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Off-Pump Coronary Artery-Bypass Grafting (OPCAB) at Sudan Heart Institute : Is it A Safe Operation for Coronary Revascularization in Sudan?

By Leena E Elmokashfee & Nezar B Elhassan

University of khartoum, Sudan

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Objective: To assess the preoperative characteristics and outcome of patients undergoing off-pump coronary artery bypass surgery.

Method: This is a combined retro-prospective descriptive consecutive case series study conducted at Sudan Heart Institute (SHI) and included all the patients with CAD; who were candidates for CABG; presented in the period between Aug/2011 to Aug/2013

Keywords: *CABG, OPCAB, SHI, sudan.*

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(A Single Surgeon's Experience)

Leena E Elmokashfee [α] & Nezar B Elhassan [σ]

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Results: 91 patients were included in this study. Females (30.8%) were less affected compared to males and the most affected age group was 41-69 years. 63.7% had HTN, 52.7% had DM. The majority (76.9%) presented with angina CCS class III or VI. Significant LM coronary artery disease was detected in 38 (41.8%). None of the patients had post operative MI. 10 (11.0%) patients developed atrial fibrillation. 56 (61.5%) were extubated within the first 6 hours and 61 (67%) needed primary ICU care for one or 2 days. One death (1.1%) was reported during 30 days- postoperative follow up.

Conclusion: Off-pump coronary artery bypass grafting could be conducted safely in SHI with reasonable outcome compared to the international data.

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I. Introduction

Beating-heart surgery is not a revolutionary new approach. It was well recognized main surgical technique for CABG before the advent of cardio-pulmonary bypass (CPB) (1,2).While CABG on a beating heart was developing, Gibbon performed his first successful application of cardiopulmonary bypass (CPB) in human in 1953(3) diverting the surgeons' interest towards this procedure as it enables operating comfortably in an asystolic heart. However with the develop-ment of anaethesia and proper monitoring of the patients, the deleterious effect of CBP rose in the horizon and rang a bell to revolutionize the previous era of operating on a beating heart. Thus, Buffolo et al and Benneti et al published their retrospective series concluding that," OPCAB could be performed safely with results similar to the conventional CABG" (4, 5). Many studies showed the benefit of OPCAB compared with conventional CABG especially in elderly, high risk patients and those with concomitant Comorbidities (6-9).

Although conventional CABG is still the essential operation at most of the cardiac centres in Sudan, OPCAB became the major operation for myocardial revascularization in SHI, started since 2007.

Aim of this study: to reflect SHI experience in OPCAB during the 2-year interval specified by this study and to highlight the preoperative features, operative procedure, outcome, feasibility and safety of this operation in our settings.

II. Patients and Methods

A combined retro-prospective descriptive case series study was designed to include all the patients with CAD presented to our unit at Sudan Heart Institute (Mr. Nezar's cardiac surgery unit) and scheduled for isolated surgical myocardial revascul-arization in the time interval between Aug/2011 and Aug/2013. There were not any exclusion criteria.

The total number of patients was 94 with average of 47 pt per year. Approximately all patients' criteria, clinical presentation and investigations including their coronary angiograms were discussed in the weekly conjoint cardiology/cardiac surgery meeting. All patients were operated on by one staff; led by a single surgeon with experience in CABG with and without

Author α: (MBBS) University of khartoum, General Surgery MD part1 (SMSB), MRCS- A, Edinburgh. e-mail: blue.candle_13@hotmail.com
Author σ: Head department of cardiothoracic surgery, Sudan Heart Institute (SHI), Khartoum, Sudan.

cardiopulmonary bypass. They were followed up for 30 days post operatively.

The collected data was entered in a master sheet of IBM SPSS program version 20. Then computerized analysis was run. Frequencies, percentages, means ± SD, median and ranges were calculated. Cross tabulation and Chi square test were also performed with statistically significant difference between the variables when P value was less than 0.005.

III. The Operative Procedure

a) Anaesthesia

All patients were anaesthetized according to the standard clinical routine of the department. The patients were artificially ventilated during the procedure, while maintaining MAP over 60 mmHg. Noradrenaline, adrenaline and GTN were given as intermittent injections via syringe pumps to compensate for fluctuation in blood pressure. Beta blockers were used to induce a controlled bradycardia and facilitate distal anastomosis on the beating heart.

During lifting of the heart to graft the branches of the CX artery or the posterior branches, Mean BP was maintained by flooding the patients with IV fluids, extreme Trendlenberg position and inotropic manip-ulation. The patients were not extubated immediately at the end of the opertation, but they were lightly sedated in the ICU till they regain normal physiological parameters and extubated thereafter.

b) Surgical procedure

The patients were operated through a standard median sternotomy. Initial heparinization was achieved with 5000 IU of low molecular weight heparin. The conduits; Left Internal Mammary Artery (LIMA) and great saphenous vein; were harvested. Then, heparin 150 IU/kg was given to keep the ACT above 300 seconds throughout the anastomoses and it was reversed at the completion of the last proximal anastomosis using protamine sulfate in 1:1 ratio. Only the left pleura needed to be opened. intra-aortic balloon pump (IABP) was neither used preoperatively nor intraoperatively.

CTS stabilizer and Octopus 2 (Medtronic Inc) were used and distal anastomoses were achieved using continuous 7-0 polypropylene sutures over intracoronary shunts. A side- biting clamp was applied to the ascending aorta to perform the proximal anastomoses using continuous 6-0 polypropylene suture. All patients were transferred to the Cardiac Intensive Care Unit (CICU) without or with minimal inotropic support.

IV. Results

During 2 year- interval (from Aug/2011 to Aug/2013), there were 94 patients with CAD presented at our unit. All of them were candidates for CABG alone without associated any other cardiac procedure and none of them had a previous cardiac surgery. Initially, 3 patients were excluded from the study as part of their data was lost. OPCAB was the primary operative choice and the average number was 47 patients per year.

a) Preoperative characteristic

as summarized in table (1) showed: 63(69.2%) patients were males, while females represented 28 (30.8%) of them. The mean age at presentation was (60.43 ± 1.03) years. The most affected age group was (41-69) years; in which 71 (78%) of the pts were clustering.

b) Patients having co-morbidities were

58 (63.7%) with hypertension, 38 (41.8%) had hypercholesterolemia and 48 (52.7%) with DM; 22 (24.2%) of them were insulin dependent. 44 (48.4%) were either current or former smokers. 70 (76.9%) patients presented with CCS class III/ IV and 18 (19.8%) with NYHA class III/IV.

c) Angiograhic data

showed 57 (62.6%) had good left ventricular function with EF > 50% and 1(1.1%) had poor LVEF < 30%.Those who had significant LM coronary artery disease were 38 (41.8%). There were 14(15.4%) patients with single vessel disease, 16(17.6%) had double vessel disease and 23(25.3%) had triple vessel disease. Previous non surgical coronary intervention in form of PTCA ± stent was done in 11 (12.1%) pts; 10 (90.9%) had instent restenosis, while the procedure failed in 1 pt (9.1%).

Table 1 : Preoperative Patient Characteristics

Variable	N (%)
Total patients	91 (100)
Sex	
Male	63(69.2)
Female	28 (30.8)
Age (Years)	
Mean **± SD**	60.43 ± 1.03
Range	30- 77
HTN	58 (63.7)
Diabetes mellitus ID	22 (24.2)
Diabetes mellitus NID	26 (28.6)
Hypercholesterolemia	38 (41.8)
Smoking	44 (48.4)
CCS class	
I & II	21(23.1)
III & IV	70 (76.9)
NYHA class	
I & II	73 (80.2)
III & IV	18 (19.8)
EF	
>50%	57 (62.6)
30 – 50%	33 (36.3)
< 30%	1 (1.1)
LM	38 (41.8)
PCI	11 (12.1)

HTN=hypertension, CCS=Canadian Cardiov-ascular Society classifications of functional limitation related to angina, NYHA=New York Heart Association Functional Classification in a Patient with Heart Disease, ID= insulin depe-ndent, NID= Non-insulin dependent, EF=Left Ventricular Ejection Fraction, LM= Left main stem disease, PCI=Percutaneous coronary intervention

d) The operative features

regarding the priority of care; 75 (82.4%) of the patients were scheduled for elective operation, while 16 (17.6%) needed urgent surgical intervention. Emergency OPCAB was not performed during the period of the study.

139 bypass grafts were performed with average number of 1.5 grafts per patient. The total number of distal coronary anastomoses was 1 in 47(51.6%), 2 in 40 (44.0%) and 3 in 4 (4.4%) patients. Pedicle LIMA was used as a vascular conduit in 90 (98.9%) patients, while LIMA & SVG together were used in 44 (48.4%) patients. The most frequently grafted vessel was LAD in 90 (98.8%) patients.

LAD was found to be diffusely diseased in 1 (1.1%) patient; so its first diagonal branch was grafted instead. There was no reported conversion to conventional CABG.

e) Operative time

ranged from 2 to 6 hours. A chi-square test was performed and a statistically significant difference between number of grafts and the operative time was found, $X2$ (4, N = 91) = 74.82, $p < 0.001$.

f) Post operatively

as showed in table(2): total blood loss of 0.5L or less was recorded in 38 (41.8 %) patients, while the average blood loss was (878 ml ± 0.05). 44 (48.4) needed blood transfusion, however 35 (38.5%) received only 1 or 2 units of blood and none of them needed blood transfusion of more than 5 units.

None of the patients developed post operative MI. 10 (11.0%) patients developed atrial fibrillation; transient in 8 (72.7%) and intermittent in 2 (18.2%). 3 (3.3%) patients had VT that reversed back to sinus rhythm after DC shock.

g) Regarding the systemic complications

none of the patient developed stroke, but there were 3(3.3%) with acute confusion state recovering during the first postoperative days. 1 (1.1%) had renal failure requiring dialysis.

56 (61.5%) were extubated within the first 6 hours following surgery and 7 (7.7%) were extubated after more than 12 hours.

Only one patient needed primary ICU care more than 5 days. 82 (90.1%) were discharged from hospital within 7 days of their surgery and 2 (2.2%) needed to stay for more than 10 days.

There was no hospital mortality in the initial admission for surgery. One death (1.1%) was reported during 30 days- postoperative follow up.

Table 4 : Postoperative features

Variable	N (%)
Mean total blood loss (ml) ± SD	878 ± 0.05
Transfusion	44 (48.4)
Reoperation for bleeding	1 (1.1)
Pleural effusion requiring puncture	3 (3.3)
Myocardial infarction	0 (0.0)
Atrial fibrilation	10 (11.0)
Stroke	0 (0.0)
Acute confusion state	3 (3.3)
Sternotomy infection **Superficial** **With sternum dehiscence**	9 (9.9) 5 (5.5) 4 (4.4)
Renal failure requiring dialysis	1 (1.1)
Extubation within first 6 hours	56 (61.5)
ICU length of stay (days) **Mean ± SD** **Range**	 2.5 ± 0.10 1- 7
Hospital length of stay (days) **Mean** **range**	 5.7 3- 36
Initial hospital mortality	0 (0.0)
30 days mortality	1 (1.1)

V. Discussion

The annual incidence of CAD in Sudan; as estimated in 1989; reached 112/100 000 with a total mortality of 36/100 000(10). However, according to the latest WHO data published in April 2011, the mortality rate reached 212.02/100,000(11). Coronary Artery Bypass Grafting (CABG) becomes the current surgical benchmark for coronary revascularization. Despite being conducted irregularly, conventional CABG is the main operation performed in Sudan except in SHI, where we adopted OPCAB as the routine operation for myocardial revascularization. This study reflected that; the initial total number of patients undergoing OPCAB was 94 with average around 47 per year and this is more than the number of operations done at the same centre in 2007 and 2008; which were 7 and 14 respectively; when most of the operations done were conventional CABG (12). Thus, CABG in this centre is moving quickly and efficiently towards being predominantly done without CPB. The regular cardiac operation and follow up

systems in our centre dedicate a continuous improvement in the surgical process

30.8% of the study population were Females; which indicated a genuine gender difference in the pattern of affection with CAD that necessitates surgical intervention .This finding was consolidated by other studies (13- 17) .We had 4 young patients less than 40 years with equal incidence between males and females. More patients having DM were reported in our study with a percentage of 52.7 (13, 14) ; this needs further elaboration as DM may explain the nature of diffusely diseased vessels encountered during the research period and the late presentation reflected by the functional class CCS III/IV and NYHA class III/IV.

There were 16 (17.6%) patients requiring urgent operation and their outcome didn't differ from those done electively. Intra-coronary shunts were used routinely as their use during OPCAB has been shown to preclude left ventricular dysfunction (18). IABP was not used in our patients and we reported 1(1.1%) patient having poor LVEF < 30% but he had smooth operative and post operative course, so the poor left ventricular function was not regarded as exclusion criteria in our study in contrast to the Beating Heart against Cardioplegic Arrest Study-1 (BHACAS-1)(15).Those patients with severe left ventricular dysfunction can benefit a lot from OPCAB as been stated by Tugtekin and associates (19).

Those who had LM coronary artery disease were 38 (41.8%) which was far more than those in other studies; Salah'study (8.33%) and Gwozdziewicz et al (24.2%) (13, 14).139 bypass grafts were performed with average number of 1.53± 0.06 grafts per patient which was less than those mentioned in the literature; more than 2 grafts per patient in both pro-spective and retrospective studies; and this may be explained by the diffusely diseased small non graftable coronary arteries (20, 21). The diffusely diseased coronary vessels are also seen in the south East-Asian population, and more so in patients with Indian origin (22). Pedicle LIMA alone was used as a vascular conduit in all patients except one as it was damaged accidently by the harvesting trainee. Radial artery and RIMA were not used. 10 (11.0%) patients developed atrial fibrillation representing 0.5 or less of those reported in a number of randomized controlled trials and reflecting less incidence of developing atrial fibrillation in our patients(23- 27).

Only one patient stayed for more than 5 days in the CICU: he was a heavy smoker with a huge mediastinal cyst, which was excised and biopsy revealed a simple thymic cyst. 82 (90.1%) were discharged from hospital within 7 days of their surgery. The short in-hospital stay in OPCAB patients reduces greatly the burden on the hospital as been concluded in three large meta-analysis studies (28- 30).

One death (1.1%) was reported during 30 day-postoperative follow up as the patient developed severe pneumonia with sepsis and MODS. He was the only pt needed renal replacement therapy in our study.

VI. Conclusion

OPCAB, when compared with conventional CABG, is associated with at least equivalent clinical outcome at lower cost. However, benefits of OPCAB were well documented in reducing mortality and morbidity. It is associated with fewer incidences of chest infection, inotropic requirement, arrhythmias, total chest tube drainage and consequent transfusion requirement, intubation time, intensive care, and hospital stay. It reduces myocardial, renal, neurocognitive and gastro intestinal complications (31-34).

This study proved that, performing Off-pump coronary artery bypass grafting (OPCAB) in our setting is a safe procedure, and its pioneer application at Sudan Heart Institute met the international outcome. We have to go a step further in designing other studies including mid-term and long-term follow up, together with assessment of graft patency. The obstacles facing OPCAB in Sudan are the scarcity of the professional personnel and the steep learning curve for mastering this operation with capability of converting into conventional CABG when being necessary.

VII. Abbreviations

CAD: Coronary artery disease
CABG: Coronary artery bypass grafting
CBP: Cardiopulmonary bypass machine
CABG: coronary artery bypass grafting
OPCAB: Off –pump coronary artery bypass grafting
SHI: Sudan Heart Institute
MODS: Multi- organ dysfunction

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