Pak Heart J

PERIOPERATIVE STROKE IN PATIENTS UNDERGOING CONVENTIONAL CORONARY ARTERY BYPASS GRAFTING (CABG)-AN EXPERIENCE AT NICVD KARACHI

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Date Received: August 28, 2015
Date Revised: December 27, 2015
Date Accepted: February 25, 2016

Contribution
AN conceived the idea, planned the study and critically revised the manuscript. RT, AK and NA helped in data collection and statistical analysis. SK and MID helped in manuscript. All authors contributed significantly to the submitted manuscript.

All authors declare no conflict of interest.

This article may be cited as: Nasreen A, Tanveer R, Khuwaja A, Khan S, Amjad N, Dar MI. Perioperative stroke in patients undergoing conventional coronary artery bypass grafting (cabg)-an experience at nicvd karachi. Pak Heart J 2016;49(02): 56-60.

ABSTRACT

Objective: To identify the effect of duration of cardiopulmonary bypass as a risk factor in the incidence of stroke in elective conventional surgery for coronary artery bypass grafting (CABG).

Methodology: It was a cross-sectional, descriptive, retrospective study conducted from 1st February 2014 to 31st January 2015 at Department of Cardiac Anaesthesia & Surgery, National Institute of Cardiovascular Diseases (NICVD), Karachi. All patients between 30-70 years of age undergoing elective isolated CABG surgery were included while emergency CABG, patients with history of TIA or stroke, patients with coronary stents, diagnosed case of atrial fibrillation, low ejection fraction, intraoperative hemodynamic instability and renal dysfunction were excluded. The effect of duration of cardiopulmonary bypass with emphasis on the occurrence of stroke was analyzed in consecutive patients who underwent conventional CABG. Variables included demographic data, clinical symptoms, risk factors for stroke and CABG, investigations and other surgical parameters. Chi square test was applied for comparison. Significant p value was set for <0.05.

Results: The study included 80 (100%) patients who underwent conventional CABG. There were 30 (37.5%) female patients with mean age of 64.6 ± 2.1 years. Postoperative stroke was found in 03 patients (3.75%). Out of these, stroke was found in patients in whom bypass time was more than 100 minutes.

Conclusion: Prolonged cardiopulmonary bypass time is a common risk factor for post CABG stroke.

Key Words: Stroke, Cardio Pulmonary Bypass, Conventional CABG, TIA

INTRODUCTION

Coronary artery bypass grafting (CABG) surgery is the surgery that is performed most commonly for coronary artery diseases worldwide. Stroke is one of the most devastating complications of cardiac surgery and it can lead to a decreased quality of life, increased mortality and also has important economic consequences, with estimated costs that exceed $2 to $4 billion annually worldwide for patients with stroke after CABG surgery.[1] Neurologic deficits are still a major problem after CABG despite modifications in anaesthesia and surgical techniques. The incidence of post CABG stroke is 2-9%.[2,3] Stroke may occur during surgery or even after an initial uneventful neurological recovery from surgery. After CABG, stroke can present with variable severity as delirium, transient or persistent cognitive deficits, seizures, anterior spinal artery infarction, transient focal cerebral ischemia, and stroke. Numerous risk factors after coronary artery bypass grafting for perioperative stroke have been identified which are patient related and procedure related.[4-6] Duration of bypass time is associated with higher intraoperative risk of stroke. Studies showed an increased incidence of stroke in patients with duration of bypass 114 minutes or more.[7, 8,34] The aim of our study was to identify the effect of duration of cardiopulmonary bypass on the incidence of stroke in elective conventional CABG surgeries in patients who had no history of stroke or transient ischemic attack.

METHODOLOGY

It was a cross-sectional, descriptive, retrospective study conducted from 1st February 2014 to 31st January 2015 at Department of Cardiac Anaesthesia & Surgery, National Institute of Cardiovascular Diseases (NICVD), Karachi. Adult patients with age range of 30-70 years, undergoing elective, isolated CABG surgery were included in the study. Exclusion criteria was emergency CABG, patients with history of TIA or stroke, patients with coronary stents, diagnosed case of atrial fibrillation, low ejection fraction, intraoperative hemodynamic instability and renal dysfunction. Clinical data, including demographics, risk factors and complications, were prospectively collected. Informed consent was obtained. CABG was performed under general anaesthesia. Vitals were continuously monitored which included arterial pressure, central venous pressure, oxygen saturation, ECG and capnograph. General anaesthesia with balanced technique was used. All patients were induced with Dormicum 0.03 mg/kg, Morphine 0.15 mg/kg, Etomidate 0.3 mg/kg and Esmeron 0. 9 mg/kg. Great saphenous vein and internal mammary artery were harvested as conduit. After all aseptic measures, the operation started with median sternotomy and standard Cardiopulmonary Bypass (CPB) was established with ascending aortic and two stage atrial cannulation with non-pulsatile flow. The technique of moderate systemic hypothermia along with topical cooling was applied. In order to induce and maintain cardioplegic arrest of the heart, we used cold blood cardioplegia given through antegrade approach. Left anterior descending artery (LAD) was grafted by internal mammary artery. The other sites were grafted through great saphenous vein. Time for cardiopulmonary bypass and aortic cross clamp were recorded. The patient was weaned off from CPB with esophageal temperature of 37.0°c. Adrenaline was started as inotropic support if required. Patients were shifted in the intensive care unit. Any new stoke occurring after the surgery was considered as a single end point. Stroke was categorized as early or late depending on whether it was detected immediately after surgery or after an initial, uneventful neurological recovery from surgery respectively. SPSS version 10 was used for data analysis. Frequencies and percentages were used to present qualitative data which included sex, NYHA functional class, risk factors, drug history, ECG finding, x-ray finding. To determine the comparison of these variables, Chi square test was applied. Significant p value was set for <0.05. Mean and standard deviation was calculated for age.

RESULT

About 80 patients were included in the study with age ranging from 30 to 70 years (mean age 64.6±2.1years). There were 50 (62.5%) male patients (Table1). About 16 patients (20%) had left main coronary artery disease while 64 (80%) had three vessel disease. Mean cardiopulmonary bypass time was 78.1±13.1 min (range: 55- 150 minutes). Mean aortic cross- clamp time was 52.1±2.0 min. Out of 80 patients included in the study, 4 patients had CPB time more than 100 minutes. Mean number of grafts per patient was 3. 7 ±0.5 (Table 2). Early postoperative recovery was smooth in 76 patients with minimal inotropic requirement. In 4 patients recovery was not smooth as 3 (3.75%) of them developed stroke after weaning off from ventilator. CPB time was more than 100 minutes in all these 3 patients. The fourth patient developed sepsis and died on 17th

Table 1: Demographic Variables of Study Population

Variables	Percentages (n %)
M:F	50(62.5%) : 30(37.5%)
Age (years) range, (mean±SD)	30-70, (64.6±21)
Smoker	12(15%)
Diabetes Mellitus	06(7.5%)
Chronic Renal Failure	0(0%)
Hypertension	10(12.5%)
MI History	18(22.5%)
EF% <50%	09(11.2%)
Carotid Artery Disease	0(0%)

Table 2: Operative Data of Study Population

Variables	Numbers n (%)
Pump time: mean±SD, range	78.1±13.1, 55 - 150 min
Pump time >100 min	03(3.75%)
Mean aortic cross-clamp	52.1±2.0 min
Left main Coronary Artery Disease	16(20%)
Three Vessel Disease	64(80%)
IMA used	80(100%)
Mean number of grafts per patient	3.7±0.5
Blood Transfusion	05(6.2%)

postoperative day. None of the eighty patients suffered from any arrhythmias. Two patients required intra-aortic balloon pump but they were not the ones who developed postoperative stroke. The average length of hospital stay and intensive care unit stay was 13.3±11.2 and 6.0± 3.8 days, respectively. About 04 patients died during the hospital stay (05%). Out of these 04 patients, 03 were those who developed stroke and one who had developed sepsis. All 04 patients were male (Table 3).

Study population included patients who were smokers 12(15%), Diabetics 06(7.5%), hypertensives 10(12.5%) and with history of MI 18 (22.5%) (Table 1).

Post CABG complications recorded were stroke 03(3.75%), sepsis 01(1.2%) with average ICU stay of 06±3.8 days and average hospital stay of 13.3±11.2 days. In hospital death occurred in about 04 (05%) patients.

DISCUSSION

According to AHA/ASA 2013 guidelines "CNS infarction is defined as brain, spinal cord or retinal cell death attributable to ischemia, based on neuropathological, neuroimaging, and clinical evidence of permanent injury." Despite the continuous modification of operative techniques and improvement in intra- and postoperative care, stroke is one of the major complications after CABG. This is usually noticed when mechanical ventilatory support is weaned off.[2,9] It is imperative to identify the risk of peri-operative stroke in order to assess the patient risk for CABG to the best possible limit and to develop strategies to reduce the incidence of neurological events. The incidence of stroke in studies is reported from 0.8 to 6%. Post CABG stroke has 24.8% mortality. The mortality of stroke is high because of delayed diagnosis and delayed treatment. In our study all three patients who developed stroke died. In large observational studies a prior history of TIA or stroke is identified as an independent determinant of stroke in patients who have CABG. The incidence of stroke may increase during cardiopulmonary bypass owing to carotid vascular disease due to unstable plaques that may embolize.

Table 3: Postoperative Complications of Study Population

Variables	Number (n,%)
Stroke	3(3.75%)
Sepsis	01(1.2%)
Arrhythmias	0(0%)
Average ICU stay(days)	06±3.8
Average Hospital stay(days)	13.3±11.2
In Hospital Death	04(05%)

Stroke may also increase due to decreased blood flow distal to critical stenosis. None of our patient had carotid artery disease as there was no previous history and carotid bruit was not present and carotid Doppler did not show significant lesion in any of patient. We did carotid Doppler in patients with left main disease, 16 patients (20%) and age more than 60 years.[10] The risk factors for stroke during CABG in addition to carotid artery stenosis are ascending aortic atherosclerosis, previous stroke or transient ischaemic attack, age, hypertension, diabetes, smoking, peripheral vascular disease, left ventricular dysfunction, left main coronary artery disease, renal failure, and increased cardiopulmonary bypass time.[11-16] Stroke is also associated with calcifications in proximal aorta, giving rise to the fact that disease in proximal aorta may cause atheroembolization during cardiac surgery. In our patients none of them had proximal aortic calcification.

Studies showed female sex as an independent risk factor for stroke.[17] In our study all three patients who developed stroke were male. All three patients who developed stroke were less than sixty years of age. The risk increases with a 10-year increment in age.[18-22] Atrial fibrillation is a frequent complication of cardiac surgery that has been reported to increase the risk of peri-operative stroke in some studies.[23-27] One of our patients developed atrial fibrillation that was treated successfully with amiodarone. Although the temperature at which bypass is performed does not seem to affect stroke incidence, hypothermia as a protective mechanism against stroke is advocated.[12,21] We did all CABG operations with moderate hypothermia. The use of intra-operative balloon pump is identified as another predictor of stroke after cardiac surgery.[15,27,29] Two patients in our study required insertion of intra-operative balloon pump to wean off from CPB but they were not those who developed stroke. Other increased risks include requirements for multiple transfusions intra-operatively, with possible intra-operative volume depletion and decreased cerebral perfusion.[30,31] Multiple blood transfusions were not required in any of our patients. Duration of bypass time was associated with higher intra-operative risk of stroke. The Coronary Artery Surgery Study, a multi-center randomized control study of medical therapy versus CABG surgery, showed that duration of bypass surgery of more than 200 minutes was associated with 4.5-fold increase in risk of stroke in high-risk patients.[7-

[9,16,32] Similar data were demonstrated in a study conducted retrospectively which included 11,825 CABG patients, with a higher risk of stroke among patients with cardiopulmonary bypass greater than or equal to 114 minutes or more (odds ratio = 2.36).[33] In our study average duration of cardio pulmonary bypass time was 55-150 minutes, while duration of CPB was more than hundred minutes in all three patients who developed stroke. By decreasing the CPB time we can minimize the incidence of stroke after CABG.

LIMITATIONS

This is a single center study and number of patients were limited. Moreover emergency CABG cases were not included along with the patients undergoing CABG plus valvular heart surgeries.

CONCLUSION

Multiple factors act as risk factors for post CABG stroke including arrhythmias, hyperlipidemia, hypertension, diabetes and age older than 65. Prolonged cardiopulmonary bypass time is an independent risk factor for post CABG stroke. Further studies are needed to confirm this.

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