

## STROKE AFTER CORONARY ARTERY BYPASS GRAFTING; A SINGLE CENTRE STUDY

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### Contribution

HA Conceived, Designed and wrote the manuscript, and is accountable for originality of research work. AB & ZRK: Helped in data Collection, Data analysis, and writing of manuscript and did review of manuscript.

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### ABSTRACT

**Objective:** To determine the frequency of perioperative stroke after conventional coronary artery bypass grafting.

**Methodology:** This cross sectional study included the data of patients who underwent conventional on-pump coronary artery bypass grafting (CABG) from January to December 2014 at Cardiac Surgery Unit of Chaudhry Pervaiz Elahi Institute of Cardiology. Patients who underwent valvular operations, off-pump CABG, root replacement and those who failed to wean off from cardiopulmonary bypass were excluded. Occurrence of any new permanent or transient neurologic deficit was defined as perioperative stroke. Multi-nomial logistic regression was applied to determine the effect of risk factors on perioperative stroke. Odds ratio and p value were calculated for each variable.  $p < 0.05$  was taken as significant.

**Results:** Out of 500 patients, 86% patients were males. The incidence of perioperative stroke was 1.8%. The need of high dose of inotropic support on weaning from CPB and post-operative atrial fibrillation were the strongest predictor of post-operative stroke with odds ratio of 9.50 (0.75-119.7) and 5.43 (1.42-20.77) respectively. The odds of having stroke after CPB in hypertensive patients was 5.43 (1.42-20.77), 2.27 (0.23-22.53) in hyper-cholesteremic, 1.13 (0.24-5.25) in patients with family history of IHD, and 1.06 (0.25-4.55) in diabetic patients.

**Conclusion:** Post-operative atrial fibrillation and requirement of high dose inotropic support after weaning from CABG are the strongest predictor of perioperative stroke.

**Key Words:** Stroke, CABG, Atrial fibrillation, Inotropic support.

## INTRODUCTION

Despite many advances in the field of cardiac surgery, neurologic complications are still common after cardiac surgery. Stroke has been recognized as one of the most devastating complications after cardiopulmonary bypass.<sup>1</sup> More than 21000 patients in U.S and 42000 patients worldwide suffer from stroke after cardiopulmonary bypass, increasing the burden on health care cost from 2 billion to 4 billion dollars annually. Early studies on stroke focused on the mechanisms and risk factors of stroke and found higher mortality rate in stroke patients.<sup>1-3</sup> Various patient related and procedure related mechanisms of stroke have been defined that increase the likelihood of stroke after cardiac surgery.<sup>4-7</sup> Very limited data is available from Pakistan regarding incidence of stroke after cardiac surgery. A recent study from Pakistan found higher incidence of stroke after CABG in Pakistani patients as compared to the other developed countries and these authors demanded for more studies to determine the incidence of stroke in our local population.

The aim of this study was to determine the risk of perioperative stroke after coronary artery bypass grafting so that we can have exact estimates of this devastating complication in our population.

## METHODOLOGY

This cross sectional study included the data of patients who were operated in year 2015 in cardiac surgery unit of Chaudhry Pervaiz Elahi Institute of Cardiology. Patients who underwent on-pump coronary artery bypass grafting (CABG) were selected for this retrospective analysis. Data of patients operated from January to December 2014 regarding operation and post-operative outcomes was retrieved from the data base of cardiac surgery unit of the hospital. Patients

who underwent valvular operations, off-pump CABG, root replacement and those who failed to wean off from cardiopulmonary bypass were excluded.

All procedures were done using cardiopulmonary bypass. Cardiopulmonary bypass circuit was primed using lactated ringer solution. Cold blood cardioplegia was used for myocardial protection and complete cardiac arrest after application of the aortic cross clamp. Three minutes before removal of clamp magnesium sulphate at the dose of 30 mg/kg was given to all patients. The main outcome of the study was perioperative stroke. The following criteria was used to define stroke. Occurrence of any new permanent or transient neurologic deficit was defined as perioperative stroke. A reversible neurological deficit lasting more than 24 hours but less than 3 weeks was defined as transient ischemic attack. Any permanent deficit either focal or global permanent neurologic deficit lasting > 3 weeks was noted as permanent local paralysis and complete brain death.

Data analysis was done using software SPSS v23. Data was presented as percentage and mean (along with standard deviation) for qualitative and quantitative variables respectively. Multi-nominal logistic regression was applied to determine the effect of risk factors on perioperative stroke. Odds ratio and p-value (<0.05 taken as significance) was calculated for each variable.

## RESULTS

There were a total of 500 patients in this study. About 86% patients were males. The most common risk factor was hypertension, presented in 38.6% patients while smoking and diabetes were present in 34% patients. About 375 (75.0%) patients were in Canadian cardiovascular angina class III and only 36 (7.2%) presented with angina IV (Table 1).

**Table 1: Demographic, Echocardiographic and Angiographic Variables of Study Population (n=500)**

Variable	Value n (%)
<b>Age</b>	56.64 (9.61)
<b>Male Gender</b>	430 (86.0)
<b>Female Gender</b>	70 (14.0)
<b>Risk Factors</b>	
Smoking	170 (34.0)
Diabetes	173 (34.6)
Hypertension	193 (38.6)
Hyper-cholesterolemia	44 (8.8)
Family History	115 (23.0)
<b>Angina Class</b>	
Class I	54 (10.8)
Class II	35 (7.0)
Class III	375 (75.0)
Class IV	36 (7.2)
<b>Ejection Fraction</b>	51.58 (10.15)
<b>Additive EuroSCORE</b>	1.22 (1.29)

Moreover 259 (51.8%) patients required mild inotropic support on weaning from cardiopulmonary bypass, 155 (31.0%) required moderate and 25 (5.0%) required high dose inotropic support on weaning from cardiopulmonary bypass. The mean duration of support was 14.72+26.80 hours (Table 2). Neurologic complications were noted in 9 (1.8%) patients in early post-operative period. Out of these 9, acute confusional state occurred in 5 patients, permanent brain death in 2 patients, localized paralysis in 1 patient and transient ischemic attack in 1 patient.

Multi-logistic regression analysis was done to analyze the

effect of risk factors of stroke on its occurrence. There was no effect of age > 60 years, female gender, smoking, diabetes, family history and prolonged bypass time on occurrence of perioperative stroke. Requirement of high inotropic support on weaning from cardio-pulmonary bypass was strongly associated with perioperative stroke. The odds of having stroke in patients of high inotropic support was 9 times higher as compared to patients who receive mild to moderate inotropic support ( $p=0.04$ ). Risk of perioperative stroke was also high in hypertensive and hyper-cholesterolemic patients (Table 3).

**Table 2: Operative Characteristics of Study Population (n=500)**

Variable	Value n(%)
Bypass Time	126.47 (36.90)
Clamp Time	77.04 (24.91)
Mechanical Ventilation Time	10.23 (33.57)
<b>Need of Inotropes</b>	
Mild	259 (51.8)
Moderate	155 (31.0)
High Dose	25 (5.0)
Nil	61 (12.2)
Duration of Inotropic Support	14.72 (26.80)
ICU Stay	7.72 (84.64)
Hospital Stay	6.05 (3.76)
Post-op Atrial Fibrillation	67 (13.4)
Neurologic Complications	9 (1.8)

**Table 3: Analysis of Independent Predictors of perioperative Stroke in Study Population (n=500)**

	Perioperative Stroke		Odds Ratio (95% CI)	p-Value
	No	Yes		
Age $\geq$ 60 Years	187 (97.4)	5 (2.6)	0.49 (0.13-1.85)	0.31
Female Gender	68 (13.8)	2 (2.9)	0.79 (0.13-5.1)	0.81
Smoking	168 (98.8)	2 (1.2)	0.54 (0.09-3.30)	0.50
Diabetes	169 (97.7)	4 (2.3)	1.06 (0.25-4.55)	0.93
Hypertension	188 (97.4)	5 (2.6)	2.12 (0.46-9.88)	0.33
Hypercholesterolemia	43 (97.7)	1 (2.3)	2.27 (0.23-22.53)	0.51
Family History	112 (97.4)	3 (2.6)	1.13 (0.24-5.25)	0.88
Bypass time > 2 Hours	265 (97.4)	7 (2.6)	0.39 (0.07-2.09)	0.24
High Inotropic Support	22 (88.0)	3 (12.0)	9.50 (0.75-119.7)	0.04
Post-op Atrial Fibrillation	5 (55.6)	4 (44.4)	5.43 (1.42-20.77)	0.02

## DISCUSSION

Despite the fact that prevalence of atherosclerosis has been increased in patients undergoing CABG, the occurrence of stroke has been decreased in these patients. But stroke is still a major life threatening complication after cardiac surgery. So there is a need to identify the frequency and risk factors of stroke in patients undergoing cardiac surgery. In this study,

we took patients who underwent CABG surgery only. In our study, incidence of stroke was 1.8% patients within one month after surgery. Anyanwu et al. reported 1.7% incidence of stroke in patients with isolated CABG. Merie et al reported 2.0% incidence of perioperative within one month after surgery.<sup>11</sup> In other studies the reported incidence of perioperative stroke varies from 1.6% to 6.0%. Nasreen et al reported 3.75% incidence of stroke in patients of

conventional CABG surgery with one month after surgery in Pakistani population. The incidence reported by these authors was high as compared to our findings.

Different studies have reported different risk factors of stroke after cardiac surgery. Nasreen et al reported that cardiopulmonary bypass time is an independent risk factor of stroke after conventional CABG surgery.<sup>8</sup> These authors also concluded that cardiopulmonary bypass time > 100 minute is an independent risk factor of stroke. But we did not found any significant effect of prolonged bypass time (CPB time > 120 minutes) on the occurrence of stroke after CABG surgery. Some studies have found CPB time > 200 minutes significantly increases the risk of stroke after CPB.

Anyanwu et al. found ten risk factors of stroke after cardiopulmonary bypass. Out of these, pulmonary hypertension, preoperative deteriorated health status, aortic valve surgery, pulmonary hypertension and preoperative stroke were most important predictors of stroke.

Méridie et al reported that age more than 70 years at the time of Cardiopulmonary bypass (CPB) surgery is an independent risk factor of stroke. AlWaqfi et al found that advanced age, previous stroke and chronic renal impairment are important contributors to stroke after CABG surgery.<sup>16</sup> Wareing and colleagues found female gender is a risk factor of stroke after CPB. In our study, we did not found any significant effect of advanced age and female gender on the incidence of perioperative stroke.

Oliveira et al found diabetes and hypertension as independent risk factor of stroke after CPB. Our study also showed similar findings. In our study, the odds of having the stroke in diabetic and hypertensive patients after CPB were 1.06 and 2.12 respectively.

Numerous studies have found post-operative atrial fibrillation as a risk factor of stroke after CPB. In our study, we also found significant effect of post-op AF on incidence of post-operative stroke. The odds of having stroke after CABG was 5.38 times the odds of not having atrial fibrillation after CABG. Hogue et al concluded that atrial fibrillation associated with low output syndrome is a risk factor of stroke but not the AF alone after CPB<sup>20</sup>.

## CONCLUSION

In our study, need of high dose of inotropic support on weaning from CPB was the strongest predictor of post-operative Stroke. Requirement of high dose inotropic support after weaning from CPB, atrial fibrillation, hypertension, hyper-cholesterolemia, family history and diabetes were independent predictors of stroke after conventional on-pump isolated coronary artery bypass grafting.

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