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Research Article

Intraoperative Management of a Patient Undergoing Cardiac Surgery in Sao Luis Public Hospitals in Brazil versus to that Seen at an Isolated Cardiac Institute in Tanzania: A Comparative Study between Centers of Middle and Low-Income Countries

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Abstract

Introduction: In low income countries of Africa where there no adequate cardiac facilities and expertise, lack of adequate data for patients with cardiac disease, the pattern of cardiac disease is not well known, but a continuum attendance of patients seeking medical care prevails. While we know quite well the disease process and profile for developed countries where there is adequate and published data we lack adequate knowledge to compare the surgical technique that is used in middle income countries. The objective of this study was to compare the disease pattern and surgical technique as seen in a newly established Cardiac Institute, The Jakaya Kikwete Cardiac institute located within the Muhimbili National Hospital in Tanzania and patients seen at three public Hospital in Sao Luis Brazil.

Patient and Methods: This was a retrospective study that reviewed all cases seen by the author during his fellowship training at The Federal University Hospital of Maranhao and compared to cases seen at the Jakaya Kikwete Cardiac institute, in Dar es Salaam Tanzania. All patients that were either managed by local adult surgeons or by visiting team in a form of surgical mission were included into the study. Patient were seen at various occasions in Sao Luis public Hospital represented by State hospital, the Hospital Dr. Carlos Macieira, The Federal University of Maranhao and Santa Casa de Misericordia-Hospital do Coracao. Patients included in this study were the case only whom the author took part in their surgical interventions.

Data Collection: Data were collected and entered into a structured data sheet in an SPSS program and analyses using the program. Results were obtained constructed in tabular form, discussed and a conclusion was drawn.

Results: The study showed a difference in mean age between the two treatment centers. Coronary ischemic heart disease was more frequently observed in middle economic country than in lower economic country, which in turn showed more rheumatic valvular heart disease. There was high efficiency in performing cardiac surgeries in the middle economic country as compared to the low economic country. No difference in terms of mortality was observed between the centers.

Conclusion: The use of intermittent aortic cross-clamp a technique that is based on myocardial ischemic preconditioning is a modern, safe and effective technique to use during coronary revascularization.

Keywords: *Disease Pattern; Cardiac Disease; Surgical Intervention; Low and Middle Income Countries*

Introduction

Cardiac diseases are one of the challenging diseases to manage especially in low income countries. The health sector in low income countries tend to ignore such disease either due to financial constraints as it is real expensive to establish and ensure smooth running of a cardiac centre, consequently there are few cardiac centers in low income countries of Africa. Some countries devote more on health sector on other diseases such as malaria; infectious diseases rather than cardiac disease consequently there are few centers. In Tanzania efforts to start cardiac treatment dates back in early 1970s however could not take place until 2008 where they started as a unit under the Department of general surgery till in 2017. The will of the Government managed to have a single institute to date Jakaya Kikwete Cardiac institute, which is located within the main Hospital, Muhimbili National Hospital. The country is a large with a population of 50 million people but it has one and only one cardiac centre, so many patients seek medical care at this institute, to make things worse the neighboring countries are sending patients to this overwhelm institute for care. The number of cardiac surgeons and cardiac anaesthesiologists is also low, there are only three qualified cardiac anaesthesiologists and 5 cardiac surgeons to say, 4 perfusionists and a number of intensive care nurses. There no any industry that is manufacturing cardiac items so many of the equipments and consumables has to be imported. It has been recently the government has strengthened its health sector and is giving priority to this institute to make sure cardiac activities continue. There is no training centre for cardiac staff and training has to be obtained abroad with limited exposure, some of the surgical missions visiting the institute, some staff cannot expose the local staff in full, only for limited techniques and for common procedures, this further limit the progress of acquisition of skills to local team. With a few number of staff, cardiologists and cardiac surgeon the institute has now been seeing patients with various cardiac diseases: congenital heart diseases, rheumatic valvular heart diseases, coronary artery disease and vascular diseases with increasing number throughout the country.

Statement of the Problem

While there is well established research programs in high economic income countries there no data showing the disease pattern of a middle economic income as compared to that of a low economic income. The presence of poverty, lack of expertise and technology as a whole as seen in underprivileged low income countries puts the countries at high risk of death and late referral of patients to seek medical care.

Literature Review

Cardiovascular diseases represent one entity of Non-communicable diseases occurring worldwide. Cardiovascular disease encompasses Congenital, valvular and coronary ischemic heart diseases. Coronary artery disease has been sited as the single most killer disease among the Americans accounting for more than half a million death per year with 80% of death occurring in those aged more than 65 years of age [1]. In Brazil representing middle economic income country cardiovascular disease has been the leading cause of mortality since 1960s and has accounted for substantial percentage of hospitalization. In 2011 cardiovascular disease in Brazil was the leading cause of deaths accounting for 31% of all deaths with ischemic coronary disease 31%, cerebral vascular 30% [2]. While there is well established and preserved database in economically and middle economic countries, there is a lack of such documentation and searched data in lower underprivileged countries, still in the developed countries there is no rheumatic valvular diseases while there are still a few number of cases in the mid economically countries but a relatively large number of such cases in the economically underprivileged countries and is the burden of cardiac disease [3]. The cause of such high incidence of rheumatic valvular disease has been due to overcrowding and poor hygiene. Still the incidence of congenital heart disease is also at higher rate, and with emerging modern life a quite number of patients with ischemic coronary disease are frequently being seen, though there is a lack of data. The risk factors identified for ischemic coronary artery disease appears to be common throughout however differ in the total number of people affected. Hypertensive heart disease, diabetic mellitus, inactivity, obesity, hyperlipidemia and older age are the most prevalent identified risk factors [4]. In Brazil it has been clearly sited that the incidence and increase of ischemic heart disease went in parallel with urbanization, with better sanitation, nutritional condition and rising economic growth [5,6]. There different surgical techniques utilized at different centers; though the basic

principles remain the same. Since its invention, open heart surgery with use of cardioplegia and heart arrest is the standard techniques [7,8], however in some centers the use of off-pump and ischemia preconditioning is well adapted. In this study we will be able to see different surgical approach that is utilized in either centre by the operating surgical team and be able to compare the results in terms of overall conduct of surgery.

Patients and Methods

Broad objective

To determine he pattern and surgical technique of adult cardiac disease seen in two cardiac centers of a middle economic income and a low economic income countries.

Specific objectives

- To determine the demography of patients.
- To determine the diagnosis of cardiac diseases.
- To determine the conduct of surgery during surgical interventions.

Hypothesis

Null hypothesis (α)

There is no difference in the adult cardiac disease profile between middle economic income and low economic income countries.

Alternative hypothesis (β)

There is a difference in disease profile between the middle economic income and low economic income countries.

Sample size

The sample size was obtained from simple sampling.

This was a retrospective study that enrolled all patients with cardiac diseases who underwent surgical intervention at the JKCI from February to May 2019 and compared to patient whom the author was involved in surgical management during his fellowship training at the three public institution of Sao Luis in Brazil from April, May and June 2019. Excluded were those who could not consent. Ethical clearance was obtained from the relevant Institutional Review Board. Patients demography including age, sex, weight height, body surface area, diagnosis, conduct of surgery and type of surgery. The time of aortic cross clamp was categorized into short time when the time ranged from 20 to 50 minutes, moderate when it ranged 50-70 minutes, prolonged when it ranged from 70 - 120 minutes and highly risk or hazardous when it was more than 120 minutes. Similarly, the time spent during cardiopulmonary bypass was categorized into short time (50 - 70), moderate (70 - 120), prolonged (120 - 170) and high risk or hazardous when it was beyond 170 minutes. The patient outcome whether recovered fully, partially or died was described as disposition. All data were entered into master data sheet of an SPSS program

Data analysis

The data were analysed using SPSS version 20 IBM. Comparison of mean was done using student t test, and categorical variable using Hanzel-Mantes Chi square test. Test for homogeneity was done using Komologove test. P-Values less than 5% were considered statistically significant. Data were entered into table of results, a discussion made and a conclusion drawn.

Total of 114 patients with cardiac heart diseases underwent surgical interventions between the two institutes, of which 58 patients were operated at Public Hospitals in Maranhao-Sao Luis while, 56 patients were operated at the JKCI-Muhimbili National Hospital in Tanzania, making 50.9 % and 49.1 % respectively.

There was an overall 65 (57%) and 49 (43%) male and female patients respectively, making a male to female ratio of 1.3:1.

Results

		Hospital De Maranhao-Sao Luis	JKCI-Muhimbili Hospital-Tanzania	Total
Sex	Male	32 (49.2, 55.2)	33 (50.8, 58.9)	65 (57.0)
	Female	26 (53.1, 44.8)	23 (46.1, 41.1)	49 (43.0)
	Total	58 (50.9)	56 (49.1)	114 (100.0)

Table 1: *Cardiac centre versus gender distribution.*

Cochrans' Mantel-Haenszel (df=1), $\chi^2 = 0.685$.

67.24% of patients seen at Maranhao hospitals were aged more than 50 years old, while 60.71% of patients seen at JKCI Muhimbili were aged 50 years and below. The mean age of patients operated at public Hospitals of Maranho was 51.75 ± 19.35, (range 0.3-77) years as compared to those operated at JKCI-Muhimbili; 42.54 ± 18.50 (range 13 - 78). These data shows that there was statically significant difference in disease occurrence with age wise (p = 0.001, x = 23.68, df = 7) (Table 2).

Age groups	Hospitals Maranhão N (%)	JKCI-Muhimbili N (%)	Total N (%)
< 10	03 (100.0)	00 (00.0)	3 (02.60)
10.1 - 20	05 (35.70)	09 (64.30)	14 (12.30)
20.1 - 30	00 (00.00)	09 (100.0)	09 (07.90)
30.1 - 40	02 (18.20)	09 (81.80)	11 (09.60)
40.1 - 50	09 (56.20)	07 (43.80)	16 (14.60)
50.1 - 60	18 (62.10)	11 (37.90)	29 (25.40)
60.1 - 70	17 (70.80)	07 (29.20)	24 (21.10)
70.1 - 80	04 (50.00)	04 (50.00)	08 (07.00)
Total	58 (50.90)	56 (49.10)	114 (100.00)

Table 2: *Age distribution.*

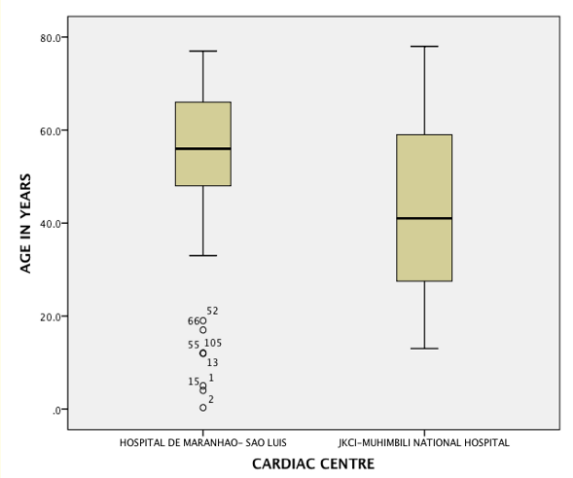

Figure 1: *The data from box plot showed negative skewed (-1.278) for patients from Maranhão Hospital and positive skewed (0.134) from JKCI Muhimbili, as depicted in the figure above.*

Coronary artery disease accounted for 47.4% of all cases with 68.5% of cases being seen and treated at Hospital Maranhão as compared to 31.5% of cases, which were treated at JKCI-Muhimbili. The presence of coronary artery disease associated with valvular and left ventricular aneurysm were exclusively seen at Hospital maranhão, no such cases were seen at JKCI Muhimbili. Rheumatic Valvular heart disease was the second leading cause of operations seen at these centers accounting for 36.8% of all cases, with 88.1% of the cases being seen and treated at JKCI-Muhimbili., as compared to 11.9% of cases which were treated at Hospital Maranhão (Table 3).

Category of disease	Hospitals-Maranhão N (%)	JKCI-Muhimbili N (%)	Total N (%)
Congenital Heart Disease (CHD)	06 (85.70)	01 (14.30)	07 (06.10)
Rheumatic Heart Disease (RHD)	05 (11.90)	35 (88.10)	42 (36.80)
Coronary Artery Disease (CAD)	37 (68.50)	17 (31.50)	54 (47.40)
Vascular Disease (VD)	03 (75.00)	01 (25.00)	04 (03.50)
CAD + Valvular Disease	03 (100.0)	00 (00.0)	03 (02.60)
CAD + LV Aneurysm	04 (100.0)	00 (00.00)	04 (03.50)
Total	58 (50.90)	56 (49.10)	114 (100.0)

Table 3: *Category of the disease versus treatment centre.*

The more prevalent disease was ischemia coronary artery disease followed by mixed aortic and mitral valvular heart diseases (Figure 2).

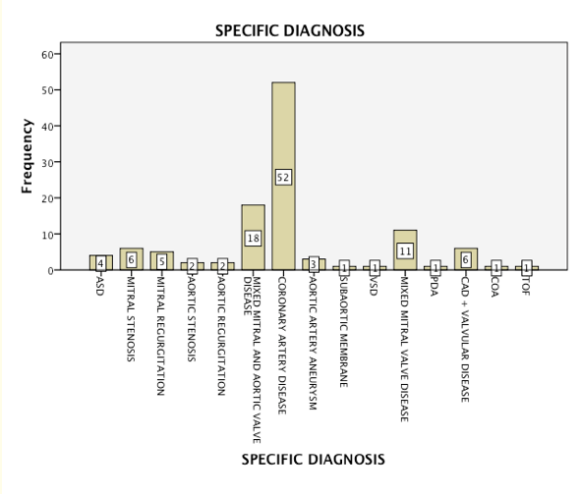

Figure 2: *Specific diagnosis versus Number of occurrence.*
Legend: TOF: Tetrallogy of Fallot; COA: Coarctation of Aorta; ASD: Atrial Septal Defect; VSD: Ventricular Septal Defect; PDA: Patent Ductus Arteriosus; CAD: Coronary Artery Disease.

Cardiopulmonary bypass time exhibited short time in 25.4% of all cases operated with 93.1% of cases being operated at Public Hospitals in Maranhão, as compared to only 6.9% of cases operated at JKCI-Muhimbili. Majority of cases operated at JKCI-Muhimbili had

moderate to prolonged time, and among those who had hazardous cardiopulmonary bypass time, the majority 83.3% were done at JKCI-Muhimbili. The difference was highly statistically significant (Table 4).

Time Category	Hospital Maranhão N (%)	JKCI-Muhimbili N (%)	Total N (%)
Short (30 - 70)	27 (93.1)	02 (06.9)	29 (25.4)
Moderate (70 - 120)	15 (35.7)	27 (64.3)	42 (36.8)
Prolonged (20 - 170)	13 (43.3)	17 (56.7)	30 (26.3)
Hazardous (> 170)	2 (16.7)	10 (83.3)	12 (10.5)
Total	58 (50.9)	56 (49.1)	114 (100.0)

Table 4: *Total cardiopulmonary bypass time versus Institutions.*

$\chi^2 = 31.822$, *df = 4: p = 0.000.*

The duration of aortic cross-clamp was noted to be short in 15.8% of all cases with 88.9% of cases being done at Maranhão Hospital as compared to only 11.1% done at JKCI-Muhimbili. Majority of cases in either institute had moderate and prolonged aortic cross-clamp in 28.9% and 32,9% respectively. In 21.9% of cases that showed risk, that is hazardous time 72% were done at JKCI-Muhimbili. This difference was statistically significant (Table 5).

Time Category	Hospital Maranhão N (%)	JKCI-Muhimbili N (%)	Total N (%)
Short (< 50)	16 (88.9)	2 (11.1)	18 (15.8)
Moderate (50 - 70)	19 (57.6)	14 (42.4)	33 (28.9)
Prolonged (70 - 120)	15 (40.5)	22 (59.5)	37 (32.5)
Hazardous (> 120)	07 (28.0)	18 (72.0)	25 (21.9)
Total	58 (50.9)	56 (49.1)	114 (100.0)

Table 5: *Category of total aortic-cross clamp time versus institutions.*

$\chi^2 = 18.781$, *df = 4, p = 0.001.*

Cardiac surgery with administration of cardioplegia and total heart arrest was done in 68.4% of all cases with 71.8% 0f these cases being done at JKCI-Muhimbili and 28.2% of cases being operated at Maranhão Hospitals. Operation with intermittent aortic cross clamp without use of cardioplegia was done in 30.7% of all cases with all cases exclusively operated at Maranhão Hospitals, such technique was not used at JKCI-Muhimbili. The difference was statistically significant (Table 6).

Mode of conduct	Hospital MarahanhaoN (%)	JKCI-MuhimbiliN (%)	Total N (%)
Cardiac surgery with cardioplegia and total heart arrest	22 (28.2)	56 (71.8)	78 (68.4)
Intermittent Aortic-cross clamp without cardioplegia	35 (100.0)	0 (00.0)	35 (30.7)
Non-pump cases	01 (100.0)	0 (00.0)	01 (00.9)
Total	58 (50.9)	56 (49.1)	114 (100.0)

Table 6: *Conduct of cardiac surgery versus institutions.*

$\chi^2 = 50.801$, *df = 2; p = 0.000.*

Valve heart surgery was done in 55 patients. 26.8% of cases had Bioprosthetic valve replacement and all such cases were operated at Maranhão Hospital, There was no use of bioprosthesis valve at JKCI-Muhimbili. 71.4% of all cases had mechanical valve replacement of which 92.5% being done at JKCI-Muhimbili and only 7.5% of patients had mechanical valve replacement done at Maranhao Hospitals. The use of type of prosthesis was statically significant (Table 7). During the treatment period the success rate was 96,6% at Maranhao Hospital and 96.4% at JKCI-Muhimbili with mortality rate of 3.4% and 3.6% respectively. There was no statistical difference in terms of success and mortality rates.

Type of Bioprosthesis used	Hospital Maranhão N (%)	JKCI-Muhimbili N (%)	Total N (%)
Bioprosthesis	15 (100.0)	00 (00.0)	15 (26.8)
Mechanical	03 (07.5)	37 (92.5)	40 (71.4)
PTEE graft	01 (100,0)	00 (00.0)	01 (01.8)
Total	19 (33.9)	37 (66.1)	56 (100.0)

Table 7: *Type of prosthetic valve commonly used versus institutions.*

$\chi^2 = 43.621, df = 2; p = 0.000.$

Discussion

The study showed a mean age of 51.75 ± 19.35 and 42.5 ± 18.50 years between Public Hospital of Maranhao and JKCI-Muhimbili, respectively the difference was observed to be statically significant, that could only be explained by variation in life expectance between the two countries, which are 76 years, and 65.68 years respectively according to 2016 data on either country [2]. Maranhao hospital recorded high incidence of ischemic coronary disease as compared to JKCI-Muhimbili which in turn showed high incidence of rheumatic valvular heart disease, with improvement in life style and development, which goes in parallel with inactivity, increase in hypertensive heart disease, is reflected with the difference in economic status between the two countries that is middle economic and low economically countries respectively [3,4]. On the other hand rheumatic valvular heart disease is reflected by poverty, overcrowding and poor hygiene a typical feature in economically disadvantaged countries [3]. The study showed statistical significant difference between the centers of treatment while considering intraoperative management: there was both short time of aortic cross-clamp and conduct of cardiopulmonary bypass that was observed at public Hospital in Maranhao as compared to that of JKCI-Muhimbili, this is because the use of intermittent aortic cross clamp and fibrillation that avoids the electrolyte derangement in blood and provide the most safe time for easy recovery of myocardium [7,8]. The JKCI-Muhimbili on the other hand utilizes the standard technique of administering cardioplegia and heart arrest. The use of intermittent aortic cross is regarded to be the safe and modern technique as it relay on principle of ischemic myocardial preconditioning, and with such techniques it allows conducting surgery in even patients with poor ventricular functions [8].

The use of bioprosthesis for valve replacement avoids the long-term use of anticoagulation and the risks of pannus formation and potential bleeding diathesis but on expense of increased rate of re-operation. In Maranhao Hospitals it was noted that majority of patients whom underwent valve replacement, bioprosthetic valve were used as compared to the counter part JKCI, where all patients whom were operated had mechanical valve replacement. Factors that prompt the use of bioprosthesis include the older age, availability of the valve, presence of facilities and expertise of doing reoperation at minimal risk, which are, factors observed in Maranhao Hospitals.

Despite differences observed in intraoperative management in both institutions there was more than 96% success rate and mortality rate was 3.4% to 3.6% in either of the institute and no difference was observed.

Conclusion

The study has shown that there is difference in age and occurrence of cardiac disease between the mid economic income country and the economically disadvantaged countries with is reflected by the difference in life expectance. Whereby coronary artery disease goes in parallel with improved standard of life, rheumatic valvular heart disease goes with poor living environment.

The use of intermittent aortic cross-clamp and fibrillation which underlies the principle of myocardial ischemic preconditioning is a safe, modern and effective technique for myocardial preservation.

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Declaration

I declare that this study is purely academic and there is no conflict of interest in whatever so.

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