ANU VARUGHES

EVALUATION OF PERIOPERATIVE PERIOD IN ADULT PATIENTS WITH EXCESSIVE BLEEDING AFTER CARDIAC SURGERY ON CARDIOPULMONARY BYPASS

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ABSTRACT

The tutor- PhD, Dr.Juozas Kapturauskas. Lithuanian University of Health Sciences, Medical Academy, the Faculty of Nursing, Department of Nursing and Care, Kaunas, 2019; 46p.

Excessive perioperative bleeding continues to complicate cardiac surgery with cardiopulmonary bypass (CPB) in spite of improvements in extracorporeal oxygenation and surgical techniques. Patients after cardiac surgery with CPB has various causes of bleeding. Postoperative bleeding may be due to surgery or coagulopathy. Patient-related factors are also indicative of bleeding reoperation. Increased blood substitution has been associated with a number of complications postoperatively, including renal failure, acute respiratory distress syndrome, sepsis, atrial fibrillation, severe infections and higher risk of death. **Aim** To evaluate the perioperative course of adult patients with excessive bleeding after cardiac surgery requiring cardiopulmonary bypass. **Objective** Evaluation of etiology of excessive bleeding after cardiac surgery. **Management of postoperative cardiac patient with increased blood loss**. **Analysis of patient outcomes: complications, intensive care unit (ICU) stay, hospitalization duration.** **Methods** A literature review of medical literature was conducted and prospective observation of a patient, scheduled for the heart surgery in Kaunas Clinics was carried out during a whole hospital stay. Laboratory data were collected from medical documentation and analyzed. **Conclusion** This reviewed work the postoperative bleeding after cardiac surgery and the factors which affects the cause of bleeding both medical and surgical. Identifying the predicting factors which cause the excessive bleeding and how to reduces the post operative bleeding by modifying ,treating and diagnosing those predicting factors. As per nursing care its important to manage a bleeding patient with number of complications in ICU which reduces the length of stay, mortality and comorbidities in the hospital as well as the heavy economic burdance too. From this review its shows the surgical reoperation due to excessive bleeding directly influence the patients quality of life overall. Cardiac surgery on CPB also have its own complications rather than the patient condition and it also contributes postoperative bleedings.
### ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACE</td>
<td>Angiotensin Converting Enzyme</td>
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<tr>
<td>ACT</td>
<td>Activated Clotting Time</td>
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<td>AF</td>
<td>Arterial Fibrillation</td>
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<td>AKI</td>
<td>Acute Kidney Injury</td>
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<td>aPTT</td>
<td>activated Partial Thromboplastin Time</td>
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<tr>
<td>ATP</td>
<td>Adenosine Triphosphate</td>
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<tr>
<td>BART</td>
<td>Biological Activity Reaction Test</td>
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<tr>
<td>BMI</td>
<td>Body Mass Index</td>
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<td>BP</td>
<td>Blood Pressure</td>
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<td>BRiSC</td>
<td>Papworth Bleeding Risk Score</td>
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<tr>
<td>C.O</td>
<td>Cardiac Output</td>
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<tr>
<td>CABG</td>
<td>Coronary Artery Bypass Surgery</td>
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<tr>
<td>cAMP</td>
<td>cyclic Adenosine Monophosphate</td>
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<tr>
<td>CHF</td>
<td>Chronic Heart Failure</td>
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<td>CPB</td>
<td>Cardiopulmonary Bypass</td>
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<tr>
<td>CPK</td>
<td>Creatinephosphokinase</td>
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<td>CPK-MB</td>
<td>Creatine phosphokinase MB</td>
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<tr>
<td>CVP</td>
<td>Central Venous Pressure</td>
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<tr>
<td>DHCA</td>
<td>Deep Hypothermic Cardiac Arrest</td>
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<td>DM</td>
<td>Diabetes Mellitus</td>
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<tr>
<td>ECG</td>
<td>Electrocardiogram</td>
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<tr>
<td>EKG</td>
<td>Electrocardiogram</td>
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<tr>
<td>ERAS</td>
<td>Enhanced Recovery After Surgery</td>
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<tr>
<td>EuroSCORE</td>
<td>European System for Cardiac Operative Risk Evaluation</td>
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<tr>
<td>FFP</td>
<td>Fresh Frozen Plasma</td>
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<tr>
<td>FIO2</td>
<td>Fraction of Inspired Oxygen</td>
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<tr>
<td>Hct</td>
<td>Hematocrit</td>
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<tr>
<td>HF</td>
<td>Heart Failure</td>
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<tr>
<td>HIT</td>
<td>Heparin Induced Thrombocytopenia</td>
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<td>HR</td>
<td>Heart Rate</td>
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ICU: Intensive Care Unit
INR: International Normalized Ratio
LOS: Length of Stay
LVEF: Left Ventricular Ejection Fraction
MAP: Mean Arterial Pressure
MrSA: Meticillin-resistant Staphylococcus Aureus
NO: Nitrous oxide
O.R: Operating room
P.O.C: Point of Care
PCA: Patient Controlled Analgesia
PCO2: Partial pressure of Carbondioxide
PL: Platelets
PO2: Partial pressure of Oxygen
PT: Prothrombin Time
RBC: Red Blood Cell
SVR: Systemic Vascular Resistance
T.A: Tranexamic Acid
TNF: Tumour Necrosis Factor
TOE: Transoesophageal Echocardiogram
TT: Thrombin Time
UDPB: Universal Definition of Perioperative Bleeding
vWD: von Willebrand Disease
INTRODUCTION

Excessive perioperative bleeding continues to complicate cardiac surgery with Cardiopulmonary Bypass (CPB) in spite of improvements in extracorporeal oxygenation and surgical techniques. Patients after cardiac surgery with CPB has various causes of bleeding. Deficient surgical haemostasis and transient platelet dysfunction acquired mainly cause bleeding in CPB patients. Haemodilution causes platelet counts to decline rapidly to about 50% of preoperative levels after starting CPB, and even the progressive loss of platelet function and prolonged PT and PTT and low levels of fibrinogen are also attributable to coagulopathy dilution.

After cardiac surgery, excessive bleeding is common and remains a major source of morbidity and mortality. The incidence of re-exploration in the literature ranges from 2% to 6% during the early post-operative period after open heart surgery. After open heart surgery, the first cause of early mediasternal re-exploration is bleeding. The mortality rates observed after bleeding revisions range from 8% to 26% in researches, but the incidence of wound infections after re-exploration is about 2%.(1)

Excessive bleeding after cardiac surgery is associated with severe complications resulting in prolonged stays in the intensive cardiac care unit (ICU) and postoperative wards. Bleeding and blood transfusions increase postoperative morbidity due to their association with prolonged mechanical ventilation, low cardiac index, and increased myocardial infarction, stroke, infections, etc.(2) The reported incidence of excessive post-operative bleeding after open-heart surgery varies from 6.4% –52.9% Excessive bleeding after cardiac surgery is a serious complication associated with increased incidence of additional surgery, longer or longer mechanical ventilation time, increased incidence of stroke in patients with major bleeding associated with coronary artery bypass grafting (CABG), transfusion of more than 4 units of red blood cells is strongly associated with increased mortality stated by Stone et al. & Christensen et al.(1)

Early detection and timely treatment of excessive postoperative bleeding can therefore decrease red blood transfusion rates and prevent morbimortality. Perioperative nursing care requires awareness of significant risk factors for bleeding following cardiac surgery to ensure prioritization of vigilance and early correction of those that can be modified. Patients with excessive bleeding after cardiac surgery also have increased mortality rates, increased blood product transfusion requirements, complications of infection, severe low cardiac output syndrome, longer use of mechanical ventilation, longer ICU stays, emergency surgical re-exploration, atrial fibrillation, acute kidney injury, mediastinitis, sepsis and sepsis.(2)

Risk of reoperation due to bleeding after cardiac surgery is shown to be 2.2–4.2% . Risk factors are
high age, low body mass index (BMI) or body surface area (BSA), time on extracorporeal circulation (ECC), five or more anastomosis or non-elective operation. Reoperated patients have a two to six times greater mortality and a greater morbidity regarding renal and pulmonary function, sepsis and arrhythmia. Postoperative bleeding can be due to surgical or coagulopathic factors. Patient-related factors are also indicative for reoperation due to bleeding.\(^3\),(22)\)

Cardiac surgery is associated with perioperative blood loss and a high risk of allogeneic blood transfusion. Patient blood management (PBM) in cardiac surgery contributes to the maintenance of perioperative haemostasis and the minimization of bleeding, which reduce blood transfusion requirements.

The main determinant of morbidity and mortality for patients requiring a surgical re-exploration after cardiac operations is the amount of packed red cells transfused. The delay before re-exploration may present higher risks especially when the delay creates the need for an excess use of different blood products, or in the occurrence of clinical signs of cardiac compression or what is known as tamponade.\(^4\)\)

**AIM OF THE STUDY**

To evaluate the perioperative course of adult patients with excessive bleeding after cardiac surgery requiring cardio pulmonary bypass.

**GOALS OF THE STUDY**

1. Evaluation of etiology of excessive bleeding after cardiac surgery.
2. Management of post operative cardiac patient with increased blood loss.
3. Analysis of outcomes: complications, intensive care unit stay, hospitalization time, mortality in patients with increased chest tube drainage.
4. Nursing priorities of post operatively bleeding cardiac patient.
1. REVIEW OF LITERATURE

1.1 Definition Of Bleeding:

The universal definition of perioperative bleeding: It uses five classes of bleeding (0: insignificant, 1: mild, 2: moderate, 3: severe, 4: massive) and considers a bleeding as severe when sternal closure is delayed (left open or packed for haemostatic issues), or five to ten units of RBC or FFP have been transfused to the patient after chest closure, or the chest drains exceed 1,000 ml/12h or surgical re-exploration has already been applied. Massive bleeding occurs when more than ten units of RBC or FFP have been transfused, or drains exceed 2,000 ml/12h or when the administration of recombinant activated factor VII (rFVIIa) was judged compulsory to stop bleeding. Perioperative RBC transfusions for compensation for the extracorporeal circulation haemodilution were not included in the definition (5),(33)

1.1.1 Common etiology of bleeding after cardiac operation in CPB

Bleeding can be divided into:

Medical: Bleeding secondary to defects in the coagulation cascade, platelets, or fibrinogen; The kind of bleeding usually is persistent noted after complex operations frequently associated with abnormal coagulation. It is hard to diagnose if bleeding is due to coagulopathies. They have a greater extent, are exposed to greater amounts of inotropes with alpha effect and has greater incidence of low cardiac output syndrome. Also hospital stay and mortality rate in higher. Therefore for patients in the ICU with unexpected high chest tube output, the goal is to normalize the patients coagulation profiles within 4 hours.(6),(36)

Causes of medical bleeding are the following:

Residual heparin effect: Patients are anticoagulated before going on CPB with a large dose of heparin to maintain their ACT >400 seconds. The heparin is 'reversed' at the end of the case with protamine administration. Occasionally, the calculated dose of protamine given is not sufficient to completely reverse the heparin effect. Patients may also receive additional heparin if they are given back blood that remained in the bypass circuit when the patient was disconnected from CPB ("pump blood"). A "heparin rebound phenomenon" can also occur several hours post-op. An ACT will be done as soon as the patient arrives in the ICU. Normal values are between 100 and 120 seconds.(27)

Qualitative platelet defect: Platelet function may be impaired for several reasons. Many patients are on anti-platelet agents pre-operatively. CPB also leads to impaired platelet function, and the longer the duration of CPB, the greater the impairment.
Quantitative platelet defects: Platelet numbers can be decreased following CPB due to hemodilution, destruction, and aggregation.

Clotting factor deficits: Hemodilution on CPB or consumption. Pre-operative defects secondary to hepatic disease.

Fibrinogenolysis: Plasminogen activation during CPB.

Surgical: The bleeding secondary to operative trauma including leaks at sites of vascular anastomosis or cannulation sites or bleeding from small mediastinal arteries or veins. Surgical bleeding requires a return to the OR for re-exploration and hemostasis.

Induced hypothermia, CPB machine use, and anticoagulation administration of heparin can all contribute to postoperative bleeding.(36)

1.2 Preoperative causes of bleeding

1.2.1 Preoperative thrombocytopenia:

Preoperative thrombocytopenia < 100 x 10^9 / litre is a serious risk factor for bleeding and for massive blood transfusions in postoperative period. Be aware that reason for thrombocytopenia also can be HIT. Up to 8% of heparinized patients develop the antibody associated with HIT and approximately 1–5% of patients on heparin progress to develop HIT. Patients with hepatic dysfunction, residual Warfarin effect, vitamin K-dependent clotting factors deficiencies, von Willebrand’s disease and also thrombolytic therapy is more likely to have excessive bleeding after CPB.

1.2.2 Preoperative anaemia

Preoperative anaemia has been recognized as a mortality risk factor in cardiac surgery in previous studies. Preoperative anaemia, unless corrected with RBC transfusions before the operation, is a major determinant of excessive haemodilution during CPB, and the nadir Hct on CPB is a well-recognized determinant of morbidity and mortality after cardiac operations. The main interpretation for this association is that the oxygen delivery during CPB may be inadequate, leading to ischemic organ dysfunction, mainly at a renal level. Preoperative anaemia, of course, is a major determinant of perioperative RBC transfusions. Red blood cell transfusions are a well-recognized risk factor for morbidity and mortality in cardiac surgery, and its confirms by researches, with a relative risk for mortality roughly three times higher in patients receiving RBC transfusions. (8),(20)

1.3 Intra operative causes of bleeding

1.3.1 Prolonged CPB

The main source for bleeding intra operatively is CPB. Prolonged cardiopulmonary bypass period is
an independent risk factor for higher mortality and morbidity rate after cardiac surgery and it is the best predictor of micro vascular bleeding. The risk for bleeding increases if CPB period is more than 120 minutes. Patients undergoing cardiac surgery in CPB acquire some degree of platelet dysfunction. CPB circuit induce platelet dysfunction because of release of alfa granule and alteration of platelet membrane receptors.(6),(27)

Increased CPB time is associated with major postoperative bleeding (Miana et al., Hernandez-Gonzalez et al., Salis et al., Emeklihas et al., Dasarathanet al., Dixon et al.). After CPB, there is a decrease in platelet counts, fibrinogen concentration, the amount of and potential for thrombin formation, which are predictive of blood loss (Karkouti et al., Bosch et al.). Bosch et al., emphasise that postoperative measurements are influenced by numerous interventions such as heparin infusion, fluid volume, administration of tranexamic acid and protamine, time since bypass and intraoperative transfusion product requirements. Increased CPB time is directly related to the need for increased doses of heparin, also a predictor of excessive postoperative bleeding (Hernandez-Gonzalez et al.). Protamine administration, to neutralise heparin, may aggravate platelet dysfunction (Despotis et al.). At rewarming during CPB and postprotamine, Orlov et al. found a decreased functional platelet count as being predictive for increased postoperative blood loss.(1)

1.3.2 Intra operative Hypothermia

Lower intra operative core body temperature was also shown to be a predictor of major post operative bleeding (Carroll et al.). Hypothermia induced during CPB to prolong tolerance to ischaemia inhibits the coagulation enzymes, depresses platelet function and stimulates fibrinolysis (Thiele & Raphael et al.). In addition, hypothermia elevates systemic vascular resistance and depresses cardiac output (Campos et al.), which can further lead to metabolic acidosis and increased amount of bleeding (Miana et al. ) (1). Hypothermia it could reduce platelet and enzyme function. Platelet agregation and adhesion decrease when body temperature is 33 degree C and less.(6)

1.3.3 Cardiotomy suction

Cardiotomy suction aviodance can also reduce the loss of perioperative blood. Blood aspired from the pericardial space has been in contact with factor tissue and contains high levels of factor VIIa, procoagulant particles, and activated protein supplements, and fibrinolytic activity is present. Blood aspired from pericardial space is a very high concentration of inflammatory mediators, such as Il-6, but there were no Il-6 and TNF-alpha data rising after reinfusion on the patient's plazma. It is not advisable to aspirant blood directly from pericardial space, it might be better to pump this blood from activated components via cell saver to wash it. Limiting blood suction reduces the formation of thrombin, platelet activation, and systematic inflammatory response Sirvinskas et al. reports on the efficacy of autologous shed mediastinal blood collected and re-infused on a patient in heart
surgery. They concluded that re-infused mediastinal blood does not increase the tendency of bleeding and the inflammatory response of the system. Cell saver processing of cardiotomy suction blood only has no beneficial effect on blood conservation and increases the use of (FFP) transfusions.(20),(27)

1.4 Postoperative causes of bleeding
The phenomenon of “heparin rebound” has been considered to be the most common cause of bleeding in the post bypass period. The phenomenon is the best defined as the reappearance of hypo coagulability of blood after adequate neutralization of heparin has been accomplished. This is more common in patients receiving large amounts of heparin, especially obese patients. Reappearance of heparin in circulation usually occur in 1-8 hours after neutralization with Protamine. Heparin effect was detected in 43% of patients after surgery where at first 2 hour, 31% at 4 hour and 37% at 8 hour. Number of reasons have been attributed to the appearance of heparin in the circulation. It may be either due to re absorption of heparin into the blood stream from extra vascular depots or it may be due to the faster degradation of Protamine.(6).

1.5 Other causes of excessive bleeding
1.5.1 Patient-related predictors
The factors are gender, higher levels of preoperative haemoglobin, lower index of body mass (BMI), diabetes mellitus, impaired left ventricular function, preoperative status of coagulation, and timing of discontinuation of anti-thrombotic drugs. Careful assessment of the history of bleeding, including known coagulopathy, epistaxis, hematoma, petechiae, wound healing defects, prolonged bleeding, abnormal blood and blood product requirements following previous surgery, hyper menorrhagia and coagulation medication (Kozek - Langenecker et al.) indicates that if any of these factors are present, the history of bleeding is considered to be abnormal.(1),(3),(31)

1.5.2 Gender
In CABG surgery, being a male predicts excessive blood loss during cardiac surgery under the effect of double anti-platelet treatment (Dixon et al.), and generally cardiac surgery with CPB (Miceli et al.). As measured by thromboelastography, healthy women have a more pro-coagulant profile than healthy men due to a rapid fibrin formation rate and higher clot strength with better visco elastic properties (Roeloffzen et al.).(1)(2)

1.5.3 Higher pre-operative haemoglobin levels
As a predictor of excessive postoperative bleeding, found higher levels of preoperative
haemoglobin. There is a strong inverse correlation between the level of haemoglobin and the speed to reach a certain level of clot strength in accordance with these results. (1)(18)

1.5.4 Lower BMI

Lower BMI was a predictive factor for excessive bleeding in any CPB cardiac surgery (Carroll et al., Dixon et al.) and in CPB for the first time (Firanescu et al.). The Society of Cardiovascular Anaesthesiologists (2007) also describes body size or body surface area as a risk factor for excessive bleeding. These results in patients with low BMI may be associated with more significant haemo dilution effects and consequent dilution of coagulation factors during CPB. Bleeding-related return to surgery is also significantly higher in patients with or without CABG underweight compared to obese or severely obese patients. (5)

1.5.5 Diabetes mellitus

Diabetes mellitus predicted excessive bleeding in a multivariate analysis of CPB's first elective CABG (Firanescu et al.). The Society of Cardiovascular Anaesthesiologists (2007) also describes insulin-dependent adult-onset diabetes mellitus as a risk factor for bleeding after heart surgery. Because diabetic patients have increased procoagulant plasma levels and decreased fibrinolytic capacity (Alzahrani & Ajjan et al.), diabetes as a predictor of excessive bleeding in cardiac surgery may result from confusing effects not included in the multivariate analysis. (1), (2)

1.5.6 Impaired left ventricular function

According to the 2012 European Cardiology Society Guide-lines for the diagnosis and treatment of acute and chronic heart failure (CHF) (McMurray et al.), at least 50 percent of HF patients have a low ejection (systolic HF) fraction. Compared to those with a preserved ejection fraction, these patients have a worse survival prognosis. (1)

1.5.7 Preoperative coagulation status

The pro-thrombinase complex converts pro-thrombin to thrombin in the blood coagulation process. Thrombin converts fibrinogen to fibrin, which will stabilize the clot and induce platelet aggregation activation. (Karkouti et al.) As a measure of thrombin formation, lower levels of pre-CPB pro-thrombin F1 + 2 have been independently associated with increased risk of postoperative bleeding, a new finding in cardiac surgery. (31)

1.5.8 Timing of discontinuing antithrombotic drugs

Many patients receive anti platelet agents, oral anticoagulants or heparin during the preoperative period of cardiac surgery to prevent thrombo embolism due to atrial fibrillation, earlier prosthetic valves or acute coronary syndrome (Achneck et al.). Therefore, the timing of preoperatively discontinuing antithrombotic drugs plays an important role in the risk of bleeding in adult cardiac surgical patients. (1)(3)
1.5.9 Procedure-related predictors
The operating surgeon is a factor that reflect higher patient morbidity and increase surgical complexity, and haemostatic disorders induced by CPB, were the procedure-related risk factors for excessive bleeding identified by the studies included in the review. (1)(31)(5)
Different risks of postoperative bleeding may be associated with changes in haemostatic practices depending on the surgeon (Dixon et al.). The postoperative mean chest tube drainage at 24 hours, the proportion of patients with over 1000 ml of chest tube drainage and the volume of red blood cell packs transfused were significant variations. These variations have been associated with the operating surgeon significantly. (1)(28)

1.5.10 Definition Of CABG Surgery:
CABG is an operation to treat coronary artery disease. The goal is to improve blood flow to your heart muscle. The surgeon creates new pathways for the blood called bypasses. This is a detour for the blood around the portion of your coronary arteries that have blockages.
The bypasses are created from arteries or veins from:
- Chest (mammary artery)
- Leg (saphenous veins)
- Arm (radial arteries)
CABG can be performed two different ways; the surgeon will determine the appropriate method for you:
Traditional: Use of a heart-lung machine, The heart is stopped while the surgeon completes the operation
Off-Pump: No heart-lung machine is used. (36)

1.6 Postoperative nursing management of excessive bleeding patient after CABG
The cardiac surgery patient's postoperative care is challenging in that changes can occur quickly. In postoperative care, the patient's preoperative condition as well as intraoperative events should be considered. In order to ensure a positive outcome for the patient, it is essential for the nurse to anticipate possible complications in order to initiate appropriate interventions in a timely manner.

1.6.1 Postoperative pulmonary management
Following CABG, pulmonary dysfunction and hypoxemia may occur in 30% to 60% of patients. In postoperative pulmonary management, the history of patients and intraoperative factors must be
considered. Postoperative pulmonary complications may increase a history of smoking, obstructive pulmonary disease, steroid use, gastroesophageal reflux disease, heart failure and poor nutrition. While the patient is intubated, the desired results include adequate oxygenation and ventilation. Early extubation is also a desired outcome as long as the patient is stable neurologically and hemodynamically. Postoperative complications may increase if patients are intubated for more than 24 hours. With longer periods of intubation, the length of hospital stay may also increase. Prolonged pump time causes fluid shifts, potentially increasing the amount of fluid in the pulmonary tissue, thereby increasing the potential for pulmonary complications. Sternotomy-induced pain can impair breathing patterns. Some patients shiver after heart surgery and this response may result in increased levels of carbon dioxide or lactic acidosis. Shivering can increase the consumption of oxygen in the body, therefore oxygen levels should be monitored and adjusted accordingly. Shivering may be the result of the body compensating for the hypothermia induced by surgery or a response to anesthetic agents. Shivering is usually managed by administering sedation and neuromuscular blocking agents during mechanical ventilation of the patient.

Postoperative pulmonary management includes accurate and frequent physical evaluation, analysis of blood gas, continuous pulse oximetry, pulmonary care (including suction while the patient is intubated and coughing and spirometry incentive after extubation), early mobilization, and pain and shiver control. Most hospitals follow a management which require an x-ray of the chest after heart surgery to determine the placement of the endotracheal tube, thermo dilution catheter and nasogastric tube, as well as information on mediastinum width, amount of atelectasis, presence of hemothorax or pneumothorax and heart size. The nurse must balance the need for pain control without breathing depression with the need of minimizing the patient's pain. The nurse must evaluate the patient for early extubation readiness. When the patient is arousable, capable of following commands, hemodynamically stable, and initiating spontaneous ventilation without excessive breathing effort, extubation should be considered. As the patient is being removed from the ventilator, ventilation support is gradually withdrawn and spontaneous ventilation must be maintained by the patient. Before extubation, physical evaluation of effective ventilation and laboratory analysis of arterial blood gases and specific ventilation parameters must be completed. Protocols may vary according to hospitals and depending on icu standards, but some standards require PO2 > 80 mm Hg on FIO2 0.40 or less, PCO2 > 45 mm Hg, pH > 7.35 to 7.45, and oxygen saturation (SaO2) > 92 %. Parameters of ventilation include a maximum inspiratory pressure of at least -20, a tidal volume of at least 5 mL / kg body weight, and an a minute volume of at least 5 liters per minute. The nurse should evaluate the patient during the weaning process for increased respiratory and/or heart rates, fatigue, and
changes in color because these findings may indicate that the patient is not ready for extubation. Now a days the use of pulmonary artery catheter is not used commonly in CABG surgery but if its used then an increase in the pressure of the pulmonary artery may indicate an increase in PCO2 and give an early indication to the nurse that the patient is not ready for extubation before analyzing the blood gas. Early extubation is a first priority outcome after surgery, but early extubation may have detrimental effects if parameters are not met and/or the patient is hemodynamically unstable.(9)

1.6.2 Postoperative Management of hemodynamics

The nurse must assess the patient on an ongoing basis for heart dysfunction and hemodynamic instability. To achieve stable hemodynamic status, the receiving nurse needs to monitor intensively the interrelationship between heart rhythm and rate, preload, afterload, contractility, and myocardial compliance.

Hemodynamic management's overall goal is to maintain adequate organ perfusion and delivery of oxygen. Preload is determined by the volume of blood returning to the right atrium as well as by myocardial compliance. Preload is a measurement of end diastolic pressure. Afterload is the force the left ventricle must overcome to eject blood during systole. Myocardial compliance is the ease with which the heart distends during diastole. Bradycardias or tachy dysrhythmias that decrease ventricular filling can decrease C.O.(21)

A mean 60–90 mm Hg arterial pressure (MAP) and a 90–140 mm Hg systolic blood pressure are reasonable goals. In hypertensive patients or patients with renal insufficiency, higher MAP may be indicated, whereas lower MAP may be present due to poor ventricular function, surgery for mitral repair, vulnerable aortic suture lines, or active bleeding. Blood pressure must be maintained within ordered parameters to provide tissue perfusion and prevent disruption of the surgical anastomoses. Lactate is an extremely sensitive marker of impaired perfusion, and even minimally elevated levels (> 2 mmol/L) can identify patients with occult hypo perfusion. Higher lactate levels (> 3–4 mmol / liter) and slow lactate clearance accurately predict major complications after cardiac surgery.(9),(24)

1.6.3 Fluid resuscitation

Perhaps the most important hemodynamic intervention in the immediate post-operative period is appropriate fluid resuscitation and should be first-line therapy for early hemodynamic instability. There are four major contributors to the need for intravascular volume replacement: blood loss, increased vascular capacity with rewarming, third-space fluid loss due to inflammation caused by CBP, and increased cardiac preload requirements for transient cardiac ischemia-reperfusion injury,
myocardial astonishment, and decreased ventricular compliance. Crystalloids are preferred for fluid resuscitation. IV fluids that contain large quantities of chloride, such as normal saline (0.9% sodium chloride), cause hyperchloremic acidosis and may be associated with acute kidney injury (AKI). A decline in AKI was associated with a change in low-chloride resuscitation fluids. Synthetic colloids are not superior to crystalloids, may aggravate coagulopathy, and may be associated with renal failure. Albumin is effective after cardiac surgery for volume resuscitation.(10)

1.6.4 Post operative hypothermia
After surgery, the nurse must re warm the patient if hypothermia persists. Hypothermia's negative effects include myocardial depression, ventricular dysrhythmias, vasoconstriction, and clotting factor depression (increasing postoperative bleeding risk). Rewarming can be accomplished if the patient is hypothermic by using warm blankets, warm humidified oxygen, convective air mattresses, and other institutional approaches.

1.6.5 Dysrhythmias
Dysrhythmias following CABG surgery are common. Constant patient assessment and continuous monitoring of the patient's heart rate and rhythm is imperative. Ventricular dysrhythmias are more common in the early postoperative period and supraventricular dysrhythmias are more likely to occur 24 hours to 5 days after surgery, the incidence of atrial fibrillation ranges from 10% to 65% depending on many factors including patient history, preoperative medication, and type of surgery. Hypothermia, inhaled anesthetics, electrolyte disorders (e.g., hypocalcaemia, hypercalcemia, hypomagnesium, and hypokalemia), metabolic disorders (e.g. acidosis), manual heart manipulation, and myocardial ischemia may be factors in postoperative dysrhythmia. Dysrhythmias may also result from increased levels of catecholamine secondary to pain, anxiety, and inadequate sedation. Atropine may be given to increase the heart rate in the absence of epicardial pacing wires. Most common arrhythmia is arterial fibrillation.(9)

1.6.6 Postoperative Bleeding management
The nurse should monitor the patient for chest tube and surgical site signs of bleeding as well as clinical signs of blood loss related hypovolemia. Hemoglobin and hematocrit should be monitored in accordance with hospital protocol at regular intervals during the postoperative period. Serial coagulation profiles are sometimes ordered by the surgeon for a patient at risk of bleeding. If bleeding is an issue, it is possible to administer drugs such as protamine sulfate (to reverse the
effects of heparin) or anti-fibrinolytic agents such as aminocaproic acid or desmopressin, as well as blood products such as fresh frozen plasma and platelets.

There is potential for the blood to accumulate in the pericardium when bleeding occurs, and therefore the nurse must be aware of the cardiac tamponade potential. The clinical manifestations of cardiac tamponade include lack of drainage of the chest tube, decreased BP, reduced pulse pressure, increased heart rate, jugular venous distention, increased central venous pressure, and muffled heart sounds. Emergency reoperation would be required to stabilize the normal hemodynamic status.(9),(30),(26),(24)

1.6.7 Transfusion management

Patients requiring surgical re-exploration have a significantly higher blood loss and need significantly higher amounts of fresh frozen plasma, packed red blood cells and concentrated platelets.

Fresh frozen plasma – Contains all factors of coagulation except platelets. It is useful if the patient has hemodilution after CPB and during ongoing bleeding there is a progressive loss of coagulation factors. Dose from 10 - 15 ml / kg.

Cryoprecipitate – It contains the factor of VIII and von Willebrand and is also a source of fibrinogen (factor I) and XIII. It is useful in patients with hypo fibrinogenemia and von Willebrand's disease.

Platelets – If the platelet count is less than 100,000/mkl should be given to the bleeding patient. It is useful when the patient has platelet dysfunction after using antiplatelet and IIb / IIIa inhibitors and CPB for a long time. Function of platelets is also impaired when hematocrit is less than 30 %. (27)

Packed red blood cells – The amount of packed red cell transfusion is still the major determinant of morbidity and mortality in patients requiring bleeding re-exploration. For patients with bleeding, hematocrit must be higher than 26-28 percent to ensure the delivery of tissue oxygen. Dial and coworkers found severe intraoperative anemia (hematocrit & lt; 19 percent) to be a strong predictor of packed red cell transfusion. Blood transfusions in excess of 4 units increase the risk of infection and the rate of surgical mortality after surgery on the pump and stay longer in ICU. The risk of developing infection is 3.9% in cases where 2 blood units are transfused, 6.9% in cases where 3-5 blood units are transfused and 22% in cases where 6 and more blood units are transfused.(6),(8)

1.6.8 Postoperative Neurologic Management

Patients requiring surgery to bypass the coronary artery are at increased risk of neurological complications. Stroke may be caused during or after surgery by hypoperfusion or an embolic event. Other stroke risk factors may include age, earlier stroke, carotid bruits, and hypertension. The
incidence of stroke is about 2.5%. In the postoperative period, the nurse should be particularly assess the neurological evaluation. Upon admission to the intensive care unit, the patient will probably be intubated and unconscious. It will be apparent the effects of the neuromuscular blocking agents. However, normal size and reactivity may not return until the intra-operatively used agents have been metabolized. The results of the neurological evaluation should gradually improve over the first few hours after surgery. When the patient is ready for extubation, he / she should follow the commands and have the same movement and strength of the extremities as the neurological function approaches the normal of the patient. Needed comfort should be provided by the nurse and neurological status cannot be fully assessed until the patient is fully awake and extubated. The patient should be evaluated at that time for person, place, time, and circumstance orientation. Also a motor and sensory evaluation should be carried out. A positive result is a good indication of the possibility of excluding an intraoperative stroke. Neurological evaluations must continue because the risk of stroke does not end with surgery. (9)

1.6.9 Postoperative Renal Management
Renal insufficiency may be associated with advanced age, hypertension, diabetes, reduced left ventricle function, and prolonged CPB. An effective CO indicator is adequate renal perfusion as evidenced by at least 0.5 mL / kg / h urinary output. During the early post-operative period, the nurse must monitor the urinary output at least hourly. The color and characteristics of the urine as well as the amount should be evaluated. Diuresis is likely when renal function is adequate in the postoperative period as the fluids move from the interstitial to the intravascular space. The potassium level of the patient should be monitored for the first 24 hours at least every 4 to 6 hours as potassium is lost through diuresis. To keep the serum potassium levels within normal limits, intravenous potassium replacement should be given. If the serum potassium level is abnormal, the patient should be continuously monitored for cardiac dysrhythmias. The blood urea nitrogen and serum creatinine are other laboratory values that should be monitored at least daily for the assessment of normal kidney function. (32)

1.6.10 Postoperative Gastrointestinal Management
Complications include disease of peptic ulcer, perforated ulcer, pancreatitis, acute cholecystitis, ischemia of the intestine, diverticulitis, and liver dysfunction. Some risk factors for gastrointestinal dysfunction include age over 70, gastrointestinal disease history, alcohol abuse history, cigarette smoking, heart valve surgery, emerging surgery, prolonged CPB, postoperative hemorrhage, vasopressor use, and low postoperative CO. If the gastro-epiploic artery is used as a bypass duct,
this may also increase the risk of gastrointestinal dysfunction. During surgery, anesthetic agents, analgesics and intestinal hypo perfusion may also contribute to gastrointestinal dysfunction. The nurse should monitor and examine for bowel sounds, abdominal distention, and nausea and vomiting. The intubated patient will have an intermittent low suction nasogastric tube or a continuous suction Salem sump. Placement and patentability as well as quantity, color and drainage characteristics should be evaluated. Before extubation, the nasogastric tube will be discontinued if bowel sounds are present and the nurse should continue to evaluate the patient for potential gastrointestinal disorders. If the patient is nauseated, the nurse should be given antiemetic agents as ordered. The patient's comfort as well as the sternal dressing sterility must be maintained. Some surgeons are ordering an histamine blocker to minimize secretion of acid until normal dietary patterns are resumed. The patient will be started on a clear liquid diet when the nasogastric tube is removed and this can be advanced as tolerated by the patient.

1.6.11 Post-operative Pain Management
The patient may have a median sternotomy incision, leg incision, and/or radial incision depending on the surgical approach. Chest cavity manipulation, retractor use during surgery, and electrocautery can all contribute to postoperative pain. Furthermore, positioning on the operating room table and the duration of the operation can also be factors in postoperative pain experienced. For each patient, nurses need to individualize pain evaluation and control as responses vary between individuals. Some of the pain control methods include opioid analgesics, positioning, mobilization, distraction, and relaxation techniques. It is beneficial to maintain serum levels of opioid analgesics in the therapeutic range. In combining opioid agents with non-steroidal anti-inflammatory agents can be used to control pain and minimize the amount of narcotic needed. Ketorolac is a non-steroidal anti-inflammatory agent that can be intravenously administered in the early postoperative period while the patient remains intubated. The nurse must monitor ketorolac patients' renal status, and if the serum creatinine is elevated, the drug may be discontinued. When a non-steroidal anti-inflammatory agent is used, the patient is at increased risk of gastrointestinal bleeding. Pulmonary care is more effective for the patient when pain is effectively managed. Teaching the patient to splint the incision when coughing and moving improves pain control. The nurse should evaluate the effectiveness of pain management interventions regularly. The removal of chest tubes is another source of pain for the patient after CABG. This usually happens after 24 to 48 hours when the quantity and characteristics of chest tube drainage meet ordered parameters as long as no air leakage is noted in the water seal chamber. Pain medication should be given per hospital
protocol prior to removal of chest tubes to minimize the procedure trauma and complications. (9), (13)

1.6.12 Other postoperative management

Postoperative infections: Compared to other complications, the incidence of sternal and leg incisions after cardiac surgery is less common. Diabetes, malnutrition, chronic diseases and patients requiring emerging surgery or prolonged surgery are risk factors for infection. Infection assessment and prevention is part of the post-operative role of the nurse. For local and systemic signs of infection, the patient should be evaluated. If infection is detected, postoperative antibiotics may be ordered. Dressings should be removed and institutional protocols should complete the incision care. Blood glucose control can help prevent infection. A continuous intravenous infusion of insulin versus intermittent subcutaneous insulin injections is desirable to control blood glucose levels greater than 150 mg / dL. In the prevention of deep sternal wound infection, this practice is thought to be helpful. (25)

Some surgeons post-operatively order corticosteroids. When used, these medicines are designed to minimize the potential risks of heart surgery inflammation. For the suppression of the immune system, patients should be monitored as this may be an adverse effect of corticosteroid administration. An elevation in serum glucose levels is the other potential effect of corticosteroid administration. In order to maintain blood glucose levels within normal limits while the patient is in the hospital, a sliding insulin order may be needed.

Sleeping Disorders: In the early postoperative period, the nurse must take intensive care of the patient. This intensive monitoring and postoperative discomfort may interfere with the need for sleep of the patient. As the patient recovers from CABG, there is a potential for sleep disturbance. Sleep shortage can have a negative effect on postoperative results. Hospital routines and too many visits can add to the problem of sleep deprivation. The patients relatives, friends or family should be able to spend time with the patient, but to balance the need for visitation with the need for rest and sleep is the role of the intensive care nurse. (9)

Post-operative management of Delirium: Delirium after cardiac surgery has been associated with increased mortality, decreased quality of life, decreased post-operative mobility, and a higher rate of long-term postoperative cognitive dysfunction. Health care utilization and costs occur due to increased lengths of ICU stay, hospital stay, and readmission. Due to alterations in monitoring and diagnosis, the estimated incidence of delirium ranges from 10% to 80%. Ketamine 0.5mg/kg at the
time of induction decreased delirium after surgery involving cardio pulmonary bypass. Dexmedetomidine has emerged as a promising alternative for sedation to midazolam or propofol in reducing delirium in the post surgical and medical intensive care settings. A novel therapeutic option is the use of ondansetron for the treatment of established delirium. In one research, intravenous ondansetron 8mg was as efficacious as intravenous haloperidol 5mg for the treatment of post cardiotomy delirium but with a more favourable side-effect profile.(7)

Mobilization of Patients: Mobilization has been shown to reduce post operative pulmonary complications and thromb embolism and prevent deconditioning. Potential barriers to mobilization faced by cardiac surgery patients include hemo-dynamic instability, bleeding, invasive monitors, chest drains, pre-existing mobility limitations, pain, sedation, and ischemia. Early removal of chest drains may facilitate mobility but has been shown in one trial involving 782 post–cardiac surgery patients to increase the incidence of effusions requiring invasive treatment.(7).

1.7 Pharmacological management of excessive bleeding by nurses

1.7.1 Anti arrhythmic drugs

Mitchell BL, Exner DV, Wyse DG, states that Amiodarone or cordarone used for the prevention of arrhythmias that begin early after revascularization, valve replacement, or repair.(11)

1.7.2 Anti microbial

Engelman R, Shahian D, Shemin R, et al. States that b-lactam antibiotics as the prophylactic drug of choice in patient populations without a high incidence of methicillin-resistant Staphylococcus aureus (MRSA) infection. The vast majority of sternal wound infections are caused by Staphylococcus aureus or epidermidis, consideration of a combination of prophylactic cephalosporin and vancomycin (based on renal function) in patients with known MRSA colonization., if a cephalosporin cannot be utilized due to concern for allergic reaction, an aminoglycoside (gentamicin 4 mg/kg) should be added to vancomycin for the purpose of gram-negative coverage.

Mupirocin nasal ointment is recommended for all patients for nasal sterilization and prevention of staphylococcal infections, and topical antimicrobials are discussed as a potential option to prevent sternal wound infections while minimizing systemic exposure to potentially toxic agents. nasal colonization with Staphylococcus aureus is a risk factor for surgical site infection, and that mupirocin nasal ointment is effective at reducing that rate of infection by sterilizing the nasal passages prior to surgery.(11)

**1.7.3 Most important precautionary step: Anti-platelets**
Ferraris VA, Saha SP, Oestreich JH, et al. Staes that If possible, clopidogrel should be discontinued 5 to 7 days before surgery to reduce the risk of bleeding, transfusions, and reoperation for bleeding.

**1.7.4 Beta blockers**
The use of metoprolol significantly reduced the rate of AF stated by Connolly SJ, Cybulsky I, Lamy A, et al.

**1.7.5 Statins**
**NB:** Statins are not using in postoperative cardiac ICU but, the use of statin therapy within 1 month following CABG surgery discharge was associated with a higher percentage of patients who were free from all-cause mortality as compared to no statin therapy.(11)

**1.7.6 Angiotensin Converting Enzyme Inhibitors**
Angiotensin-converting enzyme (ACE) inhibitors help relax blood vessels. ACE inhibitors prevent an enzyme in your body from producing angiotensin II. The drug used as ACE inhibitors are Benazepril, Captopril, Enalapril, Fosinopril, Quinapril, Ramipril etc.

**1.7.7 Blood glucose management**
Lazar HL, McDonnell M, Chipkin SR, et al. Staes that poor perioperative glycemic control is associated with increased morbidity and mortality; glycaemic control (<180 mg/dL) in patients with diabetes mellitus (DM) during cardiac surgery reduces mortality, morbidity, lowers the incidence of wound infections, reduces hospital length of stay, and enhances long-term survival; and intra operative glycaemic control using IV insulin infusions is not necessary in patients without DM provided that glucose values remain < 180 mg/dL.(31)
1.7.8 Anti fibrinolytic Medicines

Lysine analogues (ε aminocaproic acid and tranexamic acid) were frequently used to competitively inhibit the fibrin-binding site on plasminogen, thus reducing the rate of fibrinolysis.(12). Tranexamic acid and ε aminocaproic acid are synthetic anti fibrinolytic amino acids that competitively block the lysine-binding site of both plasminogen and plasmin, therefore inhibiting each enzyme action. Plasmin can no longer bind to fibrin and can no longer degrade fibrin, and thus bleeding is reduced.(12)

Side effects of T.A: Postoperative seizures reported after the use of TA was an alarming sign about the use of TA in cardiac surgery.

Side effect of aprotinin: Aprotinin, in high doses, is the only agent shown to reduce re-exploration after cardiac surgery Mangano et al. showed that aprotinin is associated with increased risk of cardiovascular events, cerebrovascular events and renal dysfunction. (12)

1.7.9 Analgesics

Pain is often under-treated after cardiac surgery. In order to improve pulmonary function, decrease delirium and increase patient satisfaction, adequate pain control is mandatory. Nurse-driven protocols facilitate pain evaluation and rapid postoperative pain treatment. Analgesia in the early postoperative phase is based on narcotics. Usually fentanyl is used. IV paracetamol is an effective analgesic agent, and narcotics can be spared. Patient-controlled analgesia (PCA) devices are effective and well received by patients and nurses once they are extubated. Once patients are able to take oral medicines, they typically followed oral narcotic regimens. But all non-steroidal anti-inflammatory drugs are suggested with a high degree of caution due to adverse effects on platelet and kidney function.(13)

1.7.10 Diuretics

Furosemide is commonly prescribed for fluid retention, which often occurs due to the large volumes of fluid used during CPB surgery. Low-dose IV diuretics (e.g., furosemide 20 mg every 12 hr) should be started with a typical aim of a net negative fluid balance of 1–2 L daily.(10)

1.7.11 Anti-emetics

To control the postoperative nausea and vomiting.(7)

1.7.12 Inotropes and vasopressor

Adrenergic (catecholamine):

Dobutamine - beta-agonist (β1 >β2). Increases contractility and HR.
Epinephrine - alpha and beta agonist (β > alpha). Increases HR, CO, and SVR.
Dopamine - stimulates dopaminergic, beta, and alpha receptors in dose-dependent fashion. In low doses (2 - 4 mcg/kg/min) it has been purported to have beneficial renal protective effects ("renal-dose dopamine").

Phosphodiesterase inhibitors:
Milrinone - Phosphodiesterase inhibitors decrease the metabolism (breakdown) of cAMP. Milrinone increases cardiac output. It also decreases Pulmonary Vascular Resistance (PVR) and thus can be useful if pulmonary hypertension or significant right ventricular dysfunction is a problem.

Vasopressor: Adrenergic (catecholamine):
Norepinephrine - Strong alpha agonist with beta activity as well. Causes vasoconstriction and thus increases SVR and BP.
Phenylephrine - Pure alpha agonist, used for the treatment of severe hypotension by bolus doses not as a continuous infusion.

Peptides: Vasopressin - used for hypotension with a normal or high cardiac output and low SVR state that is refractory to norepinephrine.(10)

**1.7.13 Protamine:**
If the ACT is elevated, the dose of protamine should be 25-50 mg. After CPB, ACT should return to baseline, but in ICU heparin rebound may occur and patient may begin bleeding. Medtronic Hepcon system can evaluate ACT and rebound heparin.

**1.7.14 Desmopressine:**
DeLaupacis and coworkers report that the 0.3mkg / kg I / v dosage of Desmopressine does not affect bleeding rates and does not decrease allogeneic transfusion rates as well, but may be effective in patients taking Aspirin. In contrast, there are few reports in the literature that Desmopressine should be given to patients who tend to bleed. It is also useful in patients with uremia and the disease of von Willebrand.

**1.7.15 Novoseven**
Recombinant Activated Factor VII. Many studies approve of its effectiveness in reducing blood loosening after cardiac surgery. But with Novoseven we should also be careful as some studies have shown that Novoseven can increase thrombosis risk. For patients with isolate VII factor deficiency, Novoseven could therefore be recommended in cardiac surgery.
1.7.16 Octoplex
The complex concentrate of prothrombins contains II, VII, IX, X and C and S proteins. In patients requiring rapid reversal of anticoagulant effect from the use of vitamin K antagonists, it is effective and safe in immediate correction of dosage-dependent INR. However, we should be aware of using it on cardiac patients as Octoplex increases oncotic pressure and volume of circulation and can cause heart failure.

1.8 Lab / Diagnostic evaluation in prediction of bleeding after CPB
The fundamental causes of abnormal bleeding are failures in primary hemostasis (platelet inhibition/dysfunction, thrombocytopenia, and vWD), failure to generate thrombin (procoagulant factor deficiency), and failure to form a stable fibrin clot (hypo fibrinogenemia or dysfibrinogenemia and excessive fibrinolysis). PT, aPTT, mixing studies, and platelet function testing such as thromboelastography as some of the most important diagnostic tests available to the cardiac surgeon and anaesthesiologist to identify the bleeding disorders.(14)

1.8.1 Use of point of care tests to minimize bleeding
Laboratory coagulation tests can provide a rational basis for diagnosis and treatment of MVB after cardiac surgery. A panel of rapidly performed screening tests for factors such as PT, aPTT, TT, platelet count, fibrinogen level, and fibrin degradation products may be useful in the differential diagnosis of intraoperative disorders of hemostasis. The clinical utility of laboratory tests is often limited by long turnaround. Waiting for laboratory coagulation results can potentially prolong operative time and increase blood loss. Accordingly, an on-site coagulation laboratory or use of point-of-care (POC) coagulation methods may help physicians establish more appropriate management of excessive bleeding by facilitating the administration of blood components according to the detected abnormalities of the coagulation system. This mode of lab investigation may result in a change in transfusion behaviour and identification of patients with a surgical source of bleeding.(27),(14),(30)

1.8.2 Viscoelastic Testing:
Preoperative assessment of haemostatic parameters using viscoelastic tests,such as rotational thromboelastometry (TEM)or thromboelastography(TEG) used to predict perioperative bleeding.(20)
Thromboelastography: Its determines clot formation and lysis within a given blood sample by measuring the shear elastic modulus of whole blood samples during clot formation .However, it
does not measure the effect of aspirin, thienopyridines (P2Y12 platelet receptor inhibitors), or low-molecular-weight heparin. Thromboelastography provides a global assessment of haemostatic function in whole blood, preserving the interplay between erythrocytes, platelets, coagulation factors, and fibrinogen. Thromboelastography has been demonstrated to be remarkably accurate when used to predict postoperative haemorrhage, with a success rate of 87%, whereas the activated clotting time and coagulation profile posted accuracy rates of 30% and 51%, respectively.(14)

1.8.3 Other investigations to diagnose the postoperative complications in CABG.

Electrocardiogram
- Check for Rhythm - post-operative bradycardias, blocks, or atrial fibrillation, ST-T changes

Chest X-Ray
- Verify correct position of the endo tracheal tube( ETT). Ideally half way between the glottis and the carina. Should be at least 1 cm above the carina.
- Verify correct position of the Swan-Ganz catheter. The tip should not be too peripheral - no more than 1 to 2 fingerbreadths beyond the lateral mediastinal shadow.
- Check the position of all other tubes and drains. The naso gastric(NG) tube, chest tubes, and mediastinal sumps.
- Check for pneumothorax.
- Check for lobar collapse, atelectasis, effusions, pulmonary edema.

Laboratory Results
- Hemoglobin
- Coagulation parameters (PLT, PT, PTT, INR, ACT)
- Potassium, magnesium - a vigorous diuresis is common in the first few hours after the OR. This can lead to significant hypokalemia and hypomagnesaemia which increases the likelihood of post-operative dysrhythmias. Standing orders are in place to replace these electrolytes.
- Glucose - Tight glycemic control post-operatively reduces morbidity. Use an insulin drip or sliding scale to keep the blood glucose between 6 and 10mMol/L.

- Cardiac markers - elevations of CPK, CPK-MB, and troponins are non-specific. They should be assessed as part of the overall clinical picture including the hemodynamic status of the patient and the EKG.(36)
1.9 Mortality rate in cardiac surgeries

An observational cohort study was carried out during a 1 year period (from November 2008 to November 2009) among cardiac surgery patients of a general, tertiary hospital in Athens, Greece shows that, The overall in-hospital mortality was 11.8%. The mortality for patients who underwent coronary artery bypass surgery was slightly less than the overall (10.7%). In addition, mortality was 9.7% for patients who underwent valve surgery. Patients with a combination of these procedures or after thoracic aorta aneurysm repair had higher mortality rates. It is worth mentioning that the main cause of death among the study of patients was refractory cardiovascular failure (37.8%). The remaining causes of death were, in decreasing order: refractory multiple organ dysfunction syndrome (24.3%), septicaemia (10.8%), acute cardiac arrest (8.1%), mediastinal haemorrhage (8.1%), pulmonary failure (8.1%) and chronic renal disease (2.7%).

1.10 ICU-los

Specifically, patients with increased ICU-LOS (> 2 days) had greater probability to die than patients hospitalized in ICU < 2 days. Patients who stayed longer in ICU have greater severity, are more sensitive to infections and have greater incidence of complications. Abrahamyan et al. found that the cardiac surgery patients who stayed in ICU > 72 hours had a mortality of 16.2%, a percentage significantly higher than the corresponding one (0.56%) for those who stayed in ICU for a shorter period. (16),(23)

1.11 The economic impact of severe bleeding

In Sweden The average cost increase for a patient undergoing bleeding re-exploration was 6290 Euro compared to the cost of controls that do not require re-exploration. Of the cost increase, 48% was due to the prolonged stay in the ICU and ward (mean increase in hospital stay of 2.8 days), 31% was due to the cost of surgery and general anaesthesia, 20% was due to the increased number of transfusions, and 1.6% was due to haemostatic drug treatment. The additional costs of postoperative complications for 14,780 patients undergoing CABG surgery in the USA were measured by Speir and colleagues. Re-exploration for bleeding in their study increased the cost by 76 percent compared to the baseline cost, that is, the cost to patients without postoperative complications.(22)

1.12 Complications of CPB

1.12.1 Systemic complications (on CPB)
- Systemic inflammatory response syndrome: Its possibly triggered by damage to red blood cells and platelets from contact with the pump surfaces. Signs and symptoms include hypothermia or fever, tachycardia, and hyperventilation.

- Coagulopathies: Caused by the destruction of platelets and the large amounts of heparin administered during CPB. Because this can lead to hemorrhage, the patient may need blood transfusions.

- Perfusion disturbances: Affects the brain, kidneys, liver, and lungs, which can lead to complications such as cognitive changes, embolic stroke, and renal insufficiency. Perfusion insults are related to surgical manipulation of the heart and cross-clamping of the aorta, which can lead to clots and emboli.

- Heparin-induced thrombocytopenia: A serious complication of heparin use during on-pump surgery. Anticoagulation during surgery helps prevent thromboembolic complications, but excessive bleeding can lead to thrombocytopenia. Researchers are investigating the use of Iloprost (a form of prostacyclin), a platelet aggregation inhibitor, to prevent bleeding and thrombosis in patients undergoing cardiac surgery.(14)

- Edema, including pulmonary edema. This complication may result from lowered oncotic pressure, release of vasoactive substances, and other complications of artificial circulation.

- Electrolyte imbalances: Due to excess sodium and water retention. Administer diuretics, potassium replacement, and fluids as ordered.(15)

- Contact of blood with artificial surfaces, ischaemia-reperfusion injury, endotoxaemia and operative trauma can cause systemic inflammatory response after CPB. Acute phase reaction is initiated by the release of complement, cytokines, endotoxins and NO leading to increased capillary permeability. Rewarming can cause stress response and release of inflammatory mediators. Sub clinical myocardial injury can occur due to cross clamping of the aorta in spite of cardioplegia. Stunning of the myocardium is responsible for immediate dysfunction. Factors include metabolic acidosis, preoperative ventricular function, reperfusion injury and inflammatory mediators.

- Acute respiratory distress syndrome: It can be present due to the effects of CPB. Anaesthesia-induced atelectasis and reduced mucociliary clearance further contribute to acute lung injury. As a result atelectasis and pleural effusions are common pulmonary abnormalities after cardiac surgery. Therefore, lung protective lung strategies are required in the pre- and post-operative periods of cardiac surgery. Vasoplegia is characterised by severe, vasopressor-resistant vasodilation due to activation of nitric oxide synthase, vascular smooth muscle ATP-sensitive potassium channels and relative deficiency of vasopressin. Treatment includes fluid resuscitation and vasopressors such as
phenylephrine, norepinephrine and vasopressin. Methylene blue (1.5 mg/kg IV) acts as a competitive inhibitor of nitric oxide and can be used as a rescue drug.(15)

1.12.2 Mechanical Complications Due To CPB
Arterial cannulation can be associated with bleeding, cannula malposition causing selective cerebral perfusion, plaque dislodgement and dissection. Dissection presents as low arterial pressure, high arterial line pressure (>300 mmHg), loss of venous return and bluish discoloration of the vessel. It can be diagnosed with TOE. Repair of the dissection is necessary under DHCA. Venous cannulation can be associated with bleeding, cannula malposition/air lock causing an inadequate return, leading to cerebral and splanchnic congestion. Massive air embolism is due to pumping from an empty reservoir. Treatment is cessation of the pump and commencing retrograde cerebral perfusion.(15)

Other complications include oxygenator failure, pump malfunction, clotting in the circuit, tubing rupture, gas supply failure and electrical failure due to which hand cranking must be available at all times.

2. ORGANIZATION AND METHODOLOGY OF A RESEARCH
A literature review of medical literature of 37 articles was conducted and prospective observation of a patient, scheduled for the heart surgery in Kaunas Clinics was carried out during a whole hospital stay. Laboratory data were collected from medical documentation and analyzed.

3. RESULTS
- Case Study
Present medical history:
82-year-old male was referred for emergency CABG at Lithuanian university of health sciences hospital Kaunas Clinics. Complaints: 1 week history of pectoral angina. On the admission day he suddenly started to have intense chest pain that radiated to the left arm and was hospitalized with the diagnosis of pain that irradiated acute myocardial infarction.
Past medical history:
Patient also have diabetes mellitus type 2, hypercholesterolemia, hypertriglyceridemia and arterial hypertension. It was known, that his father had died at age 57 due to cerebrovascular accident and his mother was alive at 73 years without cardiovascular disease (no family history).

Physical examination:
weight of 98 kg, height 162 cm, body mass index 37.3 kg/m², heart rate of 80 bpm, blood pressure 140 x 90 mm Hg. Lung assessment was normal and cardiac auscultation showed a systolic murmur in the mitral valve. No abnormalities were found on examination of the abdomen, extremities and neck. ECG – sinus rhythm with ST elevation in I, aVL, V5-V6 derivations.

Echocardiography:
Aortic diameters of 32 mm, 43 mm left atrium, left ventricle during diastole of 57 mm; left ventricular ejection fraction of 47%, interventricular septum thickness of 11 mm and 10-mm posterior wall. Inferolaterodorsal hypokinesia was observed.

Coronary angiography:
Showed a 75% lesion in the anterior descending branch in its middle third and occlusion of the circumflex branch before the posterior ventricular branch. No obstructive lesions in the right coronary artery.

Preoperative Treatment:
10 mg of simvastatin, 50 mg of metoprolol, 100 mg of acetylsalicylic acid, 150mg of clopidogrel, 50 mg of losartan right until surgery day.

Lab testing:
Hemoglobin level of 105 g/l, Hematocrit 26.9%. Leukocytes 7x10⁹/l, Platelets 180 x10⁹/lit, Blood glucose 9 mmol/l, Urea 8,5 mmol/l, Creatinine 75 mmol/l, Total cholesterol 8,1 mmol/l, HDL-C 4 mmol/l, LDL-C 2,8 mmol/l, Triglycerides 1,3 mmol/l. International normalized ratio (INR) was 0.9, and activated partial thromboplastin time (aPTT) was 33 sec., Platelet function was impaired: platelet aggregation induce by ADP – 25 %, induced by Arachidonic acid – 60 %.

Surgery:
Coronary artery bypass graft surgery consisted of performing terminolateral bypass graft from the left internal mammary artery to the left anterior descending artery, as well as saphenous vein bridge to left posterior ventricular artery. CPB duration 130 min. Cardioplegia time was 92 min.

Intraoperative episodes:
One unit of pooled platelets (PPL) together with one unit of red blood cells was transfused at the end of surgery to correct impaired platelet function and anemia. 500 ml of blood loss during surgery.

Hemodynamically patient was stable and transferred to the ICU.
Postoperative treatment:

At the ICU, chest tube drainage for first few postoperative hours was 100 to 150 ml/h. Hypocoagulopathy was suspected. Thromboelastogram revealed impaired clot formation on extrinsic pathway. Fibtem was 14mm, MCF was 35mm, alpha angle was 62°. Insufficient platelet component for clot formation was diagnosed, so that additional dose of pooled platelets with desmopresin 0.15 mg was given.

Chest tube drainage reduced to 25-50ml/h and after an hour clothing tubes were noticed. Patients condition was deteriorating, after 30 min patient became unstable. Shock developed. Blood pressure dropped to 70/42 mmHg. Adrenaline infusion was started with 0.03 μg/kg/min increasingly up to 0.06 μg/kg/min to stabilize hemodynamic. CVP rised from 12 to 23 mmHg. Blood testing showed anemia (Hb 7.2g/l), thrombocytopenia (85 *10^9/lit and slightly prolonged aPTT (52 sec). INR was normal, 1.2 seconds.

Cardiac Tamponade was suspected and was confirmed with transesophageal echocardiography: separation of pericardium ~3-4cm next to right atrium was revealed. Patient was transferred to operation room and re-sternotomy was performed in 4 hours after first admission to the ICU. About 800 ml of blood clots was found compressing the right atrium and ventricule. Tamponade was evacuated, no surgical bleeding source was diagnosed and patient was transferred back to the ICU. His condition started to improve, hemodynamically became stable, no more adrenomimetics were given. Diuresis started. Additional 3 doses of RBC were transfused to correct anemia.

Next 4 days at ICU were complicated with fever up to 38 degrees, respiratory insufficiency. Pneumonia was diagnosed with x-ray: infiltration on the right lung, increased blood markers: CRP up to 254 g/l, leukocytosis 16*10^9/lit.

Next 2 days patient was effectively treated with antibiotics when condition started to improve and 72 hours after surgery he was extubated. When all complications were threated, patients was discharged from the ICU on 9th day after surgery. After another 9 days he was discharged from hospital.

4.DISCUSSION OF THE RESULTS

Increased perioperative period of the patient due to multiple perioperative complications which was reviewed in this study, they are:

In mediastinal bleeding cases, more aggressive management and early re-exploration is one of the most important factors. It can reduce the need for homologous transfusions, reduce the risk of
respiratory and renal insufficiency, and also decrease the rate of wound infection associated with undrained mediastinal hematoma. It may eventually decrease mortality rates.

A very recent study describes an average exploration rate of 6 percent for elective [4.5 percent for coronary artery bypass grafting (CABG), 5.5 percent for single valve surgery, 9.6 percent for combined surgery, and 7.9 percent for the remainder of their cohort of cardiac surgery] and 15 percent for emergency operations.(5)

The adenosine diphosphate receptor antagonists were discontinued 5 days before surgery (clopidogrel, ticagrelor) and prasugrel, respectively, before 7 days. Discontinuation before surgery of P2Y12 inhibitors. Continuation of DAPT until surgery increases the risk of postoperative bleeding, transfusions and bleeding re-exploration, it is recommended to discontinue P2Y12 inhibitors before elective surgery. Clopidogrel to Prevent Recurrent Events in Unstable Angina at the CABG. Five days of clopidogrel discontinuation before surgery did not increase the risk of bleeding. For prasugrel, a 7-day time interval is recommended due to the longer offset time compared to clopidogrel, it has been shown in CABG patients that discontinuation of ticagrelor 3 or 4 days before surgery was not associated with a higher incidence of bleeding disorder.(35),(20)

Patients are exposed to the risks of aspiration, ventilator-associated pneumonia, and ventilator-induced lung injury during heart surgery, intubation, sedation, and mechanical ventilation. In addition, CPB induces an inflammatory system associated with ARDS.(31)

Medical type of bleeding usually occurs after complex or redo surgery and is often associated with coagulation process abnormalities. These patients are usually exposed to higher amounts of vasopressors and have a higher incidence of low cardiac output syndrome (LCOS) due to fluid shifts, a higher hospital stay and a higher mortality rate, indeed. Bleeding reoperation is an unwanted event by the surgeon or intensivist and is accompanied by the morbidity and mortality rates of higher patients, in addition to increased use of resources and excessive economic derangement.(4)

Operating surgeon, total number of distal internal mammary artery grafts, total number of distal radial artery grafts, increased cardiopulmonary bypass time, emergency surgery, tricuspid valve surgery, and extent of decrease in hemoglobin levels during surgery included surgical factors associated with increased chest tube drainage. The surgeon was an independent predictor of the extent of the drainage of the chest tube. Surgical attention offers reduced bleeding, fewer transfusions and improved patient outcomes.(16)

The pericardial sac may gradually stretch to accommodate increasing volume after cardiac surgery. The total intrapericardial volume is relatively fixed over the entire cardiac cycle at any point in time. When the pericardium's ability to stretch is exceeded by rapid or massive fluid accumulation,
any additional fluid causes the pericardial sac pressure to increase. The positive transmural pressure gradient compresses the adjacent heart chamber or chambers when the increasing intrapericardial pressure exceeds the intracardiac pressure. The pericardial pressure in different chambers at different points in the cardiac cycle will exceed the intracardiac pressure. The right chambers are first affected, with the lowest instantaneous pressure. (37)

In the immediate postoperative setting, central venous pressure elevation (CVP) has a low predictive value due to the high rate of low-pressure tamponade, concomitant hypovolemia situations, or loculated tamponade. In addition, in situations of correct ventricular dysfunction, in the presence of tricuspid regurgitation, or ventilatory abnormalities requiring high PEEP, CVP elevation may occur. Postoperative cardiac tamponade clinical presentation includes a wide range of non-specific signs and symptoms such as dyspnea, orthopnea, diminished cardiac sounds, chest pain, tachycardia and hypotension, and even cardiogenic shock. If there is a clinical suspicion of cardiac tamponade, an echocardiographic examination must be carried out without delay by transthoracic or transesophageal echocardiography. Echocardiography is used to show the presence and size of pericardial effusions, to quantify the hemodynamic consequences of any effusions, and even to drive treatment decisions. For patients with hemorrhagic cardiac tamponade and clot evidence, which is the majority of cases, surgical decompression has been reported. (37)

Patients with MB or RBC transfusion have an operating risk nearly three times higher than those without MB or RBC transfusion, while those with preoperative anemia have an operating risk of 35% higher than those without anemia. Ranucci and colleagues provide new information from a large institutional database that includes more than 16,000 consecutive adult patients who have had heart surgery. They confirm that patients with major bleeding, including thromboembolic complications, infections, and surgical re-exploration, are at higher risk of surgical mortality and morbid events. These associations persist even after confounding variables such as preoperative anemia and packed red blood cell transfusions have been adjusted, although these two factors appear to have a multiplier effect when associated with major bleeding. (21)

The surgery performed for this patient is not a preplanned one, so that the medical team can’t stop the ongoing antiplatelet therapies before surgery, this contributes the main source of postoperative bleeding. And because of this excessive bleeding the RBC units are transfused to maintain the patient haemodynamically. But RBC transfusions after cardiac surgery decreases patients immunity functions and thus causes infections which will further increases the ICU stay. During first phase of postoperative period the amount of blood collects in the drain is not a sign of excessive bleeding but after first few hours the chest drain reduced to half of its amount as compared to the first hour of
postoperative period, and the patient condition became worse by dropping the blood pressure down to 70/40mmhg and a rise in CVP. This indicates the development cardiac tamponade and its confirmed by transesophageal echocardiography. And the blood clots removed and corrected by re-exploration surgery. Further complications rise in temperature and all is because of the VAP. It’s a hospital acquired infection because of prolonged mechanical ventilation. Somehow the prolonged time of CPB also a predictive factor of bleeding in this case, due to platelet dysfunction. So in short the preoperative antiplatelet therapy was the root cause of postoperative bleeding in this patient and not because of surgical reasons. It’s a typical type of medical bleeding related to abnormalities in coagulopathy.

Excessive bleeding is defined as drainage of the chest tube greater than 3ml / kg / h in the first three hours, continued bleeding greater than 200ml / h (10) or greater than 200ml / h in the first four hours. Persistent bleeding must be immediately and aggressively treated on the basis of the suspected cause of haemorrhage.(34)

**CONCLUSIONS**

This reviewed work the postoperative bleeding after cardiac surgery and the factors which affects the cause of bleeding both medical and surgical. Identifying the predicting factors which cause the excessive bleeding and how to reduces the post operative bleeding by modifying ,treating and diagnosing those predicting factors. As per nursing care its important to manage a bleeding patient with number of complications in ICU which reduces the length of stay, mortality and comorbidities in the hospital as well as  the heavy economic burdiance too. From this review its shows the surgical reoperation due to excessive bleeding directly influence the patients quality of life overall. Cardiac surgery on CPB also have its own complications rather than the patient condition and it also contributes postoperative bleedings.

Evaluation of bleeding factors by appropriate lab investigations,post operative blood transfusions etc can reduce the excessive bleeding after cardiac surgeries. So the bleeding management results in controlling mortality rates and ICU stay in hospital. The predictors of excessive bleeding after cardiac surgery identified in the literature review were: male gender, higher levels of haemoglobin, lower BMI, diabetes mellitus, impaired left ventricular function, lower pre-bypass thrombin generation, lower pre-operative platelet counts even within the normal range, lower pre-operative platelet aggregation, pre-operative platelet aggregation. Procedure-related: surgeon, CABG with three or more bypasses, use of the internal mammary artery, surgery duration, increased cross-clamp time, increased CPB time, lower intraoperative core body temperature, and haemostatic
disorders caused by CPB. Postoperative: lower levels of postoperative fibrinogen and metabolic acidosis. Awareness of these risk factors is itself a step towards qualifying adult cardiac surgery for pre-, intra-and post-operative nursing care. Key nursing actions includes identifying a massive bleeding with the help of evidence based results and management of bleeding with proper haemodynamic stabilising management. During postoperative period the patient may have multiple system failure or decreased functioning, so in order to correct and maintain the optimal recovery of patient needs proper nursing care and priorities. At ICU, careful monitoring of mediastinal bleeding is essential in the first 30 minutes, in the first 4 hours of each hour, as well as 24 hours and 48 hours from the end of the operation. Evaluation of studies of coagulation and, if necessary, thromboelastography.

PRACTICAL RECOMMENDATIONS

During nursing care of the postoperative CABG patients the nurses must focus on nursing diagnosis related to postoperative CABG procedure. Identifying common CABG postoperative nursing diagnosis guides a proper nursing care which may improves the patient postoperative period as well as the quality of life after surgery. The nursing diagnosis and intervention includes,

- Impaired gas exchange,
- impaired mobility,
- impaired skin integrity,
- Impaired body temperature (hypo/ hyper thermia),
- Impaired cardiac output(decreased C.O),
- Impaired Kidney function,
- Impaired sleeping pattern,
- Impaired mental health,
- Impaired body function related to infection,
- Impaired fluid balance in body,
- Impaired blood glucose level( hyperglycaemia).

And the importance of the practical recommendations for the nurses is,

- Impaired gas exchange

In postoperative period, during the first 24 hours the patient’s respiratory function carried out by the help of mechanical ventilation because of anaesthetic effect and decreased vital functions. During mechanical ventilation (with the help of endo tracheal tube) it’s important to clear the airway by
proper suctioning of endotracheal secretions otherwise it may cause airway block and results in decreased level of tissue oxygenation and harms patient ongoing status.

- Impaired verbal communication (related to mechanical ventilation)

During perioperative time the patient verbal communication was compromised by mechanical ventilation and when the patient achieve his normal neurological conscious level they may uncomfortable due to the tubing’s which inserted to their trachea and this period the nurse and health care team needs to control patient’s condition by proper communication. Verbal impairment also due to induced anaesthesia too but it may disappear normally after 8 hours after surgery.

- Impaired activity (related to pain and surgery)

When the patient is in a conscious stage they can’t move their body as normal as early times because of the pain sensation and the resistance occurred by the presence of drains which attached to their body. The nurse need to assist the patient in their daily routine activities without any hesitation and argument.

- Impaired skin integrity

During perioperative period the nurse needs to more concentrate in patient’s skin which is near to the operating sites for any alterations in normal colour and during any blood component transfusion time it’s important to watch any kind of allergic reactions / rashes on the body. If the skin colour changes it may because of the tissue perfusion also.

- Impaired body temperature (related to hypo/hyper thermia)

During postoperative period most of the patient demands immediate heating to attain the normal body temperature, the nurse need to take care of the patient with extra blankets and by hot air blower if it’s necessary.

Hyperthermia is also common after cardiac surgeries and its normally related to the surgical procedure and the presence of infection in the body, which may result a high body temperature more than 37.5 degree C. The nurse must inform the intensivist and its needs to start medication which decrease the temperature and perform lab test to identify the cause of temperature is because of infection.

- Impaired cardiac function (decreased C.O)

If inadequate blood pumped by the heart to meet the normal metabolic demands of the body is called as decreased cardiac output. Its common after CABG and can be identified by hypotension, altered MAP, altered CVP, altered peripheral perfusion, alteration in skin appearance and colour. So a close and vigilant cardiac monitoring needs to identify the decreased function of heart.

- Impaired kidney function
Its happens because decreased cardiac output, if the blood flow is not sufficient to perform the normal kidney function it may leads to acute kidney failure. The nurse must strictly record the input output chart to find out the any signs of decreased diuresis volume. The nurses always check the creatinine and urea levels to evaluate the normal kidney function and filtration.

- **Acute pain diagnosis** (related to surgical incision)
  The patient have several episodes of pain due to surgical procedure which done and the drains which is attached to his/ her body. Also pain is caused by endotracheal tube insertion and other invasive procedure (Central line, arterial line etc.) and myocardial ischemia. So the patient watch the patient closely and sometimes the tachycardia happens because of pain. Administration of analgesics as per the doctors will reduce the pain and makes the patient comfortable.

- **Impaired sleeping pattern** (related to pain and hospitalization)
  It’s may happen mostly because of hospitalisation and pain. Especially during ICU stay the sounds of cardiac monitor and other machines may alter normal sleeping activity of patient. The nurse can provide a good environment by switch off lights and providing extra pillows for comfort position and providing good oxygenation during patient sleep.

- **Impaired mental health** (related to anxiety)
  A proper preoperative health education by the health care team reduces the patient anxiety directly. If the patient is more anxious then it may shoot the blood pressure high preoperatively. So pre and postoperative health education regarding CABG procedure, follow up and rehabilitation will decrease the patient stress and tension. (17)

- **Risk of Infection**
  Due to multiple wound sites and multiple invasive procedure in addition to the surgical incision like arterial line, central line, chest drainage, and mechanical ventilation may increase the chance to get infection. Proper sterile techniques as per hospital protocols reduce the spreading of infection and proper caring such as oral care( during mechanical ventilation), catheter care to avoid Urinary tract infections, wound dressing to prevent surgical site infections, early extubation as per patients vitals reduce the ventilator associated pneumonia.

- **Impaired fluid balance**
  In postoperative cardiac patients, the fluid volume alteration caused by the surgical incision (fluid loss), infusions (fluid gain), and fluid losses due to catheters and drains. Inorder to maintain optimal fluid balance the nurse/ health care team administer fluids and according to the lab results it’s important to maintain the normal electrolytes balance which directly affects heart and kidney.

- **Impaired blood glucose level**
The altered blood glucose level may affect the healing process of the wound and may cause inflammation which results in wound infections. So the nurses must check the blood glucose level and administer insulin according to the sliding scale as per the intensivist order.

Other practical considerations for nurses includes,

- **Preoperative health education**
  The objective of providing preoperative education to patients undergoing cardiac surgery is to prevent or reduce anxiety and postoperative complications that are associated with morbidity, mortality and prolonged hospital stay as well as hastening postoperative recovery. The complications that may be associated with lack of patients’ preoperative education are pulmonary infection, atelectasis, deep vein thrombosis, wound infections, and split of the sternum. Sternal dehiscence, wound infections and arrhythmia were the most common causes for unplanned 30-day hospital readmissions after cardiac surgery. For example, early mobilisation and muscle training can improve functional outcomes as well as cognitive and respiratory conditions, and reduce the risk of venous stasis and deep vein thrombosis. Interventions such as breathing and coughing exercises before CABG surgery were shown to be effective and were able to lower the risk of pneumonia and atelectasis. Extension of the length of stay (LOS) in the intensive care unit (ICU) has been associated with negative short and long-term postoperative outcomes. Prolonged intubation after cardiac surgery results in significant acute and midterm morbidity as well as longer ICU and hospital stays. Atrial fibrillation (AF) is the most common arrhythmia during the first to fifth postoperative days after cardiac surgery, and is associated with increased mortality and a higher incidence of stroke. There is an association between postoperative AF and anxiety in patients who undergo CABG. (15)

- **Nasogastric tube care**
  During postoperative period is the food/water provided through nasogastric tube, ignorance of precautionary actions before NG administration causes aspiration of fluids or food in to the lungs and cause pulmonary complications. (Check the tube position by accessing the aspiration of fluid from the stomach). Flush the NG tube after and before of every feed.

- **Central line care**
  The nurses check for any leakage or inflammation on the site of central line inserted and if the central line is multi lumen then the stopper must be kept in place to avoid oozing of blood from the body.

- **Care of Patients with A.V fistula**
If the is undergoing haemodialysis for a long term, then the nurse must take care of the A.V fistula by not taking blood pressure from the hand which have fistula.

- Nebulisation and Oxygenation of patient after extubation

The nurses must follow the proper administration of nebulising agents, steam inhalation to recover the upper respiratory tract to its normal action.
PUBLICATIONS

Varughese Anu, Kapturauskas Juozas, Evaluation of perioperative period in adult patients with excessive bleeding after cardiac surgery on cardiopulmonary bypass. In 2019 the Abstract was accepted for oral presentation.
LIST OF LITERATURE SOURCES


36. https://www.mcgill.ca/criticalcare/teaching/protocols/cardiac

Annex 3
by the Council of the Faculty of Nursing of LSMU
2018-09-13 protocol No SLF-9-5

LITHUANIAN UNIVERSITY OF HEALTH SCIENCES
MEDICAL ACADEMY
FACULTY OF NURSING

ANU VARUGHES
(Full name of the post-graduate student, student ID No)

DECLARATION OF THE AUTHOR’S CONTRIBUTION AND ACADEMIC HONESTY
The 19th of 4 2019

Title of the graduate Master’s thesis EVALUATION OF PERIOPERATIVE PERIOD IN ADULT PATIENTS WITH EXCESSIVE BLEEDING AFTER CARDIAC SURGERY ON CPB

I have (please tick the right line with “x” and fill in as appropriate):

☐ independently formed and defined the topic of the graduate thesis, the scope of the research on the basis of personal observations:
   (please specify your previous research in this field, other sources and research that helped formulate the problem, objectives and tasks of the graduate thesis)

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V. ANNEXES

Annex 1
APPROVED
by the Council of the Faculty of Nursing of LSMU
2018-09-13 protocol No SLF-9-5

INDIVIDUAL PLAN OF PREPARATION OF THE GRADUATE MASTER’S THESIS

The study programme: Advance Nursing Practice, Year: 2017-19, Group: 2nd

A post-graduate student: Anu Varughese


A supervisor of the graduate thesis: Dr. Juozas Kupturauskas MD, PhD.

<table>
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<th>Date</th>
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<th>Evaluation by a supervisor of the graduate thesis (accomplished/not accomplished), signature, date</th>
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<td>2018-09</td>
<td>Conclusions; Practical recommendations</td>
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<td>2018-05</td>
<td>Present thesis during scientific conferences or make it publicly available in peer-reviewed journals</td>
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</table>

Post-graduate student: Anu Varughese

Supervisor of the graduate thesis: Dr. Juozas Kupturauskas

Chairman of the Qualification Commission

Anu Varughese

Dr. Juozas Kupturauskas

Chairman

Signature