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Research Article

Acute Post-Operative Thrombocytopenia and Dysfunction of Platelet after Coronary Artery Bypass Graft Surgery: Off- Pump versus on-Pump

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Keywords

- Coronary artery bypass grafting
- Off- pump
- On-pump
- Postoperative thrombocytopenia
- Dysfunction of platelet

Abstract

Introduction: Thrombocytopenia in patients undergoing major heart surgery, is a common event. Various events such as cardiopulmonary bypass induced platelet damage and hypothermia are known as contributing factors but, exact role of CBP application has not been studied . The aim of this study is a comparison of acute change of platelet count and functioning after coronary artery bypass surgery with or without cardiopulmonary pump.

Methods and Materials: Present study is a descriptive cross- sectional study, and performed on 200 patients' candidate elective bypass coronary artery surgery. The patients were allocated into two groups: on – pump as study group(N--100) and off- pump as control group (N=100). No intervention except bleeding time measurement was performed. Demographic variables, bleeding time and platelet count were recorded before and after surgery.

Results: Results of this study showed that using of cardiopulmonary bypass in elective coronary artery bypass grafting significantly increased the operation time, need to exploration, increased consumptiction of corticosteroid, noradrenalin and adrenalin. Also, Thrombocytopenia frequency (45% vs 20% Pvalue<0.001), platelet dysfunction and subsequent increasing of BT (77.02 vs. 33.1% p=0.013), in comparison with off- pump surgery had statistically significant difference. Although, first day of bleeding rate was similar in both groups but need to reoperation was higher in on- pump group.

Conclusion: Results showed that in comparison with off- pump CABG, using extracorporeal circulation can lead to further platelet count reduction and its function. Although; CBP had no effect on amount of bleeding b at first day of postoperative period.

INTRODUCTION

Despite of great medical development and risk stratification based on clinical, procedural, and biological markers over recent years, CABG and other types of open-heart surgery are not without significant risk [1]. Postoperative bleeding as a serious problem is one of the main complications in cardiac surgery [2]. Between 3% to 11% of this patients develop excessive bleeding—even hemorrhage—postoperatively. Bleeding in these patients often requires high amounts of hemoderivatives and leading to a higher morbidity and mortality.

The nature of the problem is multifactorial [2]. Excessive bleeding in about 50% – 60% of cases following CABG is caused by coagulopathy [1]. Postoperative thrombocytopenia and temporary platelet dysfunction associated with CABG is a common clinical condition [3]. Several contributing Factors followed heart surgery are known as effective, including prolonged application of heparin, CBP – related platelet damage, hypothermia and platelet damage due to shed blood in operation field [3]. Heparin is usually used in almost of heart surgery procedures. Heparin induced thrombocytopenia (HIT), had been studied in different investigation but in actually, HIT has a few prevalence (0.5- 5%), and presents as delayed form in second week after initiation of heparin [4-6], it cannot plays important role in classification of acute postoperative bleeding causes [3,7]. cardiopulmonary bypass has been shown to be associated with platelet dysfunction, which has a potential for increasing the risk of preoperative bleeding and thrombotic complications. In patients undergoing CPB, several causes result in platelet consumption that along with stimulation of inflammatory system can induce micro thromboembolisms and related complications. The role of dilution in thrombocytopenia due to combination of patient blood with prime solution should be considered that may be acutely decreases 25 – 30 % of platelet count but it is corrected by restored platelets in spleen [8]. Hypothermia is almost always routinely used in patients undergoing heart surgery with CPB.

Various studies showed that stimulation and platelet destruction rate in hypothermia is severe than normothermia [9]. Platelet destruction due to shearing force commonly occurs during CPB [10,11]. Platelet damage and destruction in high-pressure suction of blood mixing with air is investigated and concluded with increased suction pressure and air mixing with blood, platelet damage is significantly evident [3]. Platelet destruction due to any causes is associated with stimulation of other pathways such as activation of monocyte cascade, neutrophils, complement system and coagulation system, contributing in systemic inflammatory condition [3], Thus it has been proposed.

Because of less information about the influence of OPCAB on postoperative platelet function, we purposed to investigate thrombocytopenia and dysfunction of platelet among patients undergoing OPCAB, and compared it with patients undergoing on-pump coronary artery bypass surgery (ONCAB)

METHODS AND MATERIALS

This cross- sectional descriptive study was performed in 200 patients undergoing elective CABG (50 cases on- pump, 50 cases off- pump), during of 6 months, 2016. Inclusion criteria included all adult patients between 18 to 70 years old, patients candidate elective CPB and we excluded patients who received heparin in recent hospitalization, no intraoperative heparin administration, preoperative thrombocytopenia (count< 150000/mm3), administration of antiplatelet drugs during 5 days before surgery, platelet transfusion in 5 days ago, known case with diabetes mellitus, renal failure, liver insufficiency, lack of platelet count in first 4 hours after surgery, expired patients in operating room or before measuring platelet count in ICU. The trend of premedication and maintenance of anesthesia, monitoring of intraoperative and postoperative were routinely performed with no intervention. In all patients, bleeding time was measured by duke method (i.e. ear lobe), before induction of anesthesia. In this way, ear lobe was punctured with depth of 5 mm by adjustable finger picker of glucometer (i.e. Accu- chek), then bleeding was controlled with soft tissue paper. Along with preoperative bleeding time, demographic variables, last platelet count (maximum up to 48 hr before surgery), data about heart disease diagnosis, duration of surgery and CPB, possibly degree of hypothermia in CPB, hypothermia time, administration of corticosteroids and inotropic drugs were recorded. After transportation of patient to Intensive care unit, postoperative BT (2- 4 hr after admission to ICU), first Platelet count in 4 hr in addition to admission to ICU (external drainage), in first day were considered. We used descriptive methods (frequency, mean ± standard deviation) and comparison of qualitative finding (Fisher's exact test if N < 5). P< 0.05 was considered as statistically significant.

RESULTS

This study was conducted on 200 patients undergoing CPB. 71% in case group and 70% in control group was male and sex distribution was same between groups. Most of patients were in range of 61- 70 years old. There was no significant association among demographic variables in two groups. The mean preoperative platelet count was 229.77×10^3/ mm^3, after surgery reached to 160.06×10^3/ $mm^3$and mean of reduced platelet count was statistically significant (P< 0.001). In control group, platelet count was reduced of240.8×10^3/ mL to was 198.2×10^3/ mL (P< 0.001). In the initiation of surgery, platelet count difference wasn't significant but in the end of surgery, platelet count reducing in case group was greater than control group and this association and delta platelet (difference of preoperative and postoperative platelet count) were statistically significant.

We showed frequency of postoperative thrombocytopenia in both groups, the comparison of bleeding time in pre and postoperative duration and time duration for using of pump. In case group, the incidence of thrombocytopenia was higher (45% vs 20%).WBC rising had no significant association. BT increased in both group but had greater prevalence and severity in case group. The time pf period that patients undergoing CBP pump, was equated to 108.4 min (in 71% of cases was applied hypothermia). The administration rate of corticosteroid, norepinephrine, and epinephrine was higher in case group. Although; blood loss amount in first day after surgery was similar between groups, but need to reoperation for blood loss management was greater in on – pump group (12% vs 4%). No significant association was not seen between decreasing rate of platelet count and duration of pump using in case group. Also, we cannot find any statistically significant correlation between increased bleeding time and duration of pump using. The degree of hypothermia and the rate of decreased postoperative platelet count in postoperative period had significant relation with each other but no with bleeding time.

DISCUSSION

Our study was conducted on two groups (200 cases) as on-pump (71 % men, mean age: 60.4 years) and off – pump (79% male, mean age: 59.03 years). In Jalali et al., study, 65.7% men (mean age: 61.5 years) [12], in Forestier et al., 83% men (mean age: 67 years) and in Tettey et al., study, 39.1% men (mean age: 65.5%) participated in study [13].

The results of study were shown that using intraoperative pump results in significant increased time of operation, reduced body temperature, need to high dose o corticosteroids, noradrenalin and adrenalin, increased need to postoperative reexploration but had no effect on WBC count and amount of bloodloss [11]. In Jalali et al., study, amount of blood loss in first day after surgery was 499.3 mL [12], in Forestier et al., study, mean of CPB period was 77 min and increased CPB duration was associated with Hb decline [12]. Gielin et al., study was shown that CABG surgery results in reduced clot strength, fibrinogen level, hematocrit and albumin concentration that statistically significant [14]. In Romlin study, low age and weight, increased surgery duration had association with platelet adherence [15].

In our study, CPB can leads to decreased platelet count and probably increased incidence of thrombocytopenia. This pump increases bleeding time by platelet dysfunction. Also, we could not observed significant association between using duration of CBP with lowering platelet count and bleeding time (i.e. CPB has adverse effects on blood even in short time). Ravenni et al., observed that in first day after surgery, mean platelet count declined to 156 × 10 3 / mL and then increased until normal count of before surgery [16]. Also, decreased platelet count and

CPB duration. No case affected by sever thrombocytopenia. Auofi et al., demonstrated that by administration of prostacyclin in patients with HIT had not any significant effect on platelet count in postoperative period and so, any thrombotic complication [17]. In Solomon et al., study was shown decreased significant adherence of platelet during surgery and CPB [18]. In another study, was suggested that after surgery and CPB platelet count and function reduced and followed by bleeding time [19]. Kunitomo et al., demonstrated significant platelet count and adherence and association with CPB duration [20].

We concluded that using of pump results in reduced function of platelet and increased bleeding likely due to increased P-selectin, Annewetin and ADP because of platelet accumulation. Thrombocytopenia in almost studies can have some reasons such as hemodilution, mechanical dysfunction, adherence to circuit and damage and destruction of platelet in organs. This study suggested on – pump advantages on off- pump.

CONCLUSION

These results showed that using of extracorporeal circulatory pump can lead to platelet count and dysfunction in patients who were undergoing cardiac surgery and likely results in enhanced bleeding disorders.

REFERENCES

1. Baughman RP, Lower EE, Flessa HC, Tollerud DJ. Thrombocytopenia in the intensive care unit. Chest. 1993; 104: 1243-1247.
2. Stéphan F, Hollande J, Richard O, Cheffi A, Maier-Redelsperger M, Flahault A. Thrombocytopenia in a surgical ICU. Chest. 1998; 115: 1363-1370.
3. Weerasinghe A, Taylor KM. The platelet in cardiopulmonary bypass. Ann Thorac Surg. 1998; 66: 2145-2152.
4. Warkentin TE, Greinacher A. Heparin-induced thrombocytopenia and cardiac surgery. Ann Thorac Surg. 2003; 76: 2121-2131.
5. Selleng S, Selleng K, Wollert HG, Muellejans B, Lietz T, Warkentin TE, Greinacher A. Heparin-induced thrombocytopenia in patients requiring prolonged intensive care unit treatment after cardiopulmonary bypass. J Thromb Haemost. 2008; 6: 428-435.
6. Pouplard C, May MA, Regina S, Marchand M, Fusciardi J, Gruel Y. Changes in platelet count after cardiac surgery can effectively predict the development of pathogenic heparin-dependent antibodies. Br J Haematol. 2005; 128: 837-841.
7. Selleng S, Malowsky B, Strobel U, Wessel A, Ittermann T, Wollert H-G, et al. Early-onset and persisting thrombocytopenia in post-cardiac surgery patients is rarely due to heparin-induced thrombocytopenia, even when antibody tests are positive. J Thromb Haemost. 2010; 8: 30-36.
8. Greeley WJ, Berkowitz DH, Nathan AT. Anesthesia for Pediatric Cardiac Surgery. In: Miller RD. Anesthesia. 7thed, Churchill-livingstone, 2010; 2618-2620.
9. Boldt J, Knothe C, Welters I, Dapper FL, Hempelmann G. Normothermic versus hypothermic cardiopulmonary bypass: do changes in coagulation differ? Ann Thorac Surg. 1996; 62:130-135.
10. Moen O, Fosse E, Bråten J, Andersson C, Høgåsen K, Mollnes TE, et al. Differences in blood activation related to roller/centrifugal pumps and heparin– coated/uncoated surfaces in a cardiopulmonary bypass model circuit. Perfusion. 1996; 11:113-123.
11. Yoshikai M, Hamada M, Takarabe K, Okazaki Y, Ito T. Clinical use of centrifugal pumps and the roller pump in open heart surgery: a comparative evaluation. Artif Organs. 1996; 20: 704-706.
12. Jalali A, Giasi M, Khalegparast SH. The survey association with plasma fibrinogen level and post-operative bleeding rate in coronary bypass surgery. J Anesthesiol Intensive care. 1390; 75: 18-26.
13. Forestier F, Coiffic A, Mouton C, Ekouevi D, Chêne G, et al. Platelet function point-of-care tests in post-bypass cardiac surgery: are they relevant? Br J Anaesth. 2002; 89: 715-721.
14. Gielen CL, Brand A, van Heerde WL, Stijnen T, Klautz RJ, Eikenboom J. Hemostatic alterations during coronary artery bypass grafting. Thromb Res. 2015; 15: 30233-30234.
15. Romlin BS, Söderlund F, Wåhlander H, Nilsson B, Baghaei F, Jeppsson A. Platelet count and function in paediatric cardiac surgery: a prospective observational study. Br J Anaesth. 2014; 113: 847-854.
16. Ravenni G, Celiento M, Ferrari G, Milano A. Reduction in platelet count after aortic valve replacement: comparison of three bioprostheses. J Heart Valve Dis. 2012; 21: 655-661.
17. Aouifi A, Blanc P, Piriou V, Bastien OH, Ffrench P. Cardiac surgery with cardiopulmonary bypass in patients with type II heparin-induced thrombocytopenia. Ann Thorac Surg. 2001; 71: 678-618.
18. Solomon C, Winterhalter M, Gilde I, Hoy L. Influence of the sample anticoagulant on the measurements of impedance aggregometry in cardiac surgery. Med Devices (Auckl). 2008; 1: 23-30.
19. Belcher PR, Muriithi EW, Milne EM. Heparin, platelet aggregation, neutrophils, and cardiopulmonary bypass. Thromb Res. 2000; 98: 249-256.
20. Kunitomo R, Tsurusaki S, Suzuki R, Takaji K, Moriyama S, Hagio K, et al. Predictive factors for platelet number after cardiopulmonary bypass and postoperative blood loss. ASAIO J. 2002; 48: 671-674.

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