

# Impact of Aortic Cross Clamp Time on Postoperative Inotropic Support in Coronary Artery Bypass Grafting Surgery

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## ABSTRACT

**Aim:** To determine the effect of Aortic clamp time on postoperative inotropic support in CABG surgery.

**Study design:** Comparative cross-sectional study.

**Place and duration of study:** Cardiac Surgical Deptt Army Cardiac Centre Lahore from Sep, 2017 to Aug, 2018.

**Methods:** Data was analyzed on 100 patients who had undergone CABG surgery. Group A (n: 50) included cases with cross-clamp time more than 60 minutes and Group B (n: 50) with cross-clamp time less than 60 min. The primary outcome measure was to estimate requirement of inotropic support in postoperative period.

**Results:** XCL, CPB and operation time was less in Group B and was statistically significant ( $p < 0.000$ ). Prolonged aortic clamp time was not found to be associated with high inotropic support requirement ( $p < 0.175$ ). One patient with preserved LV function in Group A and 8 cases with moderate EF in Group B had requirement of intraaortic balloon pump ( $p < 0.002$ ). Hospital stay was significantly lower in patients of Group A ( $p < 0.04$ ). In hospital mortality was 2% in Group A and 4% in Group B and was associated with perioperative myocardial infarction ( $p < 0.55$ ).

**Conclusion:** Prolonged aortic cross clamp time per se does not affect the increase requirement of postoperative inotropic support. Meticulous surgical technique, adequate myocardial protection and avoiding distension insult to heart on weaning off from CPB might play essential role in reducing the need for postoperative chemical and mechanical support.

**Keywords:** Aortic clamp time, By-pass time, inotropic support, intra aortic balloon pump

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## INTRODUCTION

Patients undergoing open heart surgery with prolong aortic clamp time is associated with adverse outcome<sup>1,2</sup>. The effect of prolong ischemic time has also been observed in patients requiring coronary artery bypass grafting surgery (CABG) with poor outcome in the early postoperative period<sup>3</sup>. A variety of myocardial protection techniques like use of blood or crystalloid based warm, tepid and cold cardioplegic solutions has been used during the period of aortic clamping in order to reduce ischemic insult to heart and return of adequate myocardial function in post-arrest period<sup>4</sup>. Prolong clamp time with incomplete myocardial protection may cause irreversible myocardial damage leading to unfavorable outcome. Patients with preserved left ventricular function tolerate ischemic time better than those with impaired left ventricular function with increase morbidity and mortality seen in the later group<sup>5-8</sup>. Myocardial damage, secondary to prolong clamp time, results in release of myocardial enzymes and leads to number of adverse events in the perioperative period<sup>9-12</sup>. It is further added that cardiopulmonary bypass (CPB) is directly linked to clamp time with increase in ischemic time leads to increase in CPB time<sup>11</sup>. However, there is insufficient evidence to support the negative prognostic effect of prolong CPB time on myocardial function in the early postoperative period<sup>11,12</sup>. Recently, it is found that longer XCL time is not associated with deterioration of myocardial function and mortality<sup>12</sup>. Our hypothesis is based on the assumption that prolonged Aortic clamp time in patients undergoing conventional coronary artery bypass grafting (CABG) surgery would be associated with high inotropic support due to ischemic insult to myocardium in

the early postoperative period and hence the increase in morbidity and mortality.

## PATIENTS AND METHODS

This comparative cross-sectional, single centre study was conducted in Cardiac surgical department of Army Cardiac Centre Lahore. The Centre Ethical Committee for Clinical Research approved the protocol.

Data were retrospectively collected from hospital database on a total of 100 patients undergoing Coronary artery bypass grafting surgery (CABG) between Sep, 2017 and Aug, 2018 at the Army Cardiac Centre Lahore. These patients were recruited in the study through non random consecutive sampling as per comparable demographic characteristics and were divided in two groups. Group A (n: 50) consisted of patients who underwent Coronary artery bypass grafting(CABG) surgery with aortic cross clamp time more than 60 minutes while Group B (n: 50) included cases with aortic cross clamp time less than 60 minutes . Data on patient's demography was recorded. Intraoperative variables like clamp time and CPB time along with the number of grafts were also recorded. Data of Endarterectomy or patchplasty was also collected along with the amount of inotropic support required and need for mechanical support in the form of insertion of intra aortic balloon pump (IABP). Postoperative data include ventilation time, intensive care unit (ICU) and hospital stay. The in-hospital mortality was also noted.

All patients of both sexes over the age of 45 years, underwent isolated CABG surgery were included in the study. Patients of redo CABG operations, CABG with valvular heart disease, Aortic disease and adult congenital heart diseases were excluded from study. Patients undergoing CABG surgery on CPB, without application of aortic clamp, were also excluded from study.

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Received on 19-11-2018

Accepted on 23-04-2016

Perioperative management was standardized for all patients of both groups. CPB was instituted after achieving full anticoagulation using heparin at a dose of 300 IU/kg. CPB flow rates were maintained at 2.4 l/min m<sup>2</sup> with perfusion pressure kept around 70- 80 mmHg. Hematocrit was kept above 21% and temperature was drift down to 32°C during CPB. Tepid antegrade intermittent blood based cardioplegia with additional retrograde cardioplegia in patients with critical left main stem disease was used for achieving myocardial protection. Cold cardioplegia (4°C) was used in selected cases requiring endarterectomy with patchplasty. During period of aortic clamp, distal anastomosis was performed while proximal anastomosis was done using partial aortic clamping.

The primary end point of this study was to assess the impact of aortic cross clamp time on postoperative requirement of inotropic support. Secondary end-points were postoperative requirement of intraaortic balloon pump, measurement of CPB and total operation time along with duration of ventilation, delirium or stroke, renal dysfunction, dysrhythmias, perioperative myocardial infarction, Intensive care unit and hospital stay along with in-hospital mortality.

**Operational Definitions:** Mild inotropic support was defined as use of single inotropic agent, moderate inotropic support was defined as use of two inotropic agents and high inotropic support was defined as use of three inotropic agents. Perioperative myocardial infarction was defined as the appearance of new Q waves in ECG or creatine phosphokinase myocardial band (CPK-MB) levels five times above normal. Good Left ventricular (LV) systolic function was defined as ejection fraction of more than 50%. Moderate LV systolic function was defined as ejection fraction from 31% to 49% and Poor LV systolic function was defined as EF less than 30%. Mortality was defined as death before discharge or within 30 days of surgery. Data was entered in Statistical package for Social sciences (SPSS version 23) for analysis. Data had been described through descriptive statistics. Quantitative variables of each group were analyzed using Independent sample t-test, while Qualitative variables of both the groups were analyzed by Chi-square test.

**RESULTS**

Table 1 shows demographic data of all patients underwent CABG surgery. Male to female ratio was 4:1 in each group. Almost half the cases in both groups were diabetic and hypertensive with two-third of them was in angina CCS Class 111-1V in each group. Half of the patients (50%) of group B had history of previous myocardial infarction as compared to 38% of cases in Group A. 36%of patients in group A had preserved left ventricular function as compared to 26% of the patients of Group B. 38% Of patients of Group A had diffuse coronary artery disease and 36% had either endarterectomy or patchplasty or both, while 18% of patients in Group B had diffuse disease with less than half of them underwent endarterectomy or patchplasty (p 0.001).

Table 2 shows the intra and postoperative variables of both groups. Majority of patients in each group were electively operated with 4% in Group A and 6% in Group B

underwent emergency CABG surgery. Aortic clamp time, CPB time and operation time was significantly less in Group B as compared to Group A (p 0.000), but prolonged clamp time was not identified as a significant risk factor when compared with inotropic support required in patients of each group (p 0.175). Half of the patients of each group with preserved LV function required moderate or high inotropic support, while half of patients in Group A with moderate LV function had moderate or high inotropic requirement as compared to two-third of patients with similar ejection fraction in Group B requiring moderate or high inotropic support. The only patient with poor LV in Group A had mild inotropic support while 2 patients of poor LV in Group B weaned off from CPB on moderate inotropic support. Only one patient with preserved LV function in Group A required mechanical support while 8 patients with moderate EF in Group B came off from CPB with insertion of intraaortic balloon pump (p 0.002). None of the patients in each group with poor Ejection fraction had requirement of mechanical support. Our analysis also revealed that out of 18 patients of Group A underwent endarterectomy and/or patchplasty, almost half of them came off from CPB with mild inotropic support. Conversely, three-fourth of patients of Group B with endarterectomy had moderate to high inotropic support (p 0.472). Furthermore, Mechanical support (IABP) was required in only one patient of endarterectomy in Group A and was statistically significant (0.001).

On the whole, mechanical support was 8 times more in patients of Group B than A. Incomplete revascularization was done in 4% of cases of Group B and none in Group A. Ventilation time and ICU stay was slightly more in Group B but was found to be not significant. On the contrary, postoperative hospital stay was significantly lower in patients of Group A (p 0.04). In hospital mortality was 2% in Group A and 4% in Group B and was associated with perioperative myocardial infarction, however, it was not statistically significant between the groups (p 0.55).

Postop inotropic support in Group A and B

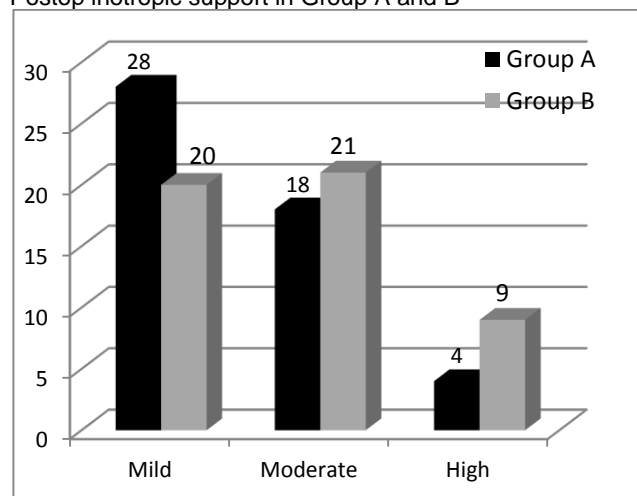


Table: 1 Clinical characteristics &amp; Demographics (GP A &amp; GP B)

Perioperative Variable	Group A	Group B	P value
Male	40(80%)	41(82%)	0.80
Female	10(20%)	9(18%)	
Age (Yrs)	56.40±8.70	58.80±8.07	0.15
BMI(Kg/m <sup>2</sup> )	26.30±3.75	27.16±6.45	0.41
Diabetic	27(54%)	30(60%)	0.54
Hypertension	29(58%)	25(50%)	0.64
Smoker	15(30%)	16(32%)	0.83
Angina	Class 1/11:	15(30%)	0.83
	Class111/1V:	35(70%)	
Creatinine clearance (ml/min)	85.22±29.20	81.14±26.21	0.46
Previous MI	19(38%)	25(50%)	0.23
Ejection Fraction (%)	Good LV	36(72%)	0.04
	Moderate LV	13(26%)	
	Poor LV	1(2%)	
Extent of Coronary Artery disease	LMS(> 50%)	8(16%)	0.55
	Triple vessel	39(78%)	
	Double vessel	3(6%)	
	Single vessel	0(0%)	

Table: 11 Comparison of Intra and postoperative variables between groups

Variable	Group A	Group B	P value
No of grafts	3.18±0.523	2.82±0.629	0.002
Endarterectomy/Patchplasty	18(36%)	4(8%)	0.001
Operation	Elective	48(96%)	0.65
	Emergent	2(4%)	
Clamp time (mins)	89.12±25.66	48.74±9.33	0.000
CPB time (mins)	134.18±34.07	87.82±21.45	0.000
Operation time (mins)	237.40±42.92	185.46±34.94	0.000
Inotropic support	Mild	28(56%)	0.064
	Moderate	18(36%)	
	High	4(8%)	
IABP	1(2%)	8(16%)	0.014
Ventilation time (hrs)	3.80±0.86	5.17±5.43	0.082
Renal dysfunction	4(8%)	7(14%)	0.34
Delirium	1(2%)	5(10%)	0.08
Dysrhythmia	4(8%)	11(22%)	0.15
Perioperative MI	1(2%)	3(6%)	0.31
ICU stay (hrs)	40.18±33.47	50.82±48.70	0.206
Hospital stay (days)	5.70±1.59	7±4.13	0.040

## DISCUSSION

In the past, longer aortic clamp time during open heart surgery has been blamed for adverse outcome in the early postoperative period<sup>2</sup>. The question about the length of clamp time causing negative impact on ventricular function is still to be determined. Some studies have claimed that clamp time more than 150 min leads to high risk of post operative death<sup>13</sup>, while other studies have shown detrimental effect on ejection fraction and high mortality rate with clamp time between 72 minutes to 90 minutes<sup>11,14</sup>. On the contrary, Verheijen and colleagues found no association between long clamp time and postoperative morbidity in patients undergoing mitral valve repair<sup>12</sup>. In the current study, we did not find significant relationship between ischemic time and left ventricular dysfunction leading to requirement of high inotropic support ( $p$  0.175). Our study have shown that in spite of prolonged clamp time in Group A, the postoperative requirement of inotropic support was less, although, not statistically significant as compared to other group with short clamp time. Based on these findings, we suspect that either myocardial protection might not be adequate in patients with shorter clamp time or fluctuating haemodynamic status of heart after weaning

off from CPB that might had added insult to heart as observed in those patients of Group B requiring high inotropic support. Although, it is hypothetical, but it is based on the assumption that both groups were operated in two different operating rooms with different anesthetist and perfusion teams. Another factor that might alter the result is the surgeon experience and skill. Many studies have found that CABG surgery performed by supervised junior surgeons produce similar outcome when compared with the attending surgeons<sup>15-17</sup>. It is, however, emphasized that CABG surgery demands perfection with zero error strategy. In this study, pts in each group were operated by different senior surgeons of same surgical skills and experience.

Previous studies have demonstrated that patients with moderate and poor left ventricular function tolerate ischemia better than those with preserved left ventricular function during period of aortic cross clamp because of the phenomena of ischemic preconditioning<sup>2,18</sup>. We did not found this effect in patients with moderate left ventricular function. Furthermore, majority of patient with moderate EF in Group B required mechanical support in addition to high inotropic support. However, patients with poor LV function behaved well in both groups and weaned off from CPB on mild to moderate inotropic support.

It is generally agreed that CABG surgery requiring endarterectomy and patchplasty behave worse in postoperative period as evident in the literature<sup>19</sup>. Patchplasty with or without Endarterectomy was performed more frequently in Group A than B (36% vs 8%) and almost half of the cases of Group A weaned off from CPB on mild inotropic support with Intra aortic balloon pump inserted in one case only ( $p$  0.001). On the whole, requirement of mechanical support was eight times more in Group B than A. It is, however, emphasized that perhaps in addition to completeness of surgical procedure, careful monitoring and managing the haemodynamic status of reperfused and ejecting heart after weaning off from CPB to prevent distention injury to myocardium might be contributing factor for reducing the need for chemical or mechanical support.

Another aspect that needs to be highlighted is the relation between the ischemic time during CABG surgery and renal and neurological dysfunction. Previous reports have claimed that these organs are affected by fluctuating perfusion pressures during CPB rather than by longer clamp time<sup>20, 21</sup>. It is further added that Dysrhythmias like atrial fibrillation and premature ventricular contraction are usually the results of either preexisting rhythm problems or use of postoperative inotropic agents<sup>22</sup>. In the current study, renal dysfunction, delirium and dysrhythmias were predominately noted in patients of Group B.

In contrast to previous studies<sup>14,15</sup> claiming high mortality rate associated with prolonged clamp time in patients undergoing cardiac surgical procedure, only one pt (2%) in longer clamp time group expired on account of postop MI. Furthermore, we did not find significant difference between groups for in-hospital mortality ( $p$  0.55).

There are few limitations of our study that needs to be acknowledged and include retrospective study with small sample size and carried out at single centre. In spite of these limitations, it is believed that this study will initiate further research on the topic.

## CONCLUSION

Prolonged clamp time during CABG surgery per se does not affect the increase requirement of postoperative inotropic support. Meticulous surgical technique, adequate myocardial protection and avoiding distension insult to heart on weaning off from cardiopulmonary bypass play pivotal role in reducing the need for postoperative chemical and mechanical support.

**Conflict of interest:** This study has no conflict of interest

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