

Case Report

Perfusing the Jehovah's Witness Patient with Heparin-Induced Thrombocytopenia

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Keywords: heparin-induced thrombocytopenia, low-molecular weight heparin, Jehovah's Witness, cardiopulmonary bypass

ABSTRACT

Heparin-induced thrombocytopenia (HIT) is an uncommon, yet dangerous side-effect of heparin therapy. The problems associated with the HIT patient while undergoing cardiopulmonary bypass increase dramatically when the patient is also of Jehovah's Witness faith. This case report depicts the techniques utilized and the decisions made over the course of a simple surgical procedure for an extremely high-risk patient.

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INTRODUCTION

Heparin-induced thrombocytopenia (HIT) is an extremely rare, yet highly dangerous side effect of heparin therapy. For those patients undergoing major, high-risk surgery involving cardiopulmonary bypass (CPB), the risks increase dramatically. Although thrombocytopenia can be effectively managed post-operatively, every effort must be made to maximize patient outcome. This is particularly true regarding patients of Jehovah's Witness faith.

Traditionally, non-fractionated heparin of porcine or bovine origin has been the anti-coagulant of choice for CPB. However, little research and clinical data has been produced for those clinical scenarios where non-fractionated heparin is not a viable option.

CASE DESCRIPTION

A 61 year old female of Jehovah's Witness faith presented with severe multi-vessel coronary artery disease (CAD), insulin-dependent diabetes mellitus (IDDM), a history significant for seizure activity, acute anterior myocardial infarction, and diabetic ketoacidosis with subsequent coma for which she required intubation and respiratory support.

The patient was admitted to the hospital while anti-coagulation options were reviewed and analyzed. After an extensive review of literature and research, the decision was made to proceed with coronary artery bypass grafting (CABG) using low-molecular weight (LMW) heparin. Laboratory testing was performed with the patient reacting only mildly to the LMW heparin. Additionally, the decision for concurrent Prostacyclin therapy (50ng/kg/min) was made to minimize the effects and reactivity of the LMW heparin on platelets (1). The patient's pre-operative blood work was essentially normal with the exception of an elevated glucose value of 312 mg%. Pre-operative lab values were Hgb 13.1g/dL, Hct 38.8%, Na⁺ 138mEq/L, K⁺ 4.1mEq/L, Plt 140, BUN 6.0mg/dL, CREAT 0.7mg/dL, PT 13.8 sec, PTT 30.0 sec, BT 3.0 min. The day of surgery the patient's weight was 60kg yielding a body surface area (BSA) of 1.62 m².

Upon cardiac catheterization, the patient was found to have severe triple-vessel CAD with a totally occluded right coronary artery and sub-total occlusion of the left anterior descending, ramus, and obtuse marginal arteries. The patient's ejection fraction was calculated to be 45%. During hospitalization, it was discovered that the patient had developed a heparin-induced thrombocytopenia. Heparin was then discontinued and the patient's platelet levels returned to normal.

CASE MANAGEMENT

The patient arrived in the operating room in stable condition, placed under general anesthesia, prepared and draped for surgery in the normal sterile fashion. A median sternotomy was performed while saphenous vein was harvested and prepared for grafting. The patient was then systemically anti-coagulated with 60mg Lovenox^a (enoxaparin sodium), which was administered via the central line into the right atrium (RA). A blood sample was taken and measured for activated clotting time (ACT)^b. With a baseline ACT measurement of 117 seconds, a post-anti-coagulation ACT of >800 seconds was obtained prior to cannulation. An 18F aortic root cannula was placed in the proximal aorta and a 42F, two-stage venous cannula was placed in the RA and secured with purse-string sutures.

In order to minimize hemodilution, the normally-used extra-corporeal circuit (ECC) was customized. Changes included switching to a venous reservoir and oxygenator with lower priming volumes, reducing line lengths, and eliminating the arterial line filter (ALF)^c. Elimination of the ALF served two purposes: to minimize hemodilution and to avoid unnecessary heparin exposure, as the ALF's at our institution are heparin coated. The ECC had one additional modification to accommodate an anticipated poor venous return: a centrifugal pump head^d. This pump was placed on a 3/8 "venous line as a precautionary measure to augment venous return. Due to the low-molecular weight of Lovenox (^a4500 Daltons), the decision was made by the perfusion team to exclude any hemofiltration device from the ECC. Additionally, the decision was made to avoid heparin-bonded circuits, as variable amounts of washout has been reported. The modified CPB circuit resulted in a priming volume of approximately 1650mls. The prime consisted of 700ml Lactated Ringer's (LR) solution, 700ml Hespan (Hetastarch 6%), 50mEq sodium bicarbonate, 50g mannitol, 1000mg cefazolin, 40mg Lasix, and 60mg Lovenox.

After an ACT >800 sec was obtained, the patient was placed on CPB and maintained at normothermic temperatures. The aorta was cross-clamped and 600ml of 1:1 blood:crystalloid cardioplegia was delivered at 4°C to the aortic root via a 10G needle. Cardioplegic pressures were maintained at 80-100mm Hg. A myocardial temperature of 9°C was obtained before discontinuing cardioplegia and venting the aorta.

The first arterial blood gas (ABG) sample and ACT was drawn from ECC approximately 10 minutes after initiation of bypass. The resultant values were: pH 7.51, pCO₂ 28mmHg, pO₂ 461mmHg, Hgb 8.2g/dL, SAT 97%, base excess (BE) 0.8mEq/L, HCO₃ 23mEq/L, K⁺ 3.9mEq/L, GLU 220mg%, and an ACT measurement of 180sec. Adjustments to correct ABG values were made and anti-coagulation status assessed. While reviewing anti-coagulation options with institutional pharmacist, the surgeon was notified and a second ACT was measured. The resulting ACT value was 149seconds. An additional loading dose of 60mg of Lovenox was given via the ECC. The circuit was visually examined for clots and a third ACT was then taken

a Rhine-Poulenc Rorer Pharmaceuticals, Inc., Colleyville, PA 19426
 b International Technidyne Corp., Edison, NJ 08820
 c Medtronic Cardiopulmonary, Inc., Anaheim, CA 92807
 d Sarns 3M Healthcare, Ann Arbor, MI 48103

and measured to be 144 seconds. Visual signs of clotting were seen in the venous reservoir and an additional 90mg Lovenox was administered via the ECC. The surgeon was again notified and prompted to terminate CPB as soon as possible. After a fourth intra-operative ACT measurement of 204 seconds, a final dose of 90mg of Lovenox was given. A second ABG and additional ACT were taken after 32 minutes on bypass. ABG results were all within normal parameters and a peak ACT value of 242 seconds was achieved.

After 30 minutes, the aortic cross clamp was removed and 100mg Lidocaine and 1g calcium chloride were given via the ECC. The heart immediately achieved normal sinus rhythm and CPB was terminated. A small dose of Protamine was given, a total amount of 100mg, bringing the ACT down to an acceptable value of 130 seconds. Venous and arterial cannulae were removed with the ECC contents aspirated into the cell-washing autotransfusion device for rapid transfusion back to the patient^e. Upon decannulation, the entire ECC was emptied out and visually inspected for clots distal to the venous reservoir. There were no signs of clotting within the arterio-venous loop, indicating that existing clots were confined to the venous cardiotomy filter.

The patient received a total of three vein grafts, with every anastomoses being completed utilizing a single-clamp technique. The surgical team was able to keep the total CPB period to 33 minutes. The patient was hemodynamically stable with a baseline electrocardiogram (ECG), no ST segment elevations, cardiac index of approximately 2.4 l/min/m² and systolic blood pressure ranging from 80 - 100mmHg. The patient produced a total of 65cc of urine while on CPB and continued to produce copious amounts of urine post-operatively. The patient was then transferred to the cardiac intensive care unit (CICU). On the first post-operative day, neurological examination showed the patient to be respondent and neurologically intact. Unfortunately, by the second post-operative day, the patient's hemoglobin level had fallen to 3.9g/dL. The patient maintained her religious convictions and continued to refuse blood products and consequently expired on the second post-operative day.

DISCUSSION

Heparin-induced thrombocytopenia can be a significant obstacle for the cardiac surgical team, particularly from a perfusion standpoint. In this case, the fact that the patient was a Jehovah's Witness further complicated the care-management plan. Spratt and colleagues cite the reported incidence of HIT varies from 1% to as high as 28% (2). It has been well established in the medical community that individuals of Jehovah's Witness faith firmly adhere to their religious convictions to refuse the use of blood and blood products. However, this should neither deter the Jehovah's Witness patient from undergoing

major vascular surgery requiring CPB, nor should it discourage the medical community from providing treatment plans for such individuals.

Prior to any major surgical procedure, all viable options must be taken into consideration. First and foremost in this decision-making process is to establish which method of anti-coagulation will best suit the needs of the patient. At the present time, possible options include: to continue using the traditional form of anti-coagulation (i.e. unfractionated heparin of bovine or porcine origin) or to continue with non-traditional anti-coagulation regimens (i.e. Hirudin, Ancrod, or Low-Molecular Weight Heparin alternatives).

There is only a handful of clinical data available regarding these non-traditional regimens. Hirudin, the most potent known thrombin-inhibitor, is derived from leeches (3). The primary advantage of Hirudin is that it is a direct thrombin inhibitor. That is, it does not require anti-thrombin III as a cofactor. Ancrod is a defibrinogenating agent which is derived from snake venom, but little data is currently available to prove Ancrod useful or advantageous as an anti-coagulant for CPB (4). Unfortunately, neither Ancrod nor Hirudin are currently available in the United States. Low Molecular Weight or fractionated heparin is classified as an anti-thrombotic agent and has become increasingly popular among clinicians in cases where traditional unfractionated heparin is not an option.

Once the issue of anti-coagulation has been resolved, the perfusionist is faced with the challenge of customizing a circuit to the needs of his or her patient. Such considerations may include the use of heparin-bonded circuits and components, ultrafiltration devices, auto-transfusion and plasma sequestration, pre-operative and/or intra-operative plasmapheresis, patient temperature etc ... In cases where LMW heparin is to be used, the perfusionist should realize that due to the molecular size of the LMW heparin (^a 4500 Daltons), there is a high probability of the LMW heparin being removed from the perfusate of many commercially available ultrafiltration devices. It is also recommended that the perfusion team select an appropriate device for measuring the degree of intra-operative anti-coagulation.

Although rapid clamp and perfusion times are preferred for virtually all cardiac cases, it is highly recommended that both be kept to an absolute minimum when perfusing those patients with heparin-induced thrombocytopenia. It is further recommended that no patient be rushed into a surgical situation without all options being thoroughly researched and evaluated.

In retrospect, certain decisions would have been made differently. In particular, the decision to use LMW heparin was obviously not the optimal choice. Additionally, the decision to utilize the ACT to monitor anti-coagulation was made prematurely. The ACT is not suitable for monitoring coagulation in the presence of LMW heparin. Although Ancrod and Hirudin were not viable options in this particular case, there were other alternatives available. The patient could have been referred to another center where non-traditional anti-coagulation techniques have been successfully utilized. Or, if at all possible, the deci-

^e Cell Saver 5, Haemonetics® Corporation, Braintree, MD

sion could have been made to avoid CPB altogether and treat the patient medically or with minimally-invasive, yet aggressive, non-surgical techniques. Overall, our experience with LMW heparin has proven to be completely unsuccessful.

With regard to the initial post-anti-coagulation ACT value of >1500 seconds, we believe that it can only be attributed to faulty sampling. Although it should be noted that similar situations have been experienced by other independent clinicians and investigators (7,8). Until additional clinical research data is collected and reviewed, it is critical that all HIT patients, especially those HIT patients of Jehovah's Witness faith, be evaluated and deemed to be good surgical candidates by both the surgical and perfusion teams.

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