

## Incidence and Risk Factors for Re-exploration Following Off Pump Coronary Artery Bypass Grafting

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### Abstract

Re-exploration post to the cardiac surgery is a troublesome complication. There is an enigma of rare reported data about the effect of re-exploration after off-pump coronary artery bypass grafting (OPCABG). We here represent our institutional experience on re-exploration following OPCABG with follow up of 5 years. In the present study total of 1852 OPCABG were performed at tertiary multi-super specialty care center. Out of these patients, 22 (1.18%) were re-explored in the operation room and were included in this study. The medical records of these patients were retrospectively reviewed. The results showed that the most common cause of re-exploration was bleeding and the most common site of bleeding was general ooze. The mean time to re-exploration was  $10.6 \pm 5.76$  (Hours, mean  $\pm$  SD), and the Hospital Mortality of 2/22 cases was observed with 5 year follow up mortality of 7/22 cases. The observations, add the preliminary data in the literature for overall incidence (1.18%) of re-exploration with most common site of the bleeding that was generalized ooze (n = 12). Summarizing the delaying re-exploration increases the three-fold risk in mortality and morbidity. This study suggests that a strategy of reducing the incidence of re-exploration, like the use of minimally invasive surgery and early re-exploration with the judicious use of products, maintaining Operation theatre temperature should be used to improve outcomes after re-exploration following OPCABG. The need for re-exploration is surely not totally alleviated by using off pump coronary artery revascularization strategies. As there is lack of data reported in literature with the rate of incidence, effect of timing and associated risk factors of re-exploration after OPCABG. Minimally invasive surgery can be suggested as option to improve outcome after re-exploration for off pump CABG. Since, Re-exploration after off pump CABG is not associated with high mortality as per our study in contrast to other data reported in literature. Delaying the re-exploration is associated with increased drain out. The recommendable stanchion of minimizing the incidence of re-exploration after OPCAB should be judicious hemostasis during primary surgery and adequate core temperature management. Minimally invasive surgery is suggested choice to improve outcome after re-exploration for off pump CABG.

**Keywords:** OPCABG; Risk Factors; Re-exploration

**Introduction**

Post-operative bleeding requiring re-exploration after cardiac surgery is a troublesome complication [1]. Reports by various authors about the adverse outcome associated with the re-exploration have contradicted by Tambe., *et al.* [1,2] Recently, Re-exploration after off pump coronary artery bypass grafting is counted as significant factor in mortality and morbidity [3]. For overall outcome of the patient at high risk for hemodynamic instability, who require prolonged ICU and overall longer hospital stay. The advancement in cardiopulmonary bypass (CPB) technology with the availability of point of care testing, the safety of cardiac surgery, in terms of bleeding, has been increased and many patients’ related, intraoperative as well as post-operative unmodifiable factors which can contribute to the bleeding still persists [4]. And all these issues, risk of bleeding could not be eliminated completely till date; raising many concerns associated with the re-exploration. Re Exploration has found to be an independent factor for mortality as well as major morbidity after coronary artery bypass surgery (CABG), which still remain the standard treatment for most patients with left main coronary artery disease and multivessel disease. CABG (OPCABG) strategy with a lower rate of adverse effects still lacks data about the factors associated with re-exploration and mortality in the patients undergoing off pump coronary arterial bypass surgery (OPCABG) [5]. We here represent our Centre’s experience regarding incidence and risk factors for re-exploration after off pump coronary artery bypass grafting.

**Methodology**

Between January 2010 and December 2015, total 1852 OPCABG were performed in the department of the adult cardiac surgery at our center. Inclusion criteria for the study was patients undergoing elective OPCAB with exclusion of cases of concomitant surgery (CABG + valve), emergent surgery. Data was collected from clinical database between time periods of January 2010 to December 2020. Twenty two cases were re-explored out of 1852 cases. The study was approved by local ethics committee. This retrospective study included collection of data as per annexure 1 from medical records of these patients with five year follow up. The intraoperative data along with demographic data as well as indication for re- exploration, duration of surgery, estimated blood loss and intraoperative findings during the re-exploration were noted. Post-operative data including hospital and intensive unit stay morbidity and in hospital mortality were observed as well.

Management of antiplatelet and anticoagulation was done as per institutional policy. The patients were administered with low dose aspirin (75 mg) from dual antiplatelet at least 5 days before elective surgeries which was continued till the day of surgery. For off pump surgeries, heparin dose of 1-2 mg/kg was administered to maintain activated clotting time of 200-250 during the procedure. The anesthesia and standard surgical protocol was followed as per standard operating protocol of the institute. With the strategy of maintaining adequate core temperature management during surgery was followed as per institute protocol.

Decision for re-exploration was done by the operating surgeon based on the standard criteria of Kirklin and Barratt-Boyes [6]. Intraoperatively at time of re-exploration, the cause of bleeding was noted and any surgical bleeding sites were controlled using stainless-steel clips, re-enforcing sutures, or electro-cautery. After the re-exploration patient was shifted to ICU and managed with qualitative standard protocols of the institute.

**Statistical analysis**

Statistical analysis was performed using SPSS software version 22. All data were expressed as mean ± standard deviation or percentage as appropriate.

**Result:**

22 cases underwent re-exploration out of 1852 cases of OPCAB. Among 22 cases 63% were hypertensive, 45% diabetic, 40% smokers and 40% had history of old (myocardial infarction) MI [Table 1]. In present study, age range was 52-82yrs among 22/1852 patients who underwent re-exploration. Out of which 5/22 female -17/22 male were of 67-78yrs and 52-82 yrs of age range respectively.

Variables	Male	Female
Hypertension	11	3
Diabetes	8	2
Old MI	7	2
Smokers	4	0

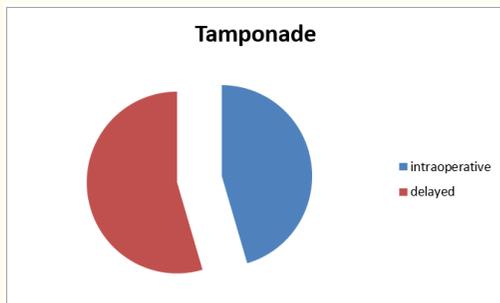
**Table 1:** 22 cases of reexploration with co-morbidity.

Among 43% hypertension cases, male (n = 11) predilection was observed. 45% diabetes cases served data of 8 male and 2 females. In systemic history added to diagnosed cases of myocardial infarction (n = 45%), reported to be 7 males and 2 females. This study with reexploration cases (n = 22) also had 40% smokers who were all male patients (n = 4).

22/ 1852 cases re-explored with incidence of 1.18% in our retrospective experience of single center study [Graph 1]. Intraoperatively, tamponade found in 5/14 patients was detected by 2D ECHO [Graph 2] and 6 patients presented with delayed tamponade (mean 6.6 days post-discharge) Two patients had new ischemic changes on ECG. Mean blood loss before and after re-exploration was 1067.2 ± 5.2 ml and 655.9 ± 5.2 ml respectively [Graph 3].

Time to re-exploration after surgery noted was 10.6 ± 5.76 (Hours, Mean ± SD), with delayed Tamponade after Discharge recorded on 6.6 ± 4.1 days mean. Intraoperatively the cause of re-exploration (n = 22), in present study were observed to be Bleeding in 17 cases (77.2%) and Cardiac Tamponade in 5 cases (22.7%). With major site of bleeding noted to be General Ooze (n = 12), followed by Sternum with LIMA bed (n = 5), Saphenous vein branch (n = 3) LIMA branch Graft (n = 2), [Table 2].

**Graph 1:** 22/ 1852 cases re-explored with incidence of 1.18%.



**Graph 2:** Intraoperatively tamponade found in 5 cases detected by 2D ECHO and 6 cases of delayed tamponade (With mean of 6.6 days post-discharge as per observations).

**Graph 3:** Mean blood loss before and after re-exploration was 1067.2 ± 5.2 ml and 655.9 ± 5.2 ml respectively.

Variables	Mean ± SD (n = 1852)
Total no Re-exploration (n, %)	22 (1.18%)
Time to re-exploration after surgery (Hours, Mean ± SD)	10.6 ± 5.76
Delayed Tamponade after Discharge	6.6 days mean
Mean Drain output before (ml, Mean ± SD)	1067.2 ± 5.2 ml
Mean Drain output after re-exploration	655.9 ± 5.2 ml
Cause of re-exploration (n = 22)	
Bleeding	17 (77.2%)
Cardiac Tamponade	5 (22.7%)
Site of bleeding (n = 22)	
Graft (n, %)	
LIMA branch	2
Saphenous vein branch	3
Sternum (n, %)	
LIMA bed	5
None (General Ooze)	12
Ventilation time (Hours, Mean ± SD)	9.87 ± 4.3
ICU stay (Days, Mean ± SD)	5.6 ± 5.2
Hospital stay (Days, Mean ± SD)	10.6 ± 4.8
Blood products used (Mean ± SD)	6.42 ± 3.3
In Hospital Mortality (n, %)	2

**Table 2:** Preliminary data of study.

Ventilation time was 9.87 ± 4.3 in Hours, Mean ± SD with ICU stay of 5.6 ± 5.2 Days, and total days of Hospital stay as Mean ± SD recorded to be 10.6 ± 4.8 days. The blood products used was of Mean ± SD 6.42 ± 3.3 and the Hospital Mortality of 2/22 cases was observed with 5 year follow up mortality of 7/22 cases.

5 year follow up of the mortality related data revealed cause of 5 male cases of mortality and among this 2 died with COVID, one died

with MI, two died with natural cause. To this added follow up, 3/4 female patients died with natural cause and among this only 1 died with MI.

## Discussion

Post-operative bleeding requiring re-exploration after OPCAB is still a troublesome complication with an incidence of 6-15% [7]. This incidence is in regards to in the early days of cardiac surgery [8]. Certain factors might be considered for reduction of bleeding postoperatively in cardiac surgery, among the incidence of the re-exploration as well out of which one of the factor is performing 'off pump CABG' (OPCABG) for revascularization [9,10]. The need for re-exploration is surely not totally alleviated by using of pump coronary artery revascularization strategies. As there is lake of data reported in literature with the rate of incidence, effect of timing and associated risk factors of re-exploration after OPCABG.

With our institutional experience we are trying to add the preliminary data in the literature for overall incidence (1.18%) of re-exploration with most common site of the bleeding was generalized ooze (n = 12). Hiroataka I, *et al.* reported on contrary findings using on-pump CABG strategy with which we can conclude that CABG performed with or without CPB is associated with most common site of the bleeding to be LIMA branch Graft [11]. However earlier reported studies were in concordance to our indings [10].

We observed that emergency surgery, age, gender, co-morbid conditions like hypertension, diabetes, smoking and history of old (myocardial infarction) MI were found to be an independent factor for the re-exploration. Though emergency surgery was well documented in our recoding datasheet as reasoning for re-exploration but it has been reported to be cause of mortality in previous reported studies [12]. On contrary as expected no association was observed with platelet count blood transfusion as well, as all patients had received either loading doses of anti-platelet aggregation therapy and/or continued use of dual antiplatelet.

Although, as per reported data in literature database with correlation to the influence of low preoperative platelet count on post-cardiac surgery bleeding is considered to be significant [13]. Earlier reported one study sates that preoperative thrombocytopenia has association with increased postoperative bleeding after CABG [14]. But, in this study, as per authors only 20% cases underwent off-pump CABG. This allows us to learn the presence of thrombocytopenia that

might have aggravated the effects of cardiac surgery on question. For instance the homeostasis &/or platelet dysfunction can lead to increased risk of bleeding; this finding is not be applicable for patients not exposed to deleterious effects of CPB.

The reported mortality of the patients undergoing re-exploration is reported to be in range of 5.7 to 15.8% [15]. In our experience mortality in hospital was (2/22) 9.09%percent, in lieu of 5 years follow up only 7/22 cases reported mortality out of which with (2/7 cases) 28.5% cases with old history of MI are present. The higher euro score is well documented cause of mortality after cardiac surgery but our experience is totally different and first to be reported to best of our knowledge [16]. Many authors advocate that re-exploration itself is an independent risk factor for mortality [17]. We have contrary statement to it as per our mentioned data numerical.

Time after re-exploration recently gained attention due to certain data reported with poorer outcome of the patients who underwent re-exploration i.e. late (>12 hour) after cardiac surgery [10]. We observed 10.6 ± 5.76 (Hours, Mean ± SD), with delayed Tamponade after Discharge recorded on 6.6 days mean in our study.

Intraoperatively the cause of re-exploration in our study was bleeding in 17 cases (77.2%) and Cardiac Tamponade in 5 cases (22.7%). With major site of bleeding noted to be generalized ooze mean blood loss before and after re-exploration was 1067.2 ± 5.2 ml and 655.9 ± 5.2 ml resp. The incidence drain output was more in the patients who explored late. Routinely all desired patients were under corrected for the heparin with protamine that underwent end arterectomies. Considering the under-correction of heparin after OPCABG as a double-edged sword was used judiciously. Murphy, *et al.* reported dose dependent relationship of blood products use with mortality and morbidity [18]. We have no association among patient who re-explored late receive more blood product as compared to patient who re-explored early for same.

## Limitation

The main limitation of our study was its retrospective nature with selection criteria for re-exploration and decision that was left open the operating surgeon so effect of bias cannot be ruled out.

## Conclusion

Re-exploration after off pump CABG is not associated with high mortality. Delaying the re-exploration is associated with increased

drain out. The strategy of minimizing the incidence of re-exploration after OPCAB should be judicious hemostasis during primary surgery and adequate core temperature management. Minimally invasive surgery can be suggested as option to improve outcome after re-exploration for off pump CABG.

### Conflicts of Interest

None.

### Sources of Funding for the Work

Nil.

### Bibliography

1. Ma X., *et al.* "Safety and efficacy outcomes of preoperative aspirin in patients undergoing coronary artery bypass grafting: a systematic review and meta-analysis". *Journal of Cardiovascular Pharmacology and Therapeutics* 19.1 (2014): 97-113.
2. Tambe SP, *et al.* "Re-exploration due to bleeding is not associated with severe postoperative complications". *Interactive Cardiovascular and Thoracic Surgery (ICVTS)* 25.2 (2017): 233-240.
3. Luan T, *et al.* "The death risk factors of patients undergoing re-exploration for bleeding or tamponade after isolated off-pump coronary artery bypass grafting: a case-control study". *BMC Cardiovascular Disorder* 21 (2021): 204.
4. Kristensen KL, *et al.* "Reoperation for bleeding in cardiac surgery". *Interactive Cardiovascular and Thoracic Surgery (ICVTS)* 14 (2012): 709-713.
5. Ruel M, *et al.* "How detrimental is reexploration for bleeding after cardiac surgery?" *The Journal of Thoracic and Cardiovascular Surgery* 154 (2017): 927-935.
6. Kirklin JW and Barratt-Boyes BG. "Cardiac Surgery". 2<sup>nd</sup> edn, Wiley, New York, (1993).
7. Dacey LJ, *et al.* "Re-exploration for haemorrhage following coronary artery bypass grafting. Incidence and risk factors". *Archives of Surgery* 133 (1998): 442-447.
8. Choong CK, *et al.* "Delayed re-exploration for bleeding after coronary artery bypass surgery results in adverse outcomes". *European Journal of Cardio-Thoracic Surgery* 31 (2007): 834-838.
9. Lopes CT, *et al.* "Factors associated with excessive bleeding after cardiac surgery: A prospective cohort study". *Heart and Lung* 45.1 (2016): 64-69.
10. Karthik S, *et al.* "Reexploration for bleeding after coronary artery bypass surgery: risk factors, outcomes, and the effect of time delay". *The Annals of Thoracic Surgery* 78.2 (2004): 527-534.
11. Khan MS, *et al.* "On pump coronary artery bypass graft surgery versus off pump coronary artery bypass graft surgery: a review". *Global Journal of Health Science* 6.3 (2014): 186-193.
12. Schumer EM, *et al.* "Emergency coronary artery bypass grafting: indications and outcomes from 2003 through 2013". *Texas Heart Institute Journal* 43.3 (2016): 214-219.
13. Benedetto U, *et al.* "O-pump versus on-pump coronary artery bypass grafting: Insights from the Arterial Revascularization Trial". *The Journal of Thoracic and Cardiovascular Surgery* 155.4 (2018): 1545-1553.
14. Nammias W, *et al.* "Impact of preoperative thrombocytopenia on the outcome after coronary artery bypass grafting". *Platelets* 30.4 (2019): 480-486.
15. Jason M Ali, *et al.* "Do patients who require re-exploration for bleeding have inferior outcomes following cardiac surgery?" *Interactive Cardiovascular and Thoracic Surgery (ICVTS)* 28 (2019): 613-618.
16. Ohmes LB, *et al.* "Incidence, risk factors, and prognostic impact of re-exploration for bleeding after cardiac surgery: a retrospective cohort study". *International Journal of Surgery* 48 (2017): 166-173.
17. Unsworth-White MJ, *et al.* "Resternotomy for bleeding after cardiac operation: a marker for increased morbidity and mortality". *The Annals of Thoracic Surgery* 59.3 (1995): 664-667.
18. Gavin J Murphy, *et al.* "Increased Mortality, Postoperative Morbidity, and Cost After Red Blood Cell Transfusion in Patients Having Cardiac Surgery". *Circulation* 116 (2007).

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