

# Effective method to control catastrophic hemorrhage during redo sternotomy

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Key words:  
Complications; Surgery.

**Redo sternotomy is a challenging surgical procedure performed with increasing frequency; catastrophic hemorrhage is a rare but highly lethal complication. We report our experience in treating this complication in 3 cases of 307 reoperations and propose a simple method to control catastrophic hemorrhage during sternal reentry.**

(Ital Heart J 2005; 6 (12): 984-986)

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Received April 29, 2005;  
revision received May 23,  
2005; accepted May 24,  
2005.

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## Introduction

The risk of catastrophic hemorrhage defined by Dobell and Jain<sup>1</sup> as "opening into the blood stream during the act of performing the sternotomy" is 0.5-1% of redo operation. This dreadful complication carries a 19-37% mortality rate<sup>1,2</sup>. High-risk categories predicting injury during sternotomy are: open internal mammary artery, right ventricular or right atrial enlargement, ascending aorta aneurysm, more than one reoperation, multivalvular disease, history of mediastinitis, and presence of conduit<sup>2</sup>. The most commonly involved structures are the right ventricle, vein and internal thoracic artery grafts, the

innominate vein, the right atrium and ascending aorta<sup>1-3</sup>. We propose a method that allows to control catastrophic hemorrhage and to repair cardiac chamber laceration during redo sternotomy.

## Description of cases

**Technique.** When a cardiac chamber is entered during redo sternotomy, a Foley (Rush, Kernen, Germany) is inserted into the laceration, the balloon is filled with saline and a gentle traction is applied to the catheter to control the bleeding (Fig. 1); an endarterectomy spatula flats the Foley balloon to protect it while passing the needle



**Figure 1.** A Foley catheter was introduced into the laceration of the right ventricle and with a gentle traction the hemorrhage could be perfectly controlled.

on the border of the laceration (Fig. 2A). When enough stitches are placed around the tear, the sutures are tied while the balloon is deflated and the catheter is pulled back (Fig. 2B). When the laceration cannot be repaired immediately, the balloon is left in place to stop or limit the bleeding until hypothermic cardiopulmonary bypass is quickly instituted. Once the core cooling is obtained, the flow is reduced and sternal division can proceed with an empty heart.

**Case 1.** A 67-year-old woman underwent a second reoperation for mitral paraprosthetic leak and severe tricuspid regurgitation. The femoral vessels were exposed for cardiopulmonary bypass. Because of pulmonary hypertension, the right atrium was very enlarged and it was entered as soon as the sternum was split. Massive bleeding was controlled with the described technique. Dissection could be carried out around the laceration which was repaired with three pledgeted sutures.

**Case 2.** A 77-year-old man previously operated of mitral repair underwent reoperation for mediastinitis 40 days after the operation. Due to a thick pericardial inflammatory adhesion the right ventricle was lacerated during dissection. Hemorrhage was promptly stopped and a 1.8 cm tear was repaired as previously described.

**Case 3.** A 75-year-old man previously operated of aortic valve replacement and subsequently of classic Bentall operation, developed pseudoaneurysm from the distal anastomosis. During the initial dissection the pseudoaneurysmal sac was entered and a massive hemorrhage obscuring the operating field could not be controlled by manual compression. A Foley catheter was introduced into the tear and the balloon filled with saline. The bleeding was not fully stopped but it was significantly reduced allowing institution of cardiopulmonary bypass and hypothermic circulatory arrest through the femoral vessels.

All these patients survived the operation and were discharged from the hospital.

## Discussion

Life-threatening hemorrhage may occur during redo operation and several methods have been proposed to reduce the risk of this catastrophic complication<sup>3-8</sup>. To prevent catastrophic hemorrhage, at the first operation, we close the pericardium whenever possible and if the left mammary artery is utilized, we place it away from the midline by widely opening the left pleural cavity. In high-risk patients we expose and cannulate the femoral or right axillary artery before opening the sternum. Cardiopulmonary bypass can be established before re-sternotomy to decompress the heart and reduce the risk of cardiac injury. The sternum is retracted upward and divided with the manual saw. Dobell and Jain<sup>1</sup> gave firm advice on the management of hemorrhage when it occurs. They outlined that the natural response to unexpected hemorrhage, to seek adequate exposure in order to achieve hemostasis, is not appropriate in case of sternotomy. In fact the necessary exposure to control bleeding requires rapid division of the remaining sternum which, with all likelihood, will result in bleeding because the opening into the bloodstream will be enlarged. In our experience the proposed technique appear to be very effective in controlling hemorrhage. In the first case reported, while control of bleeding from the atrial wall was impossible by finger compression, using the Foley catheter we obtained immediate and perfect hemostasis. In this case as in the second one the lacerations were repaired without stress prior to completing sternal division. In the third case where the pseudoaneurysm of the ascending aorta was entered, high blood pressure together with limited access between the sternal edges made it impossible to compress the thin wall of the pseudoaneurysm and all measures to stop the massive bleeding were unsuccessful. Only the introduction of the Foley into the pseudoaneurysmal sac significantly reduced the hemorrhage allowing institution of cardiopulmonary bypass and the procedure to go on. We believe that the proposed technique in case of catastrophic hemorrhage during redo sternotomy may give a little contribution to deal with this dreadful situation.



**Figure 2.** a: an endarterectomy spatula flats the balloon of the Foley catheter to protect it while passing the needle on the border of the laceration. b: the stitched border of the laceration is shown before the sutures are tied.

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