A Novel Chest Packing Technique for Intractable Bleeding After Open Heart Surgical Procedures

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Intractable bleeding after cardiac surgical procedures is a life-threatening complication. In most cases, the main bleeding site is present in the retrosternal space, not the pericardial space. Packing the chest may be a useful technique for achieving hemostasis. Herein, we describe a novel and effective procedure for the treatment of intractable bleeding in the retrosternal space using a sheet of oxidized regenerated cellulose and sponges after cardiac surgical procedures.

Intraoperative or postoperative bleeding is a serious complication of cardiac surgical procedures and is a likely result of coagulation derangements [1, 2]. Preoperative thrombolytic therapy causes a profound hemorrhagic diathesis. The coagulopathies caused by cardiopulmonary bypass, such as fibrinolysis caused by blood contact with components of the bypass circuit, platelet dysfunction and heparin use, hemodilution, and various degrees of hypothermia, often result in bleeding. In most cases, hemorrhaging can be controlled with the correction of coagulation defects by the use of blood products, proper surgical techniques, or both. However, a few patients will continue to bleed. Delayed sternal closure with chest packing has been used for uncontrolled bleeding [3, 4]. Bleeding from coagulopathy may occur in all opened spaces. General ooze usually occurs from the dissected or sutured areas and less frequently occurs from intact areas such as the pericardium and epicardium that have not been manipulated. Uncontrolled bleeding even after proper hemostatic techniques typically comes from the retrosternal space rather than the intrapericardial cavity [3, 5]. Herein, we demonstrate a very useful packing technique for bleeding from the retrosternal space using a patch of oxidized regenerated cellulose (Nu-Knit; Ethicon, Johnson & Johnson, Somerville, NJ) and sponges.

Technique

A 54-year-old man was admitted for the treatment of severe heart failure caused by acute eosinophilic myocarditis. Percutaneous cardiopulmonary support (PCPS) through the femoral artery and vein with continuous hemodialysis filtration was commenced, and a large dose of steroid was administered. The patient received PCPS for 14 days. The left ventricular assist system (LVAS) was inserted because of bleeding from the arterial cannulation site for PCPS and to establish better circulatory control. With the patient under general anesthesia, through a median sternotomy, the LVAS was inserted through the left ventricular apex with an L-shaped venous cannula, and an 8-mm Dacron graft was placed on the ascending aorta. The PCPS was removed, and the chest was closed in the usual manner. However, the chest was reopened soon after the first closure because of substantial bleeding through the chest tubes. The chest was then closed again after hemostasis was achieved. On the next day, the patient experienced cardiac tamponade, with difficulty continuing the LVAS. The chest was reopened again, and many coagula were removed, particularly from the retrosternal space. Hemostasis was achieved, but too much oozing was observed. The decision was made to pack the chest to maintain hemostasis. Because of the major oozing observed, the retrosternal space was packed with sponges and covered with Nu-Knit (Figs 1A, 2A). Several thick silk sutures were placed on the cut edges of the pericardium, and these sutures were brought up over the sternum when the sternum was closed with wires (Figs 1A, 2B). These silk sutures were tied over the sternal wires after the wires were closed together, and the retrosternal space was compressed and packed with Nu-Knit and sponges (Figs 1B, 2C). After this procedure, the amount of blood draining through the chest tubes was reduced, and the patient had stable hemodynamics for several days. Unfortunately, on the third day after the second operation, a massive brain infarction occurred, and the patient died on the sixth day after the second operation. The autopsy confirmed no major bleeding signs in the retrosternal space or pericardial space, and also confirmed active eosinophilic myocarditis.

Comment

Bleeding resulting from an alteration in the hemostatic mechanism after cardiopulmonary bypass is one of the
major complications of cardiac surgical procedures, with an increased risk of morbidity and mortality [1, 3]. Technical problems, increased heparin activity [1], hemodilution, hypothermia, increased fibrinolytic activity, abnormal platelet function, and bleeding diathesis have been associated with increased blood loss [6, 7]. Closure of the sternum in the event of continued bleeding is likely to cause life-threatening cardiac tamponade. Packing the mediastinum and delayed sternal closure have been used to solve this serious problem [3]. Packing the pericardial cavity and mediastinum with swabs around and over the heart is a useful adjunct to control hemorrhage if patients experience coagulopathy during an operation when general oozing is the major cause of bleeding [3].

General oozing is more often observed in the peristernal space rather than the pericardial cavity [3, 5], because general oozing usually occurs from dissected or sutured areas and less frequently occurs from intact areas such the pericardium and epicardium that have not been manipulated [3, 5]. Packing with sponges can effectively control oozing; however, it sometimes also compresses the heart, which may lead to low output syndrome. We packed the retrosternal space with sponges and compressed the space by lifting up the tip of the pericardium, thus not only avoiding compression to the heart but also compressing the oozing in the retrosternal space. Moreover, we also covered the sponges with Nu-Knit, the patched form of oxidized regenerated cellulose. Thus, the oozing soft tissue was directly compressed by the Nu-Knit, which had a strong hemostatic effect. This packing technique is effective for low-pressure bleeding (general oozing) from the retrosternal space. Before this technique is begun, high-pressure bleeding such as bleeding from the intercostals or from an internal mammary artery must be stopped by use of normative surgical techniques. Otherwise, bleeding into the retrosternal space may create enough pressure to strip the pericardial pleura off the chest wall, thereby causing a large extrapleural hematoma or, if the pleura resists high pressure, to result in cardiac tamponade.

In conclusion, intractable bleeding originating from the retrosternal space can be effectively controlled by use of a delayed sternal closure technique in conjunction with packing the retrosternal space with Nu-Knit and sponges and compressing this space by lifting up the tip of the pericardium. This technique not only compresses the oozing from the retrosternal space to achieve hemostasis but also avoids compression of the heart.

**Fig 1. Schematic image of technique.** (A) Several thick silk sutures were placed on the cut edges of the pericardium. The retrosternal space was packed with lumps of sponges and covered with Nu-Knit. (B) The silk sutures were brought up over the sternum when the sternum was closed with wires. These silk sutures were then tied over the sternal wires after the wires were closed together. The retrosternal space was compressed and packed with Nu-Knit and sponges.

**Fig 2. Intraoperative view.** (A) Several thick silk sutures were placed on the cut edges of the pericardium. The retrosternal space was packed with sponges and covered with Nu-Knit. (B) The silk sutures were brought up over the sternal wires (C) and tied over the sternal wires after the wires were closed together. The retrosternal space was compressed and packed with Nu-Knit and sponges.
References


