

# Outcome of Strict Peri-Operative Glycemic Control in Diabetic Patients Following Open Heart Surgery

Strict Peri-Operative Glycemic Control in Diabetic

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## ABSTRACT

**Objective:** To compare the outcome in terms of post-operative complications and early mortality of strict glycemic control among diabetics having open heart surgery with control group following open heart surgery.

**Study Design:** Prospective Cohort Study

**Place and Duration of Study:** This study was conducted at the Department of Anesthesia, Punjab Institute of Cardiology, Lahore from November 2020 to April 2021.

**Materials and Methods:** In this study, 60 patients were randomly assigned to two groups (30 patients in each group) according to a computer-generated allocation table. All the diabetic patients of 18 years to 60 years old with ASA II and III planned for cardiac surgery during this study period was included. In the control group no insulin was given to the patient unless blood glucose level exceeded 180 mg/dl. While in the study group glucose level between 80 and 110 mg/dl was targeted using continuous infusion of insulin in saline. Cardiac, Pulmonary, Renal and Neurological problems were noted. Early mortality was also documented.

**Results:** Mean duration of diabetes in the strict control of diabetes group was 13.57±6.32 years and in conventional group it was 12.89±5.88 years. Complications or poor outcome due to occurrence of complications or early mortality was seen in 29 patients in the conventional glycemic control group while only 8 patients in the strict glycemic control group. Cardiac complications were three times less in the tight control group. Early mortality was observed in the control group in 2 patients as compared to none in the strict / tight control group, difference was statistically significant p value <0.0001.

**Conclusion:** Intra-operative tight glycemic control can help in controlling post-operative morbidity after open heart surgery. With control of post-operative complications, the recovery process can be improved. All types of complications are decreased with strict glycemic control.

**Key Words:** Peri-Operative, Glycemic Control, Diabetic Patients, Open Heart Surgery

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## INTRODUCTION

Diabetes is one of the common endocrine disorders with disturbed metabolic pathways, leading to significant morbidity. Patients of cardiac surgery also having diabetes can affect the outcome and lead to many post-operative complications. These include diabetic peripheral neuropathy, renal dysfunction, fatty liver, optic neuropathy and atherosclerosis.

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Glycemic control and hyperglycemia can impact the course of anesthesia and surgery.<sup>1</sup>

Review of literature shows that a strict control of sugar can be beneficial in prevention of post-operative on reducing neurological and infectious complications yet this was offset by the possibility of hypoglycemia which is more dangerous in case of general anesthesia in the short term view.<sup>2,3</sup>

Diabetes or impaired glucose tolerance is common state of the body of candidates of cardiac surgery. Few of them are even undiagnosed diabetics with hyperglycemia leading to further increase in the chances of development of post-operative complications. Increase in the hospital stay leads to further increase in the cost of the treatment.<sup>4</sup>

Studies have concluded that the glycemic control in perioperative period is a key factor in determining the outcome of surgery and complications, especially during open heart surgery. But the extent of control is still debatable, whether the strict control of blood sugar can further improve the outcome as compared to the patients with normal or below average control.

Most of the studies concluded in the favor this notion, still few have shown the difference to be insignificant.<sup>5,6</sup>

Various societies of surgeons have recommended a controlled blood sugar level of less than 180 mg/dl during the surgery and in the ICU. No local study is available in our region regarding assessment of outcome in terms of post-operative complications of cardiac surgery with strict control of blood sugar. Can the extent of glycemic control in cardiac surgery patients affect the outcome of cardiac surgery and its complications? The aim of the study was to determine the association between perioperative glycemic control and the outcome of patients following open heart surgery. With continuous strict control of sugar, significant morbidity can be prevented, thus improving the outcome.

## MATERIALS AND METHODS

In this cohort study done at the Punjab Institute of Cardiology, Lahore, Pakistan between November 2020 to April 2021 (6 months), after the ethical clearance of the Hospital Research Review board. Informed consent was signed from the patients to asking them regarding the use of data for the purpose of study.

We conducted this study on 60 patients randomly assigned to two groups (30 patients in each group) according to a computer-generated allocation table. All the diabetic patients included were of 18 years to 60 years old and were falling in the ASA - American Society of Anesthesiologists class II and III, and were planned for cardiac surgery during this study period. Sample size calculation was done using WHO sample size calculator, assuming the incidence of adverse events in tight control of blood sugar group was 14% and 42% in the control group, taking power of the study of 80% and level of significance of 5 %.

All of these enrolled cases were put on insulin therapy two days before the operation following the routine of the hospital protocol for all the patients. All the patients with a fasting (8 hours fast) blood glucose level of more than 140 mg/dl were declared as diabetic.

Any patient with impaired renal functional renal impairment (creatinine level more than 1.6 mg/dl) in whom hyperkalemia may be present that may require insulin – glucose for correction of hyperkalemia, patients with poor glycemic control (HbA1c  $\geq 9\%$ ), having emergency surgery, having surgery with off-pump bypass, age less than 18 years, on dialysis due to renal failure, and having history of cerebral vascular accident/transient ischemic attack (CVA/TIA) within the last six months were excluded from the study.

For all patients included in the study, medical record (MR) numbers were obtained, files were retrieved from medical records, and data were collected on a

predesigned data collecting form by one of the investigators.

The day before surgery, pre-operative evaluation of patients was done which included medical history, clinical examination, chest X-ray examination, ECG, data of cardiac catheterization, echocardiography and laboratory investigations (complete blood count, bleeding time, clotting time, prothrombin time, partial thromboplastin time, blood sugar, Hemoglobin A1c, liver function tests, renal function tests, and urine analysis. Then the study protocol was explained to every patient.

The anesthetic technique was the same for all patients in the study, starting by pre-operative re-examination of the patient, and re-checking his file. On arrival to the operating room, in the fasting patient a venous cannula (22 Gauge) was inserted in the non-dominant forearm under complete aseptic technique and 1–2 mg midazolam was injected through it. The non-dominant radial artery cannulation is performed under local anesthesia using lidocaine 2% after doing modified Allen's test, followed by insertion of thoracic epidural catheter. The patient was put in the sitting position, the anesthetist wearing sterile gloves painted the patient's back with antiseptic solution, the site of epidural needle entry (mid-line – at the level of the line joining the lower angle of the two scapulae) was infiltrated with 2 ml lidocaine 2% using sterile fine needle of insulin syringe (least painful) before advancing the epidural needle with loss of resistance test applied till reaching the epidural space.

After intubation, patients were mechanically ventilated through volume-controlled ventilation with 100% O<sub>2</sub> to maintain the end-tidal CO<sub>2</sub> at 30–35 mmHg. We continued with isoflurane 0.5–1% (aided by the epidural morphine) and proceeded for central line cannulation of the right internal jugular vein with a 2-way CVP catheter.

Blood glucose was measured (venous blood samples with-drawn and sent to the hospital lab for blood glucose level) just before induction of anesthesia, before skin incision, before initiation of cardiopulmonary by-pass, every 20 min after start of by-pass till the patient was transferred to the intensive care unit where blood glucose level is measured every 2 h until extubation is done. After extubation blood glucose was monitored every 4 h routinely.

In the control group no insulin was given to the patient unless blood glucose level exceeded 180 mg/dl. If so, we initiated an infusion of rapidly acting insulin (act rapid) in saline of 6–9 units/h using syringe pump and adjusted the rate of infusion to keep glucose level between 110 and 180 mg/dl.

While in the study group where tight glycemic control of glucose level between 80 and 110 mg/dl was targeted we gave a continuous infusion of insulin in saline (50 units of rapidly acting insulin (act rapid) in

50 ml syringe) at a rate of 1–2 units/h if blood glucose between 110 and 150 mg/dl. If blood glucose level was between 150 and 200 mg/dl, we increased the rate of insulin infusion to 4–6 units/h. And if it exceeded 200 mg/dl then the insulin infusion rate was 6–9 units/h.

Delayed recovery was defined as extubation done in the next day of operation after 18 hours of intubation. Cardiac problems noted were atrial fibrillation or acute myocardial infraction. Pulmonary problems noted were prolonged bronchospasm, pneumothorax, bronchitis, atelectasis and pleural effusion. For all these serial X-rays of the chest were done. Renal problems were defined as doubling of serum creatinine level by 2<sup>nd</sup> day of operation. Neurological problems were defined as any episode of post-op stroke within 4 days of operation or any episode of post-op delirium (POD). Early mortality was defined as mortality of the patient in the cardiac ICU.

## RESULTS

In this prospective cohort study, 60 patients were enrolled and randomly assigned to two groups. Mean age of the patients included in the study was 54.76±8.32 years. Male and female ratio was almost the same in both the groups. In the strict control group, 17 were male and 13 were females while in the control

group on conventional treatment strategy 18 were male and 12 were females.

Mean duration of diabetes in the strict control of diabetes group was 13.57±6.32 years and in conventional group it was 12.89±5.88 years. Table 1 showing the comparison of outcome / complications like pulmonary complications, cardiac complications, Renal problem, Neurological problems, Surgical problems and early mortality among the patients having cardiac surgery.

Complications or poor outcome due to occurrence of complications or early mortality was seen in 29 patients in the conventional glyceic control group while only 8 patients in the strict glyceic control group. Table no. 1 below is showing various outcomes / complications of cardiac surgery with strict versus conventional peri-operative glyceic control.

Cardiac complications were three times less in the tight control group. Similarly, pulmonary complications were reduced almost two times; renal, neurological and surgical complications were reduced by 4-5 times than those in the control group.

Early mortality was observed in the control group in 2 patients as compared to none in the strict / tight control group, difference was statistically significant p value <0.0001.

**Table No. 1: Comparing the various outcomes / complications of cardiac surgery with strict versus conventional peri-operative glyceic control**

Outcomes	Control Group		Strict Control		P value
	No. of patients	%	No. of patients	%	
Pulmonary problem	5	16.67	2	6.67	0.23
Cardiac Problem	6	20	2	6.67	0.13
Renal Problem	5	16.67	1	3.33	0.08
Neurological Problem	4	13.33	1	3.33	0.16
Surgical Problem	7	23.33	2	6.67	0.07
Early Mortality	2	6.67	0	0	0.0001
Total	29		8		

## DISCUSSION

Patients of cardiac surgery are mostly diabetic and diabetes is a major factor in deciding the outcome of the cardiac surgery. A patient of cardiac surgery with controlled diabetes may have a better outcome as compared to the patient with un-controlled diabetes. Diabetes can be a major medico-economic problem, especially in the developing and under-developed countries. Can a better control of diabetes affect the outcome of cardiac surgery? It's still a matter of debate and research. This study was designed to determine the outcome of cardiac surgery in terms of various complications in the post-operative period between patients with strict glyceic control and those with poor control. Only adult patient of CABG were included.

Mean duration of diabetes in the strict control of diabetes group was 13.57±6.32 years and in conventional group it was 12.89±5.88 years. Complications or poor outcome due to occurrence of complications or early mortality was seen in 29 patients in the conventional glyceic control group while only 8 patients in the strict glyceic control group. Cardiac complications were three times less in the tight control group. Similarly, pulmonary complications were reduced almost two times; renal, neurological and surgical complications were reduced by 4-5 times than those in the control group. Early mortality was observed in the control group in 2 patients as compared to none in the strict / tight control group, difference was statistically significant p value <0.0001.

In a similar study, complications were seen more frequently among the patients with poor glyceic

control. Patients with strict control of sugar during the operation had less frequent postoperative complications (23.2% vs 34.1%), although the mean blood glucose was not significantly different ( $6.6 \pm 0.7$  vs  $6.7 \pm 0.8$  mmol/L,  $P < .001$ ).<sup>7</sup>

Siddiqui KM, et al reported in a local study including 129 patients in 2 years. Male to female ratio was 3:1. Majority was of CABG (95.3%); few were of CABG plus valve replacement. Mean fasting blood sugar (FBS) was  $154.6 \pm 55.6$  g/dl and mean duration of diabetic was  $12.3 \pm 5.5$  years. Data analysis showed that no intraoperative and postoperative complications were seen among these patients.<sup>8</sup> In our study, both the groups had complications but these were much reduced with strict glycemic control.

In a study on 100 patients of cardiac surgery, all the features related to intra-operative and post-operative complications of all the patients were noted. Among the control group of patients 21 (43%) had complications and 7 (14%) cases in the group of patients with strict glycemic control group.  $P = <0.05$ .<sup>9</sup>

Unlike the results of our study and many others like those mentioned above, Chen CP, et al studied cardiac surgery patients with diabetes. Duration of ventilation, stay in ICU, blood transfusion, postoperative infection, hypoglycemic events were not significantly different between case and control groups ( $p > 0.05$ ).<sup>10</sup>

In a study published in 2005, open heart surgery patients having poor glycemic control had poor outcome. Among all these cases, poor intra operative glycemic control was seen in 18% cases. Frequency of patients with poor intraoperative glycemic control was more in patients with severe postoperative morbidity (37% vs. 10%;  $P < 0.001$ ).<sup>11</sup> This was almost similar to our data analysis.

A review study was published in 2018, in which it was concluded that a higher sugar level before the surgery and during the surgery is associated with poor outcome. A strict control of blood sugar for patients with diabetes and moderate control for pre-diabetic patients can improve outcome.<sup>12</sup>

Intensive insulin therapy for strict control in diabetic patients of cardiac surgery was done in the peri-operative period. 82 of 185 (44%) cases in this group and 46% in the conventional therapy group had complications. This raised mortality and incidence of stroke with strict control of blood sugar through insulin therapy, unlike the results of other studies, can raise a concern for cardiac surgeons.<sup>13</sup>

Studies have proved with evidence from clinical data that perioperative control of hyperglycemia in cardiovascular surgery patients, can affect the outcome. Guidelines should be made regarding the control of blood sugar for all the cardiac surgery patients with history of diabetes and those without diabetes.<sup>14</sup>

It has been reported previously that the variable diabetes and hyperglycemia in patients of cardiac

surgery are associated with severe outcomes. And by improving the control of the patients of cardiac surgery can improve the success rate and overall morbidity of the patients.<sup>15</sup>

## CONCLUSION

Intra-operative tight glycemic control can help in controlling post-operative morbidity after open heart surgery. With control of post-operative complications, the recovery process can be improved. All types of complications are decreased with strict glycemic control.

**Recommendations:** Study should be planned with a longer follow-up with a larger sample size to see the impact of tight control of blood sugar of diabetic patients having open heart surgery, on the outcome and post-operative complications along with length of hospital stay and 30 days mortality. With that it can be recommended to all the diabetic patients of open heart surgery with monitoring of blood sugar for any episode of hypoglycemia no fear of hypoglycemia if close monitoring of blood glucose level is done to maintain eu-glycemic stability.

### Author's Contribution:

Concept & Design of Study: Syed Imran-ul-hassan  
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**Conflict of Interest:** The study has no conflict of interest to declare by any author.

## REFERENCES

1. Kang ZQ, Huo JL, Zhai XJ. Effects of perioperative tight glycemic control on postoperative outcomes: a meta-analysis. *Endocr Connect* 2018;7(12):R316-R327.
2. Barker P, Creasey PE, Dhatariya K, Levy N, Lipp A, Nathanson MH, et al. Peri-operative management of the surgical patient with diabetes 2015: Association of Anaesthetists of Great Britain and Ireland. *Anaesthesia* 2015;70:1427-1440.
3. Krzych LJ, Wybraniec MT. Glycaemic control in cardiac surgery patients: a double-edged sword. *Current Vascular Pharmacol* 2015;13:578-586.
4. Chan RP, Galas FR, Hajjar LA, Bello CN, Piccioni MA, Auler JO. Intensive perioperative glucose control does not improve outcomes of patients submitted to open-heart surgery: a randomized controlled trial. *Clinics* 2009;64:51-60.
5. Lazar HL, McDonnell MM, Chipkin S, Fitzgerald C, Bliss C, Cabral H. Effects of aggressive versus

- moderate glycemic control on clinical outcomes in diabetic coronary artery bypass graft patients. *Ann Surg* 2011;254:458–63.
6. Vongsumran N, Buranapin S, Manosroi W. Standardized Glycemic Management versus Conventional Glycemic Management and Postoperative Outcomes in Type 2 Diabetes Patients Undergoing Elective Surgery. *Diabetes Metab Syndr Obes* 2020;13:2593-2601. <https://doi.org/10.2147/DMSO.S262444>
  7. Bláha J, Mráz M, Kopecký P, Stříteský M, Lipš M, Matias M, et al. Perioperative tight glucose control reduces postoperative adverse events in nondiabetic cardiac surgery patients. *J Clinical Endocrinol Metabolism* 2015;100(8):3081-9.
  8. Siddiqui KM, Asghar MA, Khan MF, Khan FH. Perioperative glycemic control and its outcome in patients following open heart surgery. *Ann Card Anaesth* 2019;22(3):260-4.
  9. Asida SM, Atalla MM, Gad GS, Eisa KM, Mohamed HS. Effect of perioperative control of blood glucose level on patient's outcome after anesthesia for cardiac surgery. *Egyptian J Anaesth* 2013;29:71-6.
  10. Chen CP, Gomes GF, Abrahão HL, Narvaes BC, Albuquerque PM, Auler Jr, et al. Intensive perioperative glucose control does not improve outcomes of patients submitted to open-heart surgery: a randomized controlled trial. *Clinics* 2021;64(1):51-60.
  11. Ouattara A, Lecomte P, Manach YL, Landi M, Jacqueminet S, Platonov I, et al. Poor Intraoperative Blood Glucose Control Is Associated with a Worsened Hospital Outcome after Cardiac Surgery in Diabetic Patients. *Anesthesiol* 2005;103:687–94.
  12. Navaratnarajah M, Rea R, Evans R Effect of glycaemic control on complications following cardiac surgery: literature review. *J Cardiothorac Surg* 2018;13:10.
  13. Gandhi GY, Nuttall GA, Abel MD, et al. Intensive intraoperative insulin therapy versus conventional glucose management during cardiac surgery: a randomized trial. *Ann Intern Med* 2007;146(4): 233-243.
  14. de Souza AC, Vilca MO, Aparecida LG, de Almeida BC Perioperative management of the diabetic patient referred to cardiac surgery. *Braz J Cardiovasc Surg* 2018;33( 6 ): 618-25.
  15. Reddy P, Duggar B, Butterworth J. Blood glucose management in the patient undergoing cardiac surgery: A review. *World J Cardiol* 2014;6(11): 1209-17.