Revision for postoperative bleeding: timing and decision making

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Citation

Abstract
Five percent of patients require re-exploration during early postoperative period after open heart surgery. The first cause for early mediastinal re-exploration after open heart surgery is the bleeding. In this review report we evaluated the major risk factors, the decision making for revision and the frequent complications after revision for bleeding under light of the literature. To reduce the risk for bleeding and blood transfusion rates, we recommend that discontinuation of the drugs affecting platelet functions, achievement of shortest CPB time possible, recurrent effective hemostasis before closure and faster elimination of hypothermia after arrival into the intensive care unit.

Rationales for early mediastinal re-exploration after open heart surgery could be arranged as follows:

1. Bleeding
2. Cardiac tamponade
3. Occlusion of the coronary bypass grafts
4. Cardiac arrest
5. Valve dysfunction

Five percent of patients require re-exploration during early postoperative period after open heart surgery. Early revisions for bleeding constitute 80% of these (1). In literature, the need for reoperation with bleeding revision was evaluated while investigating series of large numbers: Moulton 4.2% (2), Dacey 3.6% (3), Selman 4.4% (4), Kaiser 3.1% (1), Gereçeko?lu 1.7% (5) and Ekim 1.5% (6).

In studies held before 1990, reexploration rates were as high as 14%, whereas they dropped down to 3% in recent studies. Reasons for this may be as follows:

1. Shortening of the duration of the operations
2. With the advances in technology, construction of extracorporeal circulatory and oxygenator lines that cause less hemorrhagic trauma
3. Better evaluation of patients pre- and perioperatively in terms of hemorrhagic diathesis
4. Transfusion of the autologous blood components

Major risk factors for bleeding requiring revision are (1,5,7):

1. Advanced age [increase in tissue fragility with age, increase in bleeding tendency in surgical interventions of aorta and main arteries due to increased calcification (8)]
2. Small body surface area
3. Previous cardiac operations (5): Particularly, tears due to adhesions, estimated prolonged CPB period, continuation of preoperative use of ASA and oral anticoagulants
4. Renal insufficiency
5. Prolonged cardiopulmonary bypass period [9-fold increase in risk for bleeding for CPB periods over 120 minutes (2)]
6. Increased numbers of distal anastomoses
7. Use of internal thoracic artery [it is necessary to evaluate the side branches, arterial bed, stump and associated vein. Bleeding control should be performed while preparing the graft (8)].
Complications seen or increased in frequency after revisions for bleeding are (\(\text{Complications}\)):

1. Operative mortality
2. Prolonged duration of stay in intensive care unit (particularly with mechanical ventilation)
3. Increased need for IABP (These first three are independent risk factors)
4. Atrial arrhythmia
5. Deep sternal wound infections
6. Respiratory and renal insufficiency
7. Increased need for hemofiltration

Mortality rates seen after revisions for bleeding are between 8 and 26% in literature (\(\text{Mortality rates}\)). Incidence of wound infections after re-explorations is 2% in average (\(\text{Incidence of wound infections}\)).

Reasons of increased tendency for mediastinitis and sternal wound infections are as follows (\(\text{Reasons of increased tendency}\)):

1. Deterioration in perfusion of surgical area,
2. Prolonged exposure period to microorganisms,
3. Prolonged mechanical ventilation,
4. Prolonged in-hospital stay

Development of infection is directly proportional to the number of whole blood transfused before revision. Risk of development of infection is 3.9% in cases with 2 units of whole blood transfused, 6.9% in cases with 3 to 5 units of whole blood transfused and 22% in cases with 6 or more units of whole blood transfused (\(\text{Development of infection}\)).

Bleeding after open heart surgery requiring revisions is usually due to surgically correctable reasons. The other reasons that play some role are inadequate neutralization of heparin, thrombocytopenia and thrombasthenia (most frequent disorder, directly related to prolonged CPB time. Although platelet count may not drop below 100,000/mm\(^3\), aggregatory properties of platelets may be depressed. Bleeding time exceeding 10 minutes drops down to normal values in 2-4 hours postoperatively. Since artificial surfaces of the oxygenator lines are the major factors, albumin coated CPB lines possess lower affinity to platelets. There are favorable results reported particularly for redo operations with long estimated CPB time and cases with higher risk of bleeding (\(\text{Bleeding after open heart surgery}\)). Hyperfibrinolysis [increase in fibrin degradation products (FDP) and shortening in euglobulin lysis time], isolated deficiencies of coagulation factors (usually deficiencies in Factor V and VII) and disseminated intravascular coagulation (DIC) (Sudden decrease in platelet count and serum fibrinogen levels, excessive increase in FDP are seen. Generally seen in bacterial endocarditis) are among the common causes.

What is the total amount of bleeding after open heart surgeries necessary in decision making for revision?

Total amount of hemorrhagic drainage between 800 to 1200 cc in 24 hours is accepted as within normal limits (\(\text{Total amount of hemorrhagic drainage}\)). Bleeding of more than 10 cc/kg/h any time or more than 5 cc/kg/h throughout 3 consecutive hours (if the ratio of hematocrit levels of drained blood to the serum blood is more than 0.9) requires reexploration. If the patient is low weighted, bleeding amount per kilogram should be calculated (\(\text{Bleeding amount per kilogram}\)). Bleeding of more than 500 ml within the first postoperative hour should bring surgical foci (anastomoses, side branches of grafts, cannulation sites, aortotomy site, atriotomy site, ventriculotomy site, IMA harvesting regions, pleural and pericardial fat tissues) into mind. Determination of tamponade echocardiographically constitutes another reason.

In the series of Gerçeko?lu H. et al, 1622 cases were investigated retrospectively. Twenty eight cases were reexplored (1.7%) and 3 factors were identified affecting early bleeding: advanced age, prior cardiac operation and prolonged CPB time. The risk of development of sternal wound infection and mediastinitis was higher for reexplored group. During decision making process, opinion of the operating surgeon and conventional guidelines [Kirklin JW: Cardiac Surgery. 1993;222-4.] were taken into account. Patients with total amount of bleeding of more than 500 ml within first hour, 800 ml within first 2 hours, 900 ml within first three hours, 1200 ml within first 5 hours or sudden bleeding and acute tamponade developing after bleeding were reexplored (\(\text{Patients with total amount of bleeding}\)).

In the series of Ate? M. et al, 3219 cases operated under CPB and 403 cases operated off-pump (3622 cases totally) were investigated retrospectively. One hundred and twenty three cases were reexplored (3.39%). There wasn't any active bleeding focus in 25.2% of cases. In 13.8% of cases bed of harvested IMA was the bleeding site (most common). The period from arrival into intensive care unit to the
Revision was calculated as 110±27 minutes in average (3).

In the series of Ekim H. et al, 520 cases undergoing open heart surgery were included. Early revision rate due to postoperative bleeding was 1.5%. The period from arrival into intensive care unit to the revision was calculated as 219±121 minutes (earliest 45 minutes, latest 8 hours). There wasn't any active bleeding focus in 3 (37.5%) cases (6).

If no active bleeding site could be identified during reexploration, pericardial coagulum masses should be removed anyway. Usually bleeding does not recur after closure of chest wall. This situation can be explained by elimination of regional fibrinolysis caused by coagulum. The vicious circle stimulated by fibrinolysis could be interrupted and continuous blood loss prevented (6,12).

Since many cases undergoing reexploration are hemodynamically unstable reoperation in ICU was recommended (13). But the most important drawbacks for this are whether adequate sterilization could be provided or not and the risk for mediastinal infection (6). The advantage is the 15 minutes in average required for transporting the patient from ICU to the operating room would not be consumed. The stabilization of the patient with bleeding and tamponade could be preserved without moving him/her. The complications such as accidental removal of intravascular catheters and intubation tubes could be prevented. The ideas of bringing the conditions of ICU to the level of operating room and reexploring the unstable cases in ICU when necessary are adopted in principle recently (6).

In conclusion, to reduce the risk for bleeding and blood transfusion rates, we recommend that the following precautions must be taken:

1. Discontinuation of the drugs affecting platelet functions, particularly ASA, before an elective operation.
2. Achievement of shortest CPB time possible
3. Recurrent effective hemostasis before closure
4. Faster elimination of hypothermia after arrival into the intensive care unit
5. Prevention of hypertension (reduces the risk of bleeding from suture lines).

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**References**
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