

Can skin temperature be a clue for predicting excessive postoperative bleeding?

A temperatura da pele pode ser um indicador para hemorragia grave no pós-operatório?

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Abstract

Objective: The purpose of this study was to investigate whether postoperative hypothermia evaluated by skin temperature can be a clue of excessive bleeding requiring re-exploration.

Methods: In this retrospective study, the records of 12 patients who needed re-exploration due to bleeding in the postoperative period were reviewed and the time from the first minute in the intensive care unit until the skin temperature reached 36.5°C was measured. Cardiopulmonary bypass (CPB) durations were noted as were preoperative and postoperative Activated Clotting Times (ACT) and the lowest body temperatures during the operation. A control group was formed of 16 randomly chosen patients who did not need re-exploration with CPB times similar to the study group. All parameters were compared between the two groups using the

SPSS software version 10.0.

Results: The length of time from the first minute in the intensive care unit until skin temperatures reached 36.5°C were significantly longer in the study group ($p=0.0001$). Preoperative and postoperative ACT were not significantly different ($p=0.312$ and $p=0.576$ respectively). The lowest body temperatures were also not significantly different ($p=0.157$).

Conclusions: Our findings show that skin temperature is an important indicator of excessive bleeding with a need for re-exploration. Hypothermia may be a reason for this or may be a result of the bleeding.

Descriptors: Induced hypothermia, adverse effects. Blood loss, surgical. Preoperative care, methods. Cardiopulmonary bypass.

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Resumo

Objetivo: O objetivo deste estudo é avaliar a hipotermia residual pós-operatória e sua duração, assim como discutir se a hipotermia tardia pode ser um marcador de sangramento excessivo.

Método: Neste estudo retrospectivo, os registros de 12 pacientes que tiveram re-intervenção por causa de sangramento no período pós-operatório foram revisados e suas durações, que foram desde o primeiro minuto em Unidade de Terapia Intensiva até a pele alcançar uma temperatura de 36,5 graus Celsius. O tempo de duração da Circulação Extracorpórea (CEC) foi anotado. Também foi registrado o tempo ativado de coagulação (TCA). A temperatura mais baixa do corpo durante a operação foi medida. Um grupo de controle foi criado (n=16) aleatoriamente, formado por pacientes que não precisariam de re-intervenção e no qual a duração da CEC foi similar à do grupo de estudo. Todos os parâmetros

foram comparados entre dois grupos com a versão do software SSPSSs.

Resultados: As durações desde o primeiro minuto no tratamento intensivo até a temperatura da pele alcançar 36,5 graus Celsius foram significativamente mais longas no grupo de estudo (p=0,0001). TAC pré-operatório e pós-operatório não foram diferentes (p=0,312 e p=0,576 respectivamente). A menor temperatura do corpo não foi diferente (p=0,157).

Conclusões: Nossos achados indicam que a temperatura da pele é importante no sangramento excessivo que leva à re-intervenção. Hipotermia pode ser o motivo ou a causa do sangramento.

Descritores: Perda sangüínea cirúrgica. Hipotermia induzida, efeitos adversos. Cuidados pré-operatórios, métodos. Ponte cardiopulmonar.

INTRODUCTION

Postoperative bleeding is a serious problem for all patients undergoing heart surgery. Bleeding is increased in patients exposed to cardiopulmonary bypasses [1]. There are many causes for bleeding in patients who are exposed to cardiopulmonary bypasses, which include coagulation factor loss, hemodilution, platelet loss and platelet function deficiency, hypothermia, immune response of host to the effects of heparin and protamine and inadequate surgical homeostasis [2]. Because of inadequate re-warming of body temperature, patients who undergo heart surgery associated with hypothermia are often still hypothermic after admission to the intensive care unit [3]. Some patients require re-exploration because of bleeding in the early postoperative period. Frequently the surgical source of bleeding can not be identified [1-4]. These re-explored patients may only be effectively offered control of bleeding [4]. The purpose of this study is to evaluate residual hypothermia and its duration and whether delayed hypothermia might be associated to excessive bleeding.

METHOD

Patients

This is a retrospective review of 721 patients undergoing elective heart surgery involving coronary artery bypass, valve surgery and combined procedures. Records of patients treated from March 1995 to March 2005 in our clinic were reviewed with the approval of the Research Ethics

Commission of Cumhuriyet University. A total of 662 patients underwent on-pump procedures. Thirty-one of 662 required re-exploration because of extensive postoperative blood loss. We excluded 19 of 31 patients due to inadequate surgical hemostasis. So, 12 patients with no apparent surgical source for bleeding were included in the study. A control group of 16 patients was created from randomly chosen patients who had undergone cardiopulmonary bypass without requiring re-exploration with similar cardiopulmonary bypass duration times, postoperative prothrombin time (PT), activated partial thromboplastin time (PTT), international normalized ratio (INR), hemoglobin and platelet values when compared to the Study Group. The ages of patients in the Study Group ranged from 48 to 60 years and ages in the Control Group varied from 29 to 68 years.

Patient conditions

All patients' hematological parameters including prothrombin time (PT), activated partial thromboplastin time (PTT), international normalized ratio (INR), platelet count, bleeding time were measured in the preoperative period and were considered to be within the normal range. Acetylsalicylic acid (aspirin) was routinely discontinued seven days prior to the procedure and if patients were receiving warfarin it was ceased seven days prior to the operation. All patients were taking 0.01 mL/kg low-molecular weight heparin until the day of surgery. All the PT, PTT, INR values were normal in the postoperative hours for all patients. Hemoglobin and platelet counts were similar between groups.

Preparation for operation, operation, Intensive Care Unit

Anesthetic preparation of patients was by using a narcotic based anesthetic prior to establishing the cardiopulmonary bypass. All patients were monitored with an intra-arterial line and central venous catheter. A loading dose of heparin was administered intravenously at 300 units per kilogram. The Activated Clotting Time (ACT) was maintained greater than 400 seconds during the cardiopulmonary bypass with additional heparin when needed. A roller pump with membrane oxygenators was used in all cases. The cardiopulmonary bypass circuit was primed with 1500 mL of Ringer Lactate mixed with blood. A standard median sternotomy was performed in all patients. Myocardial preservation was attained by intermittent Plegisol® (Abbot) and cold blood cardioplegia. All patients were exposed to moderate hemodilution (hematocrit 19-24%) and hypothermia (28-32°C). They were re-warmed to temperatures above 35°C. Protamine HCl ® was used to normalize the ACT (one international unit per 42 units of heparin). If the ACT remained elevated following the initial dose of protamine, an additional dose of 30 mg was given. Patients were taken from the operation room to intensive care unit under total monitoring. Patients were covered with a blanket with hot air circulation provided using a hot air pump (Warmtouch®). From the first minute in the intensive care unit, all vital parameters including central venous pressure, pulse, arterial pressure and skin temperature were recorded. Electrocardiography (ECG) and a chest x-ray were performed in the first hour. All parameters were recorded again at 30-minute intervals except the ECG and chest x-ray. Skin temperatures were measured using a glass thermometer with mercury in the axillary region. The times from entering the intensive care unit until skin temperatures reached 36.5°C were included in patients records. Skin temperatures of the Study Group were measured at re-exploration and were recorded together with the preoperative ACT levels measured using Actalyke tubes and an incubator. Cardiopulmonary bypass times were noted in patients' records as were the lowest temperatures during operations.

Re-exploration criteria

The decision for re-exploration was made based on both the rate of postoperative bleeding and the accumulated volume. Patients were explored for bleeding when the rate was 200 mL/hour for more than 4 hours or for a sudden increase in bleeding after the first two hours. Additionally, anuria without obvious cause and mediastinal enlargement seen in chest x-rays were causes of concern for cardiac tamponade due to bleeding and accepted as reasons for re-exploration.

Statistical analysis

Data analyses were performed using SPSS software

(ver.10.0) with the Mann-Whitney U test. “p<0.05” was accepted as significant.

RESULTS

Skin temperatures of all patients were below 35°C in the first minutes in the intensive care unit. CPB duration was not significant between groups (p=0.417). The times from the first minute until skin temperature reached 36.5°C were significantly longer in the Study Group (z=-4.618, p=0001). The lowest temperatures in the operation were not statistically significant comparing the two groups (p=0.157). Differences in postoperative and preoperative ACT levels between Control and Study Groups were also non-significant (Table 1).

Table 1. Comparison of parameters between the study and control groups

Parameters	Study group	Control group	p
	Mean(Std. Dev)	Mean(Std. Dev)	
Normalising duration of Skin temperatures (minute)	730 (323.44)	217 (136.42)	0.0001
CPB duration (minute)	162 (69.42)	153 (67.13)	0.417
The lowest temperatures in the operations (C degree)	28.75 (1.65)	29.37 (1.29)	0.157
Preoperative ACT (second)	107.08 (17.36)	118.32 (37.09)	0.312
Postoperative ACT (second)	121.83 (18.09)	118.25 (20.28)	0.576

Std. Dev. = Standard Deviation

DISCUSSION

Postoperative bleeding is a serious problem in patients who undergo on-pump heart surgery. This bleeding is

strange as even re-exploration frequently can not find its source or stop it [4].

In our ten years of experience, delayed hypothermia called our attention in patients who required re-exploration because of bleeding where its source could not be identified. A study performed by Lahtinen et al. encouraged us to do this study as the authors reported a correlation between volume of postoperative bleeding and low pulmonary artery temperatures [5]. Nathan et al. reported that the depth of hypothermia is an important parameter for postoperative bleeding [6]. Because of this study, we investigated the lowest body temperatures of patients in the perioperative period as noted in our records and compared them with postoperative bleeding.

We analyzed our results and found that low skin temperature duration is significantly longer in the Study Group compared to the Control Group.

Low skin temperatures may be a reason for bleeding in our patients. We can not say this definitively as many reasons, such as low cardiac output, can cause coagulation deficits [5]. We did not measure the cardiac output as this is not routine in our service and thus was not recorded on patients' records and this is a retrospective study.

CONCLUSION

There is a certain truth: Skin temperatures of patients who underwent re-exploration in this study were low in the postoperative period. Is this a reason or a result? Could re-exploration be prevented by adequate re-warming? Can this delayed hypothermia be a predictive clue of excessive bleeding? We will study and see. But we wanted to report this important finding first.

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