

## Progress and Success of Coronary Artery Bypass Graft in TANZANIA, A Retrospective Review of Patients Operated at Jakaya Kikwete Cardiac Institute: MUHIMBILI NATIONAL HOSPITAL

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### Abstract

#### Objective

The profile, success and progression of patients undergoing coronary artery bypass graft at the institute has not adequately been reviewed. Coronary artery bypass graft though a widely performed procedure in developed countries, it is uncommon procedure in a few centers found in developing countries. The procedure is skill and expertise demanding. The study aimed to evaluate patients' characteristics, number and disposition of patients after coronary artery bypass graft surgery.

#### Methods

This was a retrospective study that enrolled all patients who underwent coronary revascularization at the centre from May 2016 through November 2022. Patients' demographic was entered into a structured data sheet, excluded were those whom their surgical and clinical details could not be retrieved. Preoperative clinical details, intraoperative and postoperative patients' profile were recorded and entered into a data sheet in SPSS version 20 program and analyzed; Chi square ( $\chi^2$ ) was used to compare categorical variables.

#### Results

There was a total of 220 patients who underwent coronary artery bypass graft from May 2016 through November 2022. Male patients were 172 (78.2%) and female patients were 48(21.8%). Male patients outnumbered female patients by 3.6 folds. The minimum age was 42 years and maximum were 89 years with a mean year age of  $63.7 \pm 8$  years. The majority of patients were overweight and obese in 73%. The mean duration of presentation was  $13.5 \pm 8.6$  months and the overall early mortality rate was 10.5%.

#### Conclusion

The key to a successful of a well-established cardiac centre in sub-Saharan countries of Africa and to any newly established cardiac center requires government commitment to invest in human resource; that in turn forms a local core cardiac team that should work focused to archive its goals. Investing into a well-planned structure that fits the requirement of a cardiac Centre. There should be a system that ensures availability and constant supply of consumables. The success and progress of open heart surgery demonstrated by Jakaya Kikwete Cardiac Institute from simple open heart procedures to complex surgical procedures required a well-planned short and long term plan with good coordination and focus, backed by unwavering government commitment.

**Keywords:** Coronary Revascularization, Coronary Artery Bypass Graft

## 1. Introduction

Chronic ischemic heart disease is one of the major diseases that causes more death especially in the developed world, it is one of the diseases that shows progression and advancement with life-style [1]. In the USA, it is reported to cause about 1000/10,000 mortality in every year, it is one of the diseases that causes the government to incur high expenditure and it is an economical burden [1]. The disease parallels the development of the country and it shows a spectrum of the disease varying from a few patients to a considerable number of patients in parallel with low economic income countries to highly developed countries. Similarly, the disease appears to be in parallel with modern life style even in some ethnic families within a country.

With establishment of open-heart surgery in May 2008 in Tanzania, coronary revascularization was not the primary priority choice of surgery at its inception, this is because the surgical procedure is one of the most sophisticated procedures, time consuming and requires experience and facilities to make the diagnosis such as cardiac catheterization which was not yet in place [2]. Therefore, during that time open-heart surgery was essentially done for defect closure and valve replacement surgery [3]. The developing countries have limited access to cardiac surgery and approximately 17.65 million people die from cardiovascular disease every year with more than 80% of death taking place in low to mid income countries [4]. Estimates project an increase in cardiovascular disease mortality to more than 20 million per year by 2030 with the most substantial increase in low and middle income countries [4]. It has clearly shown that patient from lower social economic status are not easily amenable to access CABG as compared to those from high economic status, and correspondingly they have a relatively high early mortality rate 8.1% as compared to the counterpart 4.8% [5,6]. Until 2016, the institute having been overwhelmed with a quite large number of patients diagnosed to have chronic ischemic heart diseases from coronary angiography, it necessitated finding means as to how these patients could be treated within the country. During that time a number of surgical missions attended the patients at the institute, it was then possible to acquire a surgeon who could operate on patients with coronary artery disease (CAD). Gradually it became a routine, patients with CAD underwent coronary artery bypass graft (CABG) during these surgical missions at the institute. Some of the experienced visiting surgeons were eager to train the local team so that at one point in time they should, become independent and competent.

## 2. Statement of the Problem

Despite coronary artery revascularization being done in the country and especially at Jakaya Kikwete cardiac institute (JKCI), the success of the coronary artery bypass graft surgeries and the incremental progression of the surgeries in terms of numbers and surgical outcome has not been adequately evaluated. This study gives progress and success of coronary revascularization that has been achieved by the local team in this part of Sub-Saharan Africa.

## 3. Methods

Setting: Jakaya Kikwete Cardiac Institute

## 4. Sample Size and Sampling

The sample size was obtained from simple sampling that, all patients who underwent coronary revascularization from May 2016 through November 2022 were enrolled into the study, excluded were those patients whom their data could not be retrieved. There was a total of 220 patients who underwent coronary revascularization.

## 5. Broad Objectives

To determine the success and progression of patients undergoing coronary revascularization at the centre.

Specific Objectives

1. To determine patient characteristics based on demography, age, sex, Body Surface area (BSA) and Body Mass Index (BMI)
2. To determine total number of patients undergoing coronary revascularization
3. To determine the average cross-clamp time, pump time and overall operation time
4. To determine the overall mortality rate in patients who underwent CABG at the centre

## 6. Data Collection

This was a retrospective study that reviewed all patients who were referred to the adult cardiac surgical department having undergone coronary angiography at JKCI or from Benjamin Mkapa Hospital in Dodoma. Patient demography such as region of domicile, age, sex, weight, and height were entered into a structured data sheet. Patients clinical findings such as ejection fraction, presence of diastolic dysfunction and its grade, comorbidities such as presence of diabetes mellitus and or hypertensive heart disease were inquired, patients intraoperative findings and number of grafts, duration of aortic cross clamp, total operation and pump time were collected, postoperative total duration of ventilation, any presence of ICU complications were noted and the total duration of ICU stay was determined. The patient was followed to the ward, the duration of hospital stay in the ward was determined, any long-term complications such as readmission, presence of wound infection and whether or not death occurred were also followed.

## 7. Data Analysis

Patient data were entered into a structured data sheet and then transferred to an SPSS –version 20 program for data analysis. Chi-square was used to compare categorical data, ANOVA for analysis of means, descriptive statistics was used for continuous variables, data from the SPSS were transferred to an excel for graphical drawings. significance level of statistical testing was taken at when a P-value of 0.05.

## 8. Results

There was a total of 220 patients who underwent coronary artery bypass graft (CABG) from May 2016 through November 2022 a period of 6 years. Male patients were 172 (78.2%) and female patients were 48(21.8%). Male patients outnumbered female patients by 3.6 folds. The mean duration of symptoms was 13.6±9 months the minimum age was 42 years and maximum were 89 years with a mean year age of 63.7± 8 years.

Age group	Male	Female	Total
	N (%)	N (%)	N (%)
41-50	6 (54.50)	5 (45.5)	11 ( 5 )
51-60	50(73.2)	18 (26.5)	68 (30.9)
61-70	86 (82.7)	18 (17.3)	104 (47.3)
+71	30 (81.1)	7 (18.9)	37 (16.8)
Total	172 (78.2)	48 (21.8)	220 (100)

**Table 1: Age-Sex Group Distribution**

M:F = 3.6:1

Male patients accounted for 78.2% while female patients accounted for 21.8%

The majority of patients were in the age group of 61-70 years with more than 64.1 % of patients being 61 years and above (Table 1)

VARIABLE	NUMBER	MEAN±SD	MINIMUM	MAXIMUM
AGE IN YEARS	220	63.7± 8.0	42	89
WEIGHT IN KGS	220	76.8 ± 12.6	45	115
BODY SURFACE AREA	220	1.9 ± 0.2	1.4	2.4
BODY MASS INDEX	220	27.9 ± 4.5	18.3	40.4
DURATION OF SYMPTOMS(MONTHS)	220	13.5 ± 8.6	1	36
EJECTION FRACTION	220	50.8 ± 10.3	25	74
NUMBER OF GRAFTS	220	2.7 ± 0.6	1	4
CROSS-CLAMP TIME (MINUTES)	171	105.2 ± 46.2	19	287
CARDIOPULMONARYBYPASS(MINUTES)	171	164.2 ± 4.7	49	495
TOTAL OPERATION TIME IN HOURS	220	6.0 ± 1.1	3	8
TIME INTERVAL TO EXTUBATION IN HRS	216	15.8 ± 5.8	2	36
DURATION OF ICU STAY IN DAYS	216	4.2 ± 2.4	1	24

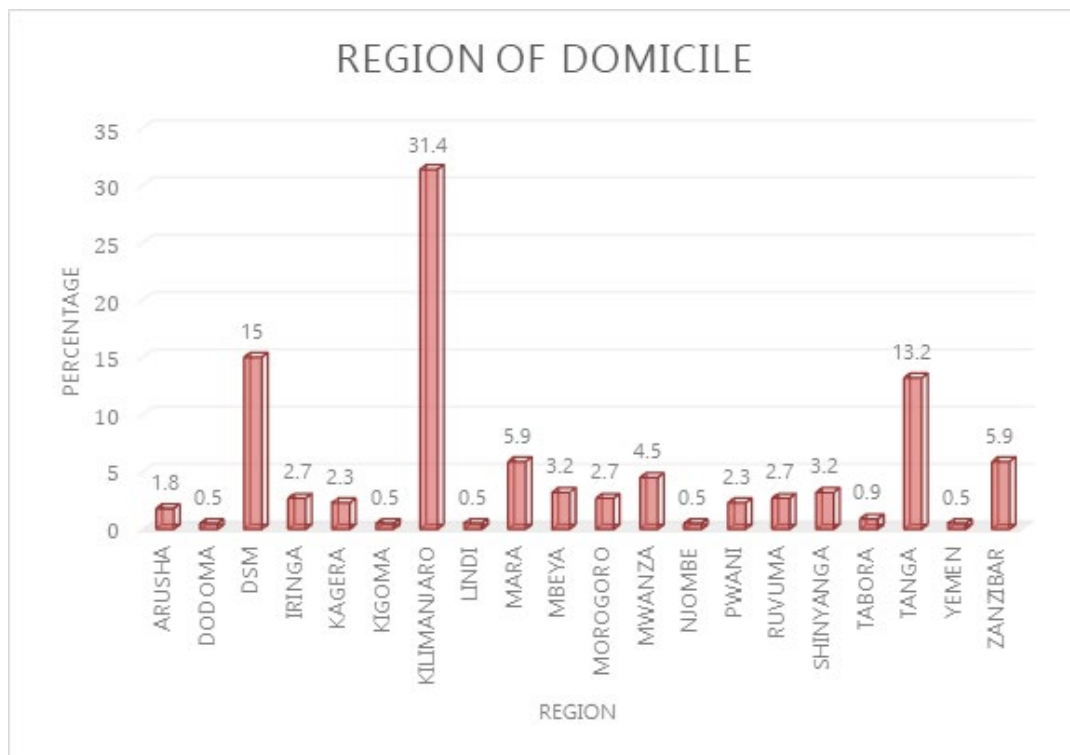
**Table 2: Discriptive Statistics of Variables**

The minimum weight was 45 kg and the maximum weight was 115 kg with a mean weight of 76.8±12.6. The mean body mass index was 27.9 ±3 with minimum 18.3 and maximum 40.4 kg/m<sup>2</sup>. The minimum height was 139cm and the maximum was 187cm with a mean height of 166.5±9.1. Patient had presented with symptoms at various time interval ranging from history of one month to 36 months with a mean duration at presentation of 13.5 ± 8.6 months.

A total 171 (77.7%) patients underwent coronary revascularization on-pump while 49 (22.3%) coronary revascularizations was done on off- pump. The mean aortic cross clamp time and mean cardiopulmonary bypass time were 105.5±46.2 and 164.2±74.7 minutes respectively. The minimum and maximum ischemic

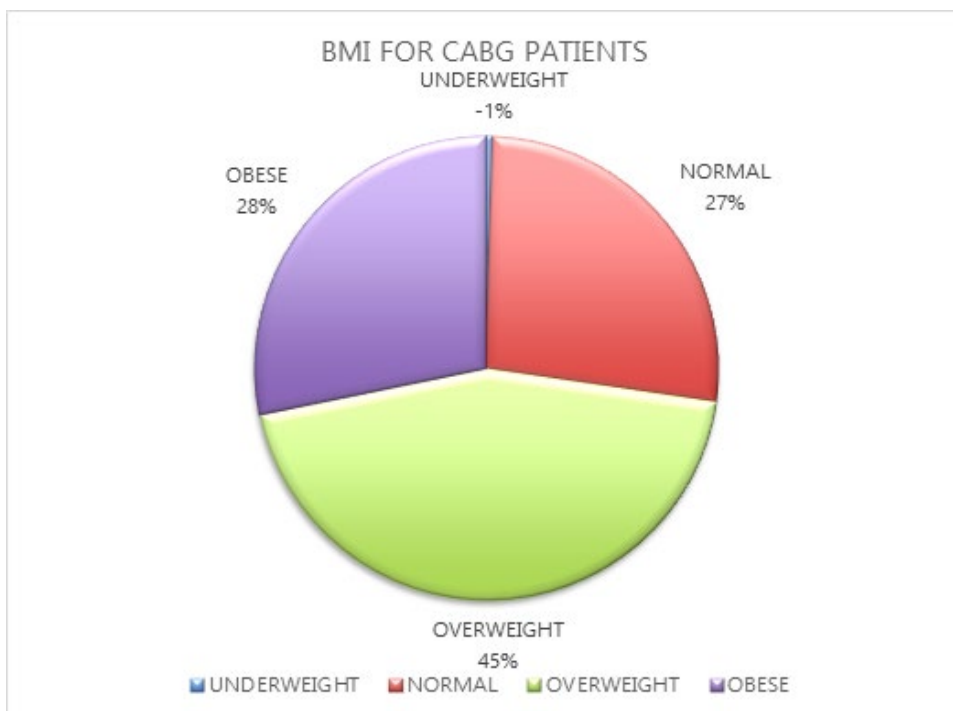
time was 19 minutes and 287 minutes respectively, while the minimum and maximum cardiopulmonary bypass were 49 minutes and 495 minutes respectively (Table 2).

Based on angiographic findings, 208 (94.5%) patients had triple vessel disease, 7(3.2%) had double vessel disease and 5(2.3%) had single vessel disease. Majority of patients about 194 (88.2%) had no associated lesion, while 26 (11.8%) had other associated comorbidities, 15(6.8%) had associated ischemic mitral insufficiency, 5(2.3%) had apical infarct, aortic insufficiency was found in 4(1.8%) patients, degenerative aortic stenosis and peripheral arterial disease were each in one patient accounting for 0.5% respectively.

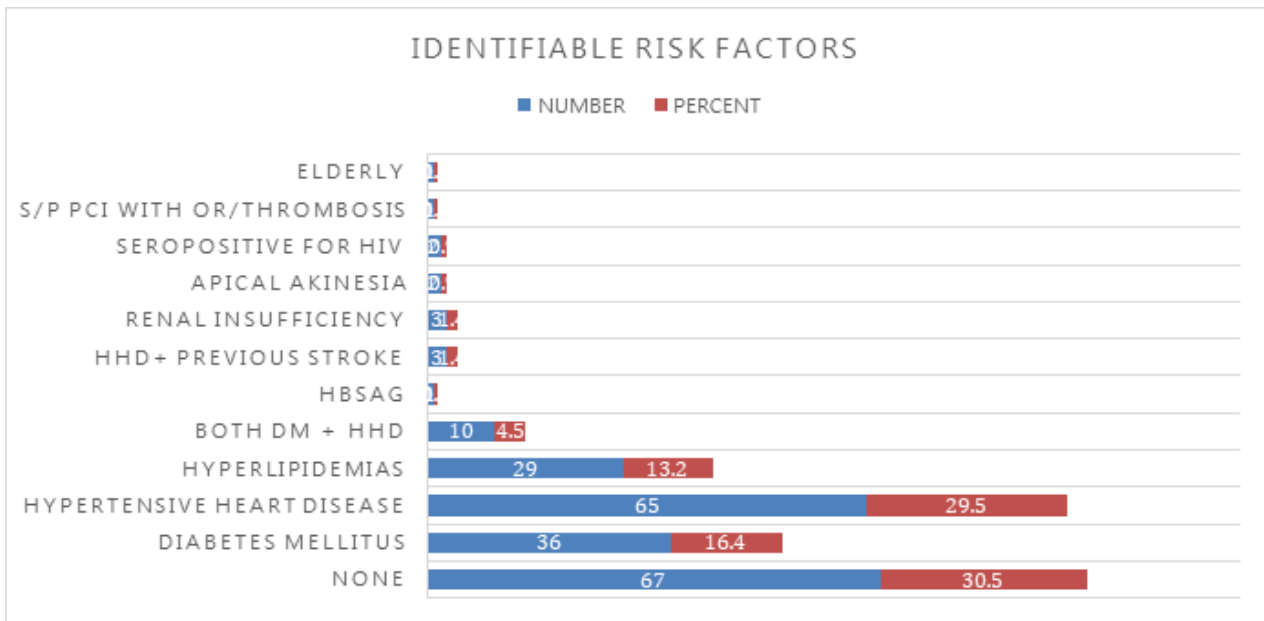


**Figure 1:** Patients who were operated at the centre came almost throughout the country, however patients coming from Kilimanjaro region were more as compared to other regions followed by Dar es Salaam and Tanga regions (Fig 1). This indicates that the disease goes in parallel with high standard of life style and different nations interactions.

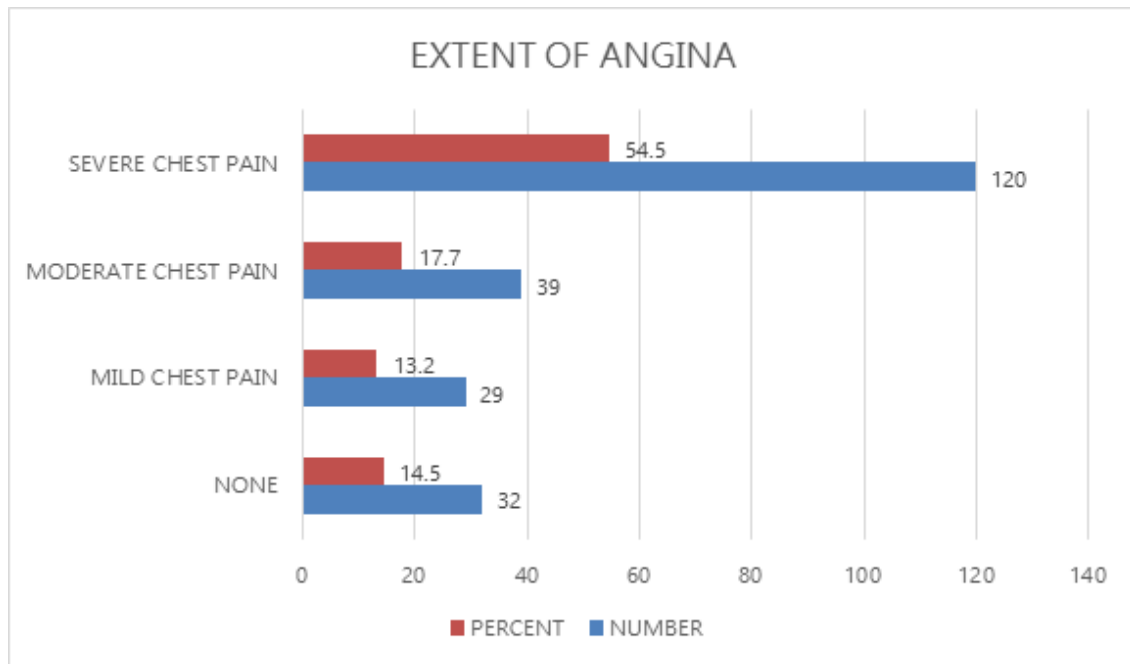
#### Proportion of Patients Based on Body Mass Index



**Figure 2:** Based on their BMI, patients who were underweight (BMI<18.5 kg/m<sup>2</sup>) were 1%, normal (BMI 18.5-24.9 kg/m<sup>2</sup>) were 27%, overweight (BMI 25.0-29.9 kg/m<sup>2</sup>) were 45% and Obese (BMI>30.0 kg/m<sup>2</sup>) were 28%. In overall the overweight and obese patients accounted for 73% of all patients operated (Fig 2).



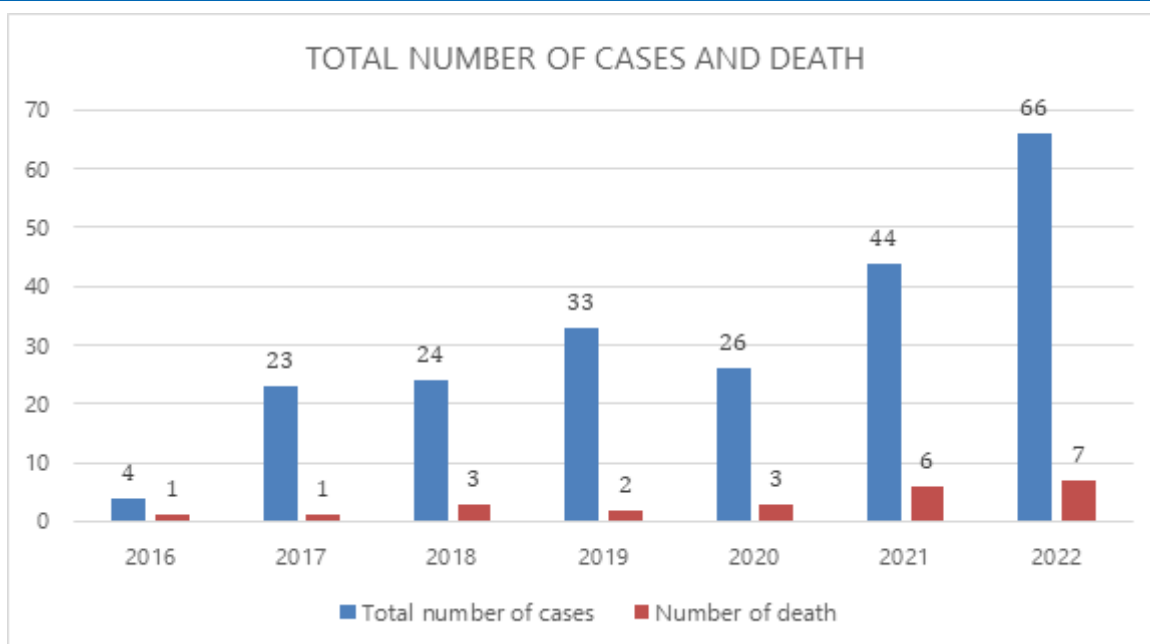
**Figure 3:** Majority of patients had no identifiable risk factors (30.5%) however patients with diabetes mellitus and hypertensive heart diseases were among the high-risk in-patient with CAD accounting for 45.9% of all the study population (Fig 3).



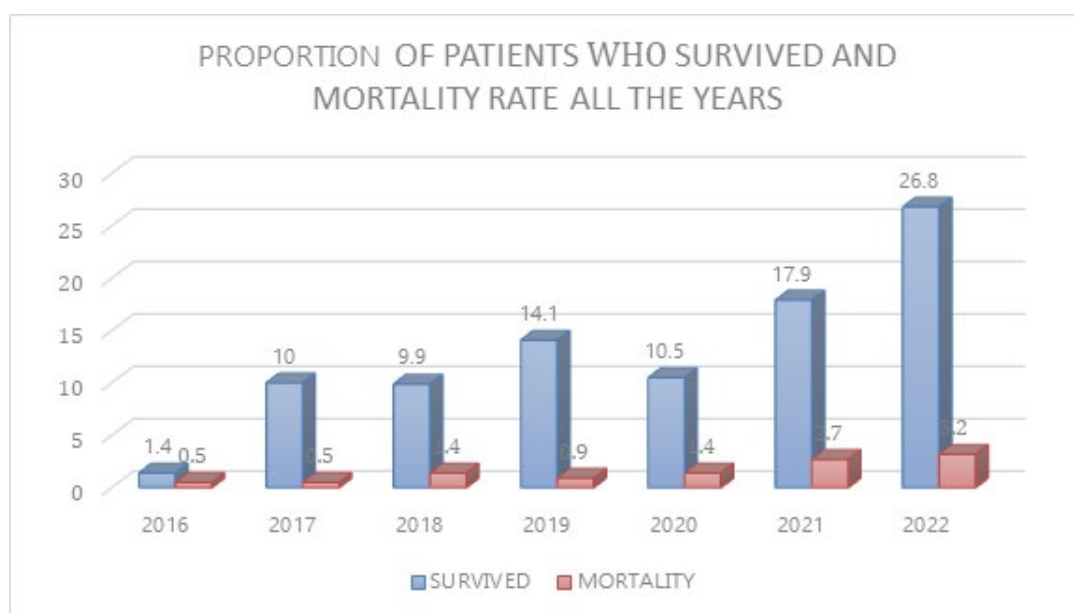
**Figure 4:** The majority of patients had presented with severe chest pain accounting for 54.5%. While 14.5 % had no chest pain but had other symptoms of mild to moderate exhaustion ( Fig 4).

A total of 217 (98.6%) patients were admitted in the ICU of whom except one were successfully weaned from ventilator and extubated in the ICU, one patient (0.4%) died in the ICU without being extubated. Three patients 3(1.4%) died intraoperatively, while 16(7.3%) patients died in the ICU, and 3(1.4%) patients died in the ward. The follow up at one year, further 5 patients had died due to various causes of which 2 patients were report-

ed to have been readmitted with acute coronary syndrome and with congestive cardiac failure respectively. The remaining three patient had died due to other causes. The overall early in-hospital death was 10.5% (mortality occurring within thirty days of surgical intervention) and the overall mortality at one year was 12.3%.



**Figure 5:** Overall there was progressing increase in number of CABG done per year as from 2016 through 2022 giving a total number of 220 patients. Twenty three(23) patients had early death (Fig 5).



**Figure 6:** The relative mortality rate and survivorship per year.

Coronary artery revascularization has been increasing exponentially from its inception May 2016 through November 2022. The success rate was 89.5% and overall mortality 10.5% (Fig 6).

COMPLICATION	FULL RECOVERED	DIED	TOTAL
None	163 (98.2))	3 (1.8 )	166(75.5)
Persistent high blood pressure	5(71.4)	2 (28.6)	7 (3.2)
Mediastinal bleeding	0 (0.00)	3 (100)	3 (1.4)
Atrial fibrillation	2 (100)	0 (0.00)	2(0.9)
Electrolyte imbalance	1 (100)	0 (0.00)	1 (0.5)
Respiratory failure-lung injury	2 (66.7)	1(33.3)	3(1.4)
Low hemodynamics + PVS <sup>#</sup>	2 (100)	0(0.00)	2 (0.9)
Poor ventricular function	1 (25.0)	3 (75.0)	4 (1.80)
Cardiac arrest	1 (50)	1 (50.0)	2 (0.90)

Requirement of high inotropic support	1 (100)	0 (0.00)	1 (0.5)
Neurological deficit	2 (66.7)	1 (33.3)	3 (1.4)
Stroke	4 (80.0)	1 (20.0)	5 (2.3)
Cardiac arrhythmias and ventricular tachycardia	15 (93.8)	1 (6.2)	16 (7.4)
Total	200( 92.2)	17 (7.8)	217(100)

**Table 3: Complications in the Critical Care Unit**

### 9. #PVS-Premature Ventricular Systole

Cardiac arrhythmias and atrial fibrillation were found in 17(7.8%) of all patients admitted in the intensive care unit. The reported incidence is 20-30% of all complications in the post CABG patients in the intensive care unit (Table 3) [7].

Coronary artery bypass graft was done in all patients. Two pa-

tients out of 15 patient who had concomitant severe ischemic mitral insufficiency underwent mitral valve repair but they had poor left ventricular function and they could not be weaned off bypass. Four patients with aortic valve disease also had aortic valve replacement and were successfully weaned off from cardiopulmonary bypass but one patient died postoperatively while in the intensive care unit due to arrhythmias.

SNO	TYPE OF GRATS	NUMBER N	PERCENTAGES%
1	LIMA-LAD	6	2.7
2	LIMA-D-LAD	1	0.5
3	LIMA-LAD, SVG-OM-D	21	9.5
4	LIMA-LAD, SVG1-D, SVG2-PDA	55	25.0
5	LIMA-LAD, SVG1-OM-D, SVG2-PDA	42	19.1
6	LIMA-D-LAD, SVG1-OM, SVG2-PDA	7	3.2
7	LIMA-LAD, SVG-OM	6	2.7
8	LIMA-LAD, SVG1-OM, SVG2-PDA	75	34.1
9	LIMA-LAD, SVG-PDA	6	2.7
10	LIMA-LAD, SVG1-OM1, SVG2-OM2	1	0.5
	TOTAL	220	100.0

**Table 4: Types of Grafts and Number of Patients**

NB: LIMA-left internal mammary artery, LAD-left anterior descending artery, D- Diagonal, OM-obtuse margins, SVG –Saphenous vein graft

Majority of patients had LIMA-LAD, SVG-OM and SVG-PDA

accounting for 34.1% of all the types of graft followed by LIMA-LAD, SVG-D, SVG2-PDA 25%(Table 4). Four patients were found to have extensive atheromatous plaques in the territory of the right coronary artery and underwent coronary endarterectomy.

Complications	Number of cases	Percentages%
None	167	84.3
Mild chest pain due to other causes	7	3.5
Recurrence of symptoms with ACS <sup>#</sup>	2	1.0
Hypertrophic scar-keleid	3	1.5
Angina + hypertrophic scar	1	0.5
Wound infection	7	3.5
Sternal dehiscence	4	2.0
Left ventricular dysfunction	4	2.0
Neurological deficit-stroke	3	1.5
TOTAL	198	100

**Table 5: Longterm Complications After Cabg**

### 10. #ACS Acute Coronary Syndrome

A total of 198(90%) patients who were successfully discharged and followed up for any long-term complications of whom 84.3% had no any complications, however 7(3.5%) had mild

chest pain due to other causes, three patients had presented with hypertrophic scar that required injection with steroid, and four (2%) patients had wound and left ventricular dysfunction (Table 5)

## 11. Discussion

Though coronary artery bypass graft (CABG) is the commonly performed type of cardiac surgery worldwide it is the most advanced and specialized type of cardiac surgery that requires high skills and expertise while being very demanding [7,8]. Open heart surgery though started at JKCI in May 2008 with defect closure and valvular heart surgery, coronary revascularization was not started until 2016 when the first case was operated by the local surgical team. Intraoperative mortality in CABG varies from centre to centre, while other series report 2.3%-3% mortality rate, the intraoperative mortality rate at the centre was 1.4%, that did not differ from other series [2,9]. Reported overall mortality rate varies from centre to centre, a mortality of 8.7% and 11.7% has been reported in other series [7,8]. The incidence of post-operative complications in most of established centre has been reported to range from 20-30% [10]. In this study the overall early mortality rate was 10.5%. Though it appears the overall number of CABG that were performed at our centre for over six years (2016 through 2022) to be relatively small as compared to high output centers where the procedure is routinely done, but the gradual yet progressive increasing in number of operations coupled with a decrease in mortality, shortened total operation time, and reduced duration of aortic cross-clamp; signifies that the local team has successfully grown-up in terms of acquisition of skills and competency to be able to handle patients who require coronary artery bypass graft.

## 12. Conclusion

The key and prerequisite to a successful of a well established cardiac centre in sub-Saharan countries of Africa and to any newly established cardiac center requires government commitment to invest in human resource; that in turn forms a local core cardiac team, investing into a well-planned structure that fits the requirement of a cardiac centre. There has to be a system that ensures availability and constant supply of consumables, the team should work in such manner that they are focused to archive their goals. The success and progress of open heart surgery demonstrated by Jakaya Kikwete Cardiac Institute with commencement from simple open heart procedures to complex surgical procedures including CABG require a well-planned short and long term plan with good coordination and focus, backed by unwavering government commitment.

## 13. Declarations

### 14. Ethics Approval and Consent to Participate

This was a retrospective study, patient even before undergoing surgical intervention as routine had informed consent from patient themselves and or from their next of kin for the study.

The study was approved by the Jakaya Kikwete Cardiac institute institutional review board (AB:123/307/01/50) and conducted in accordance with the Declaration of Helsinki.

### Consent for Publication

Not applicable

### Availability of Data and Materials

The data sets are available from the corresponding author can be made available on reasonable request

## Competing Interests

No financial or nonfinancial benefits have been received or expected to be received from any party related directly or indirectly to the subject of this article.

## Funding

Not applicable

## Author Contributions

Evarist TM Nyawawa-planned and created variables and the whole study. Angela N. Muhozya, Peter R. Kisenge, Mohamed Janabi and William Mahalu- initiated the need to have reseach. Bashir J. Nyangasa, Zhang Hailong, Moses Byomuganyizi, Khamis Ramadhan, Alex J. Benjamin- ensured work that is done in theatre and follow up are well documented. Shija Mahenda, Mahawa Assenga, Mujuni Mutagwaba, David Wapalila - data collection from theatre. Robert Luchemba, Vivianne Mlawi, Fred Mwasaga, Alex Loth, Faraji Lydenge and Hilary Shilanaiman-Traced data from ICU and perfusion, Henry Mayala-ensured data from Echocardiography are collected. Evans E.Nyawawa- statistics and Data management. Adelphina Ncheye -proof reading and editing.

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