internal tutorship is judged insufficient or inadequate, mainly intensive care, cardiac catheterization and cardiac surgery. Finally, these join projects involving the humanitarian organizations have contributed to increase knowledge of the epidemiology and natural history of cardiovascular diseases in sub-Saharan Africa, particularly those affecting children.

Pediatric cardiovascular care is a major need in

Mozambique, considering the high fertility rates and the fact that half the population is under the age of 15 years. The incidence of congenital heart disease in Mozambique does not seem to differ from that reported in other countries, and therefore high numbers of procedures would be necessary to treat these defects. On the other hand, the prevalence of diseases such as RHD and EMF, which need catheterization and surgery for management in a considerable proportion of cases, contribute to further increase the burden of cardiovascular diseases on the health system.

Although clearly insufficient to answer the needs of the Mozambican population, the humanitarian experiences here reported are important to increase availability of cardiovascular services in this poor country and its under-resourced health system. Mozambique faces simultaneously the burden of cardiovascular disease related to poverty in remote rural regions, conditions of affluence in urban areas and complications linked to the increased prevalence of HIV/AIDS.

Sustainability of these humanitarian initiatives and their extension to the entire population remains a major challenge, as there are competitive needs and priorities for local partners, industry and communities. Reutilization and re-sterilization of some consumables and equipment is a strategy to address the issue of costs in cardiac catheterization and surgery, but strict infection control measures are needed due to the high prevalence of HIV, viral hepatitis and tuberculosis. Linkage of service provision to locally relevant research programs may also be used to reinforce infrastructure, guaranty high quality of care, and improve working and salary conditions, thus contributing to increase health personal satisfaction and promote retention of highly qualified personal. Publication of research contributes to improve the reputation of the institutions, therefore increasing their capacity to apply for competitive grants and build partnerships outside humanitarian organizations.

The humanitarian efforts of health professional organizations in training the Mozambican workforce are important to improve the quality of care. These organizations must become progressively more involved in health education and promotion in the communities in order to influence their medical care seeking behavior, stimulate adoption of national strategies to reduce preventable diseases, and advocate towards adoption of lifestyles that can reduce the burden of emerging cardiovascular diseases.

Conclusions

The Mozambican experience of humanitarian cardiovascular medicine has pioneered changes that contributed to improve quantity and quality of cardiovascular care delivered to the communities, as well as to increase awareness about the profile of cardiovascular disease in the country. The joint projects involving foreign humanitarian organizations must be seen as seed efforts towards the development and reinforcement of high quality services in which care provision, training activity and research are carefully balanced to answer the major needs of local communities in this area of medicine.

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