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A Prospective Study of Neurological Complications Following Cardiac Surgery

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Abstract
Introduction: *Post cardiothoracic surgery neurological complication causing poor out come and incidence was quite high.* ***Aims & Objective:*** *To find out neurological complications, to analyze risk factors and outcome of the neurological complication in cardiac surgery.* ***Methods:*** *Total 477 patients who underwent different types of cardiothoracic operation following same anesthesia & cardiopulmonary bypass protocol evaluated. Predesigned case record form and bed head ticket, CT scan used to collect data.* ***Results:*** *Rate of neurological complication*
; Stampa 6.7%, type I -3.6%, type-II 3.1%. Incidence of neurological outcome among CABG- 8.6%, Valve-8.2%, non-valve-1.7%. Mortality of type-I neurological injury-4.1%; type-II 6.7%. CT scan report showed ischemic lesion- 26.7%; whereas normal scan found 66.7%. Only 1 patient showed hemorrhagic lesion. ***Conclusion*** *- Mortality of type I neurological complication is very high and this is very much related to CPB. In our study type I neurological complication is significantly lower in CABG cases than valve cases.*
Keyword: *neurological, complication, type-I, type- II, mortality, CT scan.*

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I. Introduction

The era of modern cardiac surgery began in the 1950 s when the cardiopulmonary bypass technology was developed.[1] Since then an astonishing evolution of methods has been seen in the field of cardiac surgery and with improved results. Each year, hundreds of thousands of patients undergo cardiac procedures worldwide. Despite advances in operative techniques and cardiac anesthesia, neurological complications remain an important cause of mortality and morbidity. [2,3]

Neurological complications after cardiac surgery may involve the central nervous system (CNS) or peripheral nerves' injury vary from mild cognitive decline to fatal stroke. According to the American Heart Association and American College of Cardiology, postoperative neurological deficit can be subdivided into two categories. Type I deficits are associated with major focal deficit, stupor and coma. Type II deficits are without detectable focal lesions but are instead associated with defuse symptoms in terms of confusion, agitation, memory deficit and deterioration in intellectual function.[4]

Type I deficits have reported frequencies in between 1.6
% And 8.4%. Whereas type II deficits are more common (15 % to 66 %). [5,6]

Previous studies have recognized several risks factors for neurological complications. Commonly reported preoperative risk factors are- advanced age, female gender, h/o cerebrovascular events, diabetes mellitus, impaired left ventricular function, hypertension and peripheral vascular disease. Identified intra and post operative risk factors are extensive aortic atherosclerosis, prolonged CPB, prolonged ionotr1opic need and atrial fibrillation. [7.8.9.10] Among suggested mechanisms behind neurological complications are; cerebral hypo perfusion during CPB, air embolism, inflammatory mechanisms and fat micro embolism from retrieved

pericardial suction blood. However, embolization from the ascending aorta is considered as the major cause of neurological complications. Aortic manipulation is believed to cause the embolization by different mechanisms; aortic cannulation, cross clamping, and aortic cannula stream jet. [11-15] Many studies have reported a highly impaired short-term survival for stroke patient, with an in hospital mortality ranging between 17% and 24% to be compared with 1.5% to 4.6% for non- stroke patients. [3,16]

The area of cerebral protection during cardiac surgery includes a wide range of various protective methods. Off-pump coronary artery bypass (OPCAB) has been suggested to have less cerebral complications compared to conventional on- pump techniques.[17] Other studies have failed to prove this advantage with OPCAB in term of neurological outcome.[18] Off-pump techniques can be combined with methods to avoid aortic manipulation from proximal anastomosis (no touch technique) and hereby reducing the risks of cerebral embolization.[19] The use of a side-biting clamp can also be avoided by means of a membrane sealing device while suturing the proximal anastomosis. Repetitive clamping can be avoided by a single clamp approach during on-pump CABG, with potential benefits.[20] Another approach to protect against emboli is by using an intra-aortic filter.[21] Moreover, the usage of side-hole instead of end hole cannulas have been suggested to decrease cerebral embolization by avoiding unfavorable stream jets from damaging the aortic wall.[22] Major neurological complication (stroke) after cardiac surgery is a devastating complication that leads to excess mortality, morbidity and health resource utilization. Increased knowledge regarding this complication is essential to develop preventive strategies and risk assessment.

Present thesis addresses the clinical problem of the neurological complications in cardiac surgery by evaluating the incidence, risk factors and prognosis in ourcenter.

AIMS AND OBJECTIVES

1. To find out the incidence of neurological complications in cardiac surgeries.
2. To analyze the risk factors of neurological complications in cardiacsurgery
3. To analyze the outcome of the neurological complications.

II. Material And Method

Consecutive cardiac surgery patients both male and female operated at the cardiothoracic department of N R S Medical College Hospital between January 2014 to June 2015 age ranging from 15 years to 80 years, were analyzed(n=477) Patient were stratified by the type of surgery performed. One group included all procedure employing CPB. Isolated CABG procedure was taken separately.

Clinical details were prospectively recorded as usual by history and clinical examination.

Preoperative conditions noted are H/0 CVA, hypertension, diabetes, peripheral vascular disease (PVD). Surgical and postoperative details were daily entered from admission until discharge. In the intra- operative period type of surgery, CPB time, aortic atherosclerosis is noted. In post- operative period appearance/presence of atrial fibrillation and neurological complication are noted. The patient having neurological complication was treated as per standard ITU protocol and the results are noted. CT scan brain is done where possible. The observational period was limited to the length of stay at cardiothoracicunit.

Operative technique

Surgical procedures and anesthetic management were according to routine and contemporary methods. Anesthesia was generally induced with propofol, fentanyl and/or midazolam. Vecuronium was used for muscle relaxation in all cases. Anesthesia was maintained with a combination of fentanyl boluses and/or isoflurane. Majority of CABG cases are off-pump surgery and partial clamp was used for proximal anastomosis.

The standard CPB setup included- moderate hypothermia, cardioplegic arrest, using a curved- tip end-hole aortic cannula and with recycling of pericardial suction blood. Our perfusion unit consisted of roller pump, membrane oxygenator, filter. The unit was primed with Ringer lactate and whole blood when necessary, diluting the patient hematocrit to 26 – 30%. Canulation was performed with separate canula in IVC and SVC and arterial return placed in the ascendingaorta.

Protocol for evaluation of neurological complications- For most patients the diagnosis was obvious at the time of the event. Any type of neurological problem was noted. Major neurotoxicity, focal deficit, stupor, coma is noted as type I neurological complication. The neurological problem without detectable focal lesion but are associated with diffuse symptoms in terms of confusion, agitation, memory deficit, visual deficit and deterioration in intellectual function are noted as type II neurological complication. However, for patient with uncertain diagnosis help from neurologist taken. This protocol was used to separate the patients into type I and type II.

CT SCANs BRAIN
Where possible CT scan brain (plain) performed from our hospital. Reports from CT scan were systematically reviewed in detail. Ischemic and/or hemorrhagic lesions were categorized and the side is alsonoted.

Study tool: 1. Questionnaire (History) 2. clinical examination (pre-operative and post- operative) 3. Bed History Ticket. 4. OT Note. 5. Investigation: CT scan. **Study technique-**interview, clinical examination and investigation.

Analysis of data-Data has been interpreted using suitable statistical technique using SPSSsoftware.

III. Result and Analysis

1. Distribution of subjects accordingto occurrence of neurological complication during the period of post-operative hospitalstays and Distribution ofneurological complication according to the type of surgery.

Distribution of subjects according to occurrence of neurological complication				
	Frequency	**Percent**	**Valid %**	**Cumulative %**
No Neurological complication	445	93.3	93.3	93.3
Type I	17	3.6	3.6	96.9
Type II	15	3.1	3.1	100.0
Total	477	100.0	100.0	
surgery	No of surg	No of NC pt.	Type I	Type II
CABG	163	14(8.6%)	5(3.1%)	9(5.5%)
Valve	195	16(8.2%)	8(4.1%)	8(4.1%)
Non valve	119	2(1.7%)	1(0.85)	1(0.85%)

0verall incidence of neurological complication in our center is =6.7. Incidence of type I neurological complication is =3.6 % Incidence of type II neurological complication is =3.1 % Incidence of neurological complication in CABG is =8.6% (Type I is 3.1 % Type II is 5.5 %) Incidence of neurological complication in valve surgery is =8.2 % (Type I is 4.1 % Type II is 4.1 %) Incidence of neurological complication in non-valve cardiac surgery is = 1.7 % (Type I is 0.85 % Type II is 0.85 %).

2. FREQUENCY of CVA, DM, PVD, HTN, NUROLOGICAL & NO-NUROLOGICALCOMPLICATION

		PRESENT		**%**	**ABS ENT**	**%**
CVA		7		1.5	468	98.1
DM		135		28.3	342	71.7
PVD		7		1.5	470	98.5
HTN		151		31.7	326	68.3
NO NUROLOGICAL COMPLICATION		Male	279	93.3	------	-----
		Female	198			
NUROLOGICAL COMPLICATION	Type-I	Male	10	3.6		
		Female	7			
	Type-II	Male	11	3.1		
		Female	4			

3. Relations of outcome of neurological complications with the continuous variables (age, ejection fraction, bypass time, x clamp time) expressed as mean with standarddeviation

Outcome	**Age**	**EF%**	**Bypass time(min)**	**X clamp time(min)**
No NC (445)	42±15	57±6	105±47	63±37
Recovered (16)	57±13	53±8	123±41	84±46
Recovered with some deficit (8)	62±14	53±6	129±30	73±17
Death (8)	63±8	53±8	141±37	81±13
Total (477)	43±15	57±6	107±47	68±37

The above table shows that outcome of neurological complications is directly proportional to age, bypass time and cross clamp time where as it is inversely related to ejection fraction.

4. Neurological complication and relation withaortic atherosclerosis.

Aortic cond.%	Pt without NC	Pt with NC	P value	
Normal	72	9.7	.001	significant
Mild	17	29	.001	significant
Moderate/sever	11	61.3	.001	significant
Post-op AF	26	25.8		

Neurological complication is directly related with the severity of aortic atherosclerosis. Mortality – 7 patients out of 17 and 1 out of 15 died in type I and type II respective.Mortality of type I is 41% and type II is6.7%.

5. CT Scanreports

CT scan	No (n=15)	percentage
Normal	10	66.7%
Ischemic	4	26.7%
Hemorrhagic	1	6.6%
Not done	17	

Among the patients CT scan brain was not possible in case of 17 patients. Majority of the showed normal scan (66.7%) and ischemic lesion (26.7%). Only 1 patient showed hemorrhagic lesion.

IV. Discussion

In this study, we sought to evaluate the incidence, risk factors and outcome of neurological complication in our center. The rate of neurological complication observed in our study (overall 6.7%, Type I -3.6% Type II-3.1%) is very much similar to the other studies. Surgery wise rate of neurological complication found in our study (CABG=8.6%, Valve=8.2%, Non valve cardiac=1.7%) is also similar to that previously reported.

In CABG and valve cases the incidence of neurological complication is almost same (around 8%) in our study which is not in line with the most of the studies. It may be due to the fact that the CABG patients in our government hospital are from the poor socioeconomic status and also having more complicated coronary angiogram refused by corporatehospital.

In non-valve open cardiac cases the incidence of neurological complication is significantly low. The mean age of the patients suffering neurological complication is much higher thanthe patients without neurological complication. Mean age for no neurological complication group is 42 years whereas type I and type II are 56 and 59 respectively. So, neurological complication is directly related to increased age. But our study has failed to demonstrate the higher risk of neurological complication in female as reported in manystudies.

Hypertension, diabetes mellitus, peripheral vascular disease is significantly associated with the occurrence of neurological complication. Risk of neurological complication is more if the bypass time and cross clamp time is increased. Outcome of neurological complication is directly related to bypass time and low ejection fraction, but not with cross clamp time. In this study we also failed to show any significant relation of sex with the outcome of neurological complication. Incidence of post operative atrial fibrillation is almost equal between no neurological complication group and neurological complication group that may signify no role of AF in the development of neurological complication (if not associated with low cardiac output syndrome) as reported in previous studies. Aortic atherosclerosis is significantly related with occurrence of neurological complication. CT brain done in 15 out of 32 patients. 10 CT scan was normaland4ischemicand1hemorrhagic(was on tab Acutrim). So, CT scan brain may not significantly influence our treatment plan in our setup. The mortality of type I neurological injury is 41% and type II is 6.7%. So, mortality of type I neurological complication is very much higher than type II.

In this prospective study, we have studied the incidence rate and the various risk factors and outcome of Neurological Complications in patients who underwent cardiac surgery in our department.

Consecutive cardiac surgery patients both male and female operated at the cardiothoracic department of N R S Medical College Hospital between January 2014 to June 2015 age ranging from 15 years to 80 years, were analyzed(n=477) Patient were stratified by the type of surgery performed. One group included all procedure employing CPB. Isolated CABG procedure was taken separately. Post CPR patient areexcluded.

Clinical details were prospectively recorded as usual by history and clinical examination. Preoperative conditions noted are H/0 CVA, hypertension, diabetes, peripheral vascular disease (PVD). Surgical and postoperative details were daily entered from admission until discharge. In the intra-operative period type of surgery, CPB time, aortic atherosclerosis was noted. In post- operative period appearance/presence of atrial

fibrillation and neurological complication are noted. The patient having neurological complication was treated as per standard ITU protocol and the results are noted. CT scan brain is done where possible. The observational period was limited to the length of stay at cardiothoracic unit. Surgical procedures and anesthetic management were according to routine and contemporary methods.

For most p a t I e n t s the diagnosis was obvious at the time of the event. Any type of neurological problem is noted. Major neurotoxicity, focal deficit, stupor, coma is noted as type I neurological complication. The neurological problem without detectable focal lesion but are associated with diffuse symptoms in terms of confusion, agitation, memory deficit, visual deficit and deterioration in intellectual function are noted as type II neurological complication. However, for patient with uncertain diagnosis help from neurologist taken. This protocol was used to separate the patients into type I and type II.

In this study, we sought to evaluate the incidence, risk factors and outcome of neurological complication in our center. The rate of neurological complication observed in our study (overall 6.7%, Type I - 3.6% Type II- 3.1%) is very much similar to the other studies. Surgery wise rate of neurological complication found in our study (CABG=8.6%, Valve=8.2%, Non valve cardiac=1.7%) is also similar to that previously reported.

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3.1 % Type II is 5.5 %) Incidence of neurological complication in valve surgery is =8.2 % (Type I is 4.1

%Type II is 4.1 %) Incidence of neurological complication in non-valve cardiac surgery is = 1.7 % (Type I is 0.85 % Type II is 0.85 %). Neurological complication is directly related with the severity of aortic atherosclerosis. Mortality – 7 patients out of 17 and 1 out of 15 died in type I and type II respectively. So, the mortality of type I neurological injury is 41% and type II is 6.7%. Among the patients CT scan brain was not possible in case of 17 patients. Majority of the showed normal scan (66.7%) and ischemic lesion (26.7%). Only 1 patient showed hemorrhagic lesion.

V. Conclusions

Neurological complication is a devastating complication of cardiac surgery. Mortality of type I neurological complication is very high and this is very much related to CPB. In our study type I neurological complication is significantly lower in CABG cases than valve cases.

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