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Retraction

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Original Research Article

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A clinical study of normothermic open heart surgery

Ishtiak Ahmed Mir[1], Ravinder Kumar[2], Madhu Digra[3], Dinesh Kumar[4]*

[1]Department of CTVS, Super Speciality Hospital, Jammu, India
[2]Department of Surgery, GMC Jammu, India
[3]Consultant Gynaecologist, J&K Health Services, Jammu, India
[4]Department of Obstetrics and Gynaecology, SMGSH, GMC Jammu, India

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***Correspondence:**
Dr. Dinesh Kumar,
E-mail: drdinesh1982@yahoo.com

ABSTRACT

Background: Normothermic open heart surgery is a new approach which is envisaged for better myocardial protection during cardiac surgery based on the concept that chemically arrested heart is perfused continuously with blood and maintained at 37ºC.
Methods: This study was conducted in 50 patients at Super Specialty Hospital, Jammu in the Department of CTVS for a period of one year from 2015 to 2016. The patients of all age groups and both sexes were taken up for surgery which included patients of congenital and acquired heart diseases. All patients were undergone thorough history taking, investigations like cardiac enzymes estimation, LFT, RFT, echocardiography, ECG. Cardioplegia used during surgery consisted of warm oxygenated blood, KCL, sodium bicarbonate, hydrocortisone, Mannitol.
Results: Majority of patients were in age group of 11-20 years which comprised 30% of all patients. the male and female patients were equal and ratio was 1:1. Per-operative diagnosis was same as pre-operative echocardiographic diagnosis except that one (2%) patient had ASD with partial anomalous pulmonary veins opening into right atrium. One patient (2%) had single ventricle with pulmonary stenosis. Maximum number of patients underwent mitral valve replacement followed by ASD repair. Mean aortic cross-clamp time was 62 patients and mean total CPB was 71.5 minutes. Mean value of volume of blood cardioplegia used was 1100 ml and for priming solution it was 1500 ml. Cardiac enzyme level showed peak rise above normal after 24 hours after surgery in majority of patients.
Conclusions: Normothermic open heart surgery can be used in any diverse surgical procedure safely and effectively.

Keywords: Clinical study, Normothermic, Open heart surgery

INTRODUCTION

Hypothermia introduced in clinical medicine by Bigelow, Lindsay and Greenwood in 1950 is widely acknowledged to be fundamental component of myocardial protection during cardiac surgery.[1] Although it prolongs feasibility of the period of ischemic arrest by decreasing oxygen demand, hypothermia is associated with a number of major disadvantages including its detrimental effect on enzymatic function, energy generation, cellular integrity.[2-4] So, a new approach is envisaged for better myocardial protection during cardiac surgery based on the concept that chemically arrested heart is perfused continuously with blood and maintained at 37ºC (normothermic open heart surgery).[5,6] Normothermic open heart surgery is associated with reduced oxidative stress and reduced risk of allogenic blood transfusion.[3,7]

In the proposed study heart is maintained at 37ºC with continuous warm blood cardioplegia which virtually eliminates the period of ischemia, drastically limits the

period of re-perfusion and completely abolishes the detrimental effects of hypothermia.

METHODS

The proposed study was conducted on 50 patients at Super Speciality Hospital, Jammu in the Department of Cardio-vascular and Thoracic Surgery for a period of one year from 2015-16. The patients of all age groups and both sexes were taken up for surgery which included patients of congenital and acquired heart diseases.

All patients were undergone thorough history taking, examination and investigations like PT, PTTK, PTI, platelet count, cardiac enzymes: SGOT, SGPT, LDH, C.K., LFT's, RFT's, echocardiography, electrocardiograph, lung function test, cardiac catheterization whenever indicated, X-ray chest: postero-anterior and lateral views.

Every patient underwent pre-anesthetic checkup before surgery to rule out any contraindication to surgery or anesthesia. Every patient was operated under general anesthesia and standard cardio-pulmonary bypass.

Surgery

Heart was approached by median sternotomy. Pericardium was opened in the midline after reflecting the pleura.

Bicaval venous cannulation was done and cardiopulmonary bypass started and time noted. Both temperature was maintained between 35-37ºC. Oxygenated blood cardioplegia was given through aortic root. In case of aortic valve surgery coronary sinus was connulated by a special ballon catheter through right atrium and connected to cardioplegic solution.

Priming solution

This was used in the C. P. Bypass circuit. The solution used in adults consists of

- Inj. Ringer lactate - 100ml
- Inj. Hydrocortisone - 1gm
- Inj. Sodium Bicarbonate - 1meq/kg body weight
- Inj. Dextrose 5% - 500 ml.

Patient was put on C.P bypass, vena cava snugged and complete bypass achieved cross clamp applied and time was noted. Clamp was applied proximal to aortic cannula and warm oxygenated blood cardioplegia was given by aortic root via 14-gauge cannula. The cardioplegia used was autologus blood. Two types of cardioplegia were used. High potassium blood cardioplegia containing 40m. Equivalent of kcl/litre for induction and low potassium blood cardioplegia having potassium concentration of 20 m.Eq/L and PCV was above 20%.

The cardioplegia used consists of

- Warm oxygenated blood - 1000 ml
- Inj. Potassium chloride - 40meq/L
- Inj. Sodium Bicarbonate - 50meq/L
- Inj. Hydrocortisone - 100-200 mg/L
- Inj. Mannitol - 50 ml/L.

After delivering high potassium blood cardioplegia at 37 via aortic root (antegrade route) cardiac arrest occurred in diastole within 2-3 minutes and 200-300ml/min. of Cardioplegia was given at a pressure of 150-250mm Hg.

Then study switched over to low potassium blood cardioplegia for maintenance. Sometime retrograde cardioplegia was given in aortic valve surgery via coronary sinus after antegrade arrest.

The rate of delivery of low potassium cardioplegia in antegrade route was 50-150ml/mint at same pressure mentioned above. In retrograde routes, the flow pressure was below recommended 40 mmHg and flow rate of 150-200ml/min.

During surgery, repeated blood gas analysis and electrolyte estimations were done.

One blood sample for cardiac enzymes and one ECG was done in immediate post-operative period and it was repeated 24 hours after surgery.

Patients were managed in intensive care unit for 24-28 hours. Prophylactic antibiotics were used post-operatively patients were discharged after a period of 10-12 days on an average. Patients were followed up monthly for one year and then 4-6 months later on. Patients who had undergone prosthetic valve replacement were given lifelong anti-coagulants and their coagulogram was repeated monthly to keep their PTI between 60-70%. Cardiac enzyme estimation and ECG was recorded in every patient at the time of discharge from the hospital and findings recorded.

RESULTS

Majority of patients were in age group of 11-20 years which comprised 30% of all patients. the male and female patients were equal and ratio was 1:1. 14 (28%) patients had palpitation, other symptoms included breathlessness, respiratory tract infections, fatigue and chest pain. Clinical signs included cyanosis, ascites, pedal odema, jaundice, right heart failure and other signs.

Per-operative diagnosis was same as pre-operative echocardiographic diagnosis except that one (2%) patient had ASD with partial anomalous pulmonary veins opening into right atrium. One patient (2%) had single ventricle with pulmonary stenosis.

Table 1: Echocardiographic diagnosis.

Type of defect	No. of patients	Percentage
Mitral valve disease	**19**	**38**
• Mitral stenosis	10	20
• Mitral regurgitation	7	14
• Mixed	2	4
ASD	13	26
VSD	6	12
Aortic valve disease	**5**	**10**
• Aortic	3	6
• Aortic regurgitation	2	4
Tetrology of fallot	3	6
Left atrial myxoma	2	4
VSD with pulmonary stenosis	1	2
Right ventricular outflow obstruction	1	2

Table 2: Surgical procedure done.

Type of procedure	No. of patients	Percentage
Mitral valve replacement	13	26
ADS repair	9	18
VSD repair	6	12
Open mitral valve repair	5	10
Aotric valve replacement	3	6
Double valve replacement	2	4
Total correction of tetrology of fallot	2	4
Excision of left atrial myxoma	2	4
Epstein anamoly	1	2
Correction of right ventricular outflow trunk obstruction	2	4
Aortic valve replacement with open mitral commussiorotomy	1	2
VSD repair with repair of pulmonic stenosis	1	2
PDA ligation with correction of pulmonary artery stenosis	1	2
Open mitral vulvotomy	1	2
ASD repair with diversion of pulmonary Vein into left atrium	1	2

Minimum cross-clamp time was 12 minutes and maximum was 112 minutes with mean value of 62 minutes. Minimum total bypass time was 23 minutes and maximum was 120 minutes with mean value of 71.5 minutes.

Minimum volume of warm blood cardioplegia used was 200 ml. Maximum volume is 2000 ml. with mean of 1100 ml. Minimum volume of prime used was 1000 ml and maximum of 2000 ml. with mean value of 1500 ml.

In 32 (64%) of patients D.C shock was needed to revert the rhythm back to pre-operative rhythm and in 18 (36%) cases spontaneous normal sinus rhythm was achieved. 20 patients out of 32 patients needed just a single sock of 20 joules each.

Table 3: Pre-operative cardiac enzyme levels in 50 patients.

Enzyme	No. of patients having normal values	%	No. of patients having elevated values	%
SGOT	45	90	5	10
SGPT	44	88	6	12
LDH	25	50	25	50
C.K/MB	48	96	2	4

SGOT level was raised in 40 (81.6%) cases SGPT was raised in 28 (57.1%) cases LDH was raised in 46 (93.8%) patients and C.K/MB level was raised in 45 patients (91.8%) in immediate post of period. One patient died on table on the day of surgery so his cardiac enzyme levels were not estimated.

SGOT level was raised in 45 (97.8%) patients. SGPT was raised in 31 (67.3%), LDH was raised in 42 (91.3%) and C.K/MB level raised 42 (91.3%) cases in 24 hours after surgery. 4 patients died within 24 hours so their cardiac enzymes could not be estimated.

Table 4: Cardiac enzyme levels at the time of discharge of patients from hospital.

Enzyme	No. of patients having normal values	%	No. of patients having elevated values	%
SGOT	12	26.6	30	66.6
SGPT	20	44	22	48
LDH	15	33.3	27	60
C.K/MB	26	57.7	16	35.5

ECG finding in immediate post-operative period showed normal sinus rhythm in 49 (100%) and R-R interval was again normal in all patients. One patient died on table, so his ECG recording could not be done. T-wave changes included T-inversion in 20 (40.8%). S-T segment showed slopping done in 14 (28.5%). S-T elevation in 2 (4.08%) and depression in 3 (6.1%) patients. RBBB was seen in 4 patients (8.1%). LBBB was found in 2 (4.08%). LVH in 4 (8.16%) and no RVH seen. Biventricular hypertrophy was seen in one (2.04%). Bigeminal rhythm seen in one (2.04%). Left ventricular strain pattern was seen in 2 (4.08%). Left anterior hemiblock was seen in 3 (6.1%). PAH seen in 1 (2.04%). No P-mitral/pulmonale seen. Sub-endrocardial ischemic pattern was seen in 14(28.5%)

patients. One (2.04%) patient had anteroseptal infarct and one (2.04%) had massive anterior wall infarct.

Table 5: Various pre-operative electrocardiographic features.

E. C. G. findings	No. of patients	Percentage
Rhythm		
Normal	45	90
Sinus tachycardia	2	4
Atrial arrhythmia	3	6
P-R interval		
Normal	48	98
Prolonged	2	4
T-wave changes		
Normal	33	66
Inverted	17	34
S-T segment changes		
Normal	40	80
Slopping down	8	16
Elevated	1	2
Depressed	1	2
Other significant changes		
RBBB	6	12
LBBB	2	4
LVH	4	8
RVH	1	2
Bivent Hypertrophy	2	4
P-Mitrale	1	2
P-pulmonale	2	4
r-in-v (down 1) (PHA)	7	14
Left anterior hemiblock	4	8
Interventricular conduction defect	2	4

Table 6: Electrocardiographic features when patients were discharged from the hospital (n=45).

E.C.G findings	No. of patients	Percentage
Rhythm		
Normal	45	100
Sinus tachycardia	Nil	Nil
Atrial arrhythmia	Nil	Nil
P-R interval		
Normal	45	100
Prolonged	Nil	Nil
T-wave changes		
Normal	20	44.4
Inverted	25	55.5
S-T segment changes		
Normal	22	48.8
Slopping	18	40.0
Elevated	2	4.4
Depressed	3	6.6
Other significant findings		
RBBB	5	11.1
LBBB	2	4.4
LVH	1	2.2
RVH	Nil	Nil
Bivent hypertrophy	2	4.4
r-in-v (down 1) (PAH)	Nil	Nil
Left anterior hemiblock	3	6.6
P-pulmonale	Nil	Nil
P-mitrate	Nil	Nil
Sub-endocardial ischemic /infarct pattern	16	35.59
LVH strain pattern	2	4.4
Bigeminal rhythm	Nil	Nil
Antero septal infarct	1	2.2
Extensive anterior wall infarct	1	2.2

ECG finding were recorded 24 hours after surgery in 46 patients since 4 patients died within 24 hours. Normal sinus rhythm and P-R interval was seen in all patients. T-wave inversion was seen in 21 (45.6%) patients. S-T segment showed down slopping in 11 (23.9%), S.T elevation in 3 (6.5%) and depression in 5 (10.8%) patients. RBBB was persistent in 5 (10.8%). LBBB was seen in 2 (4.3%). LVH seen in 2 (4.3%) and RVH in one (2.3%) patients. PAH seen in one (2%). No P-mitral/pulmonale seen. Bigeminal rhythm was found in one (2%) and left ventricular strain pattern was seen in 2 (4.3%) patients. sub-endocardial ischemic pattern was seen in 14(30.4%). One (2%) had antero-septal infarct and one (2%) had extensive anterior wall infarct.

Table 7: Post-operative complications.

Complications	No. of patients	Percentage
Low output syndrome	6	13.3
Infection	4	8.8
Haemorrhage	4	8.8
Hyperkalemia	2	4.4
Arrhythmia	2	4.4
Disseminated intra-vascular coagulation	2	4.4
Stone heart	1	2.2
Deaths	5	10

Table 8: Mortality rate in 50 patients.

Cause of death	No. of patients	Percentage
Low output syndrome	1	2
Disseminated intra-vascular coagulation	1	2
Massive myocardial ischemic damage	1	2
Conduction defect	1	2
Stone heart	1	2

Majority 29 (47.61%) patients stayed for 13-15 days. 14 (33.3350) patients stayed for 08-12 days. 6 (14.28%) for 16-20 days and only 2 (4.76%) for 21-25 days.

DISCUSSION

In present study age group of patients was from 6-50 years and male to female ratio was 1:1 where as in a study by Salerno TA8 the age group was from 21-77 years with male to female ratio of 3:1. In a study by Christakis GT9 the ratio was 7.2:1. In our study, minimum cross-clamp time was 12 minutes and maximum was 112 minutes with mean value of 62 minutes. This corresponds with studies by Frering D et al10 and Calafiore AM et al.[11] In this study minimum, total bypass time was 23 minutes and maximum was 120 minutes with mean value of 71.5 minutes. This again corresponds with studies by Frering D et al and Calafiore AM et al.[10,11] Increased levels of cardiac enzymes 24 hours after surgery correspond with the findings of Pelleteer LC et al.[12] Perioperative myocardial infarction rate was 6% in our study which was similar to study by Lichtenstein SV et al in which it was 5.4%.[13] Sub-endocardial ischemic pattern seen in 35.5% cases indicated imbalance between oxygen supply and demand. Since majority of our patients received antegrade warm blood cardioplegia, the prevalence of myocardial ischemic necrosis corresponds with study of Matsuura H et al.[14] In this study low output syndrome was found in 13.3% cases which was similar to study by Lichtenstein SV et al in which it was 10.8%.[13]

CONCLUSION

Normothermic open heart surgery can be used in any diverse surgical procedure safely and effectively.

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Ethical approval: The study was approved by the institutional ethics committee

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