Work in progress report - Cardiopulmonary bypass

Internal snaring of the caval veins by Foley catheters in case of reoperation via right thoracotomy

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Abstract

Use of the Foley catheter has been described in cardiac surgery over a wide range of applications. In recent years, the interest in minimally-invasive surgery has increased, providing several advantages in terms of mortality and morbidity. Unfortunately, challenging situations, such as re-do surgery may be encountered, and innovative strategies to reduce the invasiveness of the surgical approach need to be developed. External snaring of the caval veins in re-do patients is hazardous when a minimally-invasive approach is used because the tissues are usually fragile and sudden bleeding can be difficult to control. We propose a simple strategy using Foley catheters to provide ‘internal snaring’ of both caval veins, avoiding surgical dissection of the adhesions around the vessels. Three re-do patients were operated on for combined mitral/tricuspid surgery using internal snaring: the occlusion of the veins was satisfactory in all cases, with no complications reported so far. Even though the ‘trick’ described is not spectacular, it might be very helpful to be prepared to use this technique either on a routine basis or in special situations when the risk of injury to the atrial or caval structures appears to be increased.

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1. Introduction

Several situations have been described in cardiac surgery [1–3] when standard vascular clamps are inappropriate either for occlusion or for control of bleeding. The Foley catheter might be useful in selected cases to act as an endovascular clamp, as reported in the literature [1–3]. The range of applications of the Foley catheter is quite wide, and it might be used as follows:

- to prevent air embolism during mitral valve surgery when it may be used to vent the air bubbles;
- to control bleeding in cases of cardiac perforations during re-entry in re-do surgery;
- for endovascular occlusion of the aorta through the left ventricular apex in cases of porcelain vessel [1–3];
- to drain the caval vein and to control bleeding in cases of sudden injury.

Other authors have reported the use of Foley catheters for infusion of cardioplegia into the coronary sinus [4], for perfusion of the body during deep hypothermic arrest in aortic arch surgery [5] and for administration of cardioplegia and suture control during surgery on the ascending aorta [6]. We describe here the use of a Foley catheter for ‘internal snaring’ of the superior (SVC) and inferior (IVC) vena cava, in lieu of surgical dissection around the vessels, during a minimally-invasive approach in re-do patients in whom tricuspid surgery was planned.

2. Methods

After selective ventilation via the right lung and a small thoracotomy (in the fourth intercostal space) under trans-esophageal echocardiographic guidance, the right jugular vein and right femoral vein were cannulated to drain the SVC and IVC. The tips of the cannulae were delivered to about 5 cm away from the atroicaval junctions. The right femoral artery was used for arterial cannulation and cardio-pulmonary bypass (CPB), and vacuum-assisted venous drainage (~50 mmHg) was established.

An occluding balloon catheter (Foley) was positioned in the SVC and IVC via the incision in the right atrium. The right atrium was opened through a standard longitudinal incision, and blood suction was achieved by the pump aspirator and the vacuum-assisted CPB. The Foley catheter (12–16 Fr) was delivered towards the SVC about 2–3 cm away from the tip of the cannula, avoiding any worsening of drainage. The infusion of saline solution (about 10 ml) into the balloon of the Foley catheter positioned in the SVC (until the lumen was completely occluded) reduced the amount of blood passing into the right atrium, and the second catheter was then delivered toward the IVC (Fig. 1).

When occlusion had been achieved and the atrium was almost empty (in the case of a fibrillating heart, the amount
of blood present depends on venous blood drainage), the proximal portion of the catheters was moved out of surgical vision (Fig. 2). After the tricuspid surgery, the right atrium was sutured using a continuous Prolene suture; before completion, the balloon was deflated and the catheters were removed from the caval veins.

3. Discussion

Incision of the right atrium for tricuspid surgery in re-do patients during minimally-invasive surgery requires extensive dissection to identify and snare both caval veins, avoiding air aspiration [7]. Usually, dense adhesions between the SVC/IVC and the pericardium appear after cardiac surgery, and their management can be challenging during minimally-invasive surgery because the tissues are generally poor in quality, producing a serious risk of life-threatening complications.

Other unpublished techniques for caval snaring have been used, such as placement of a figure-of-eight or purse-string suture around the orifice of the SVC or IVC where it enters the right atrium, even though the risk of extra stitches in delicate tissues should be avoided to minimize the likelihood of injuries.

Such ‘internal snaring’ represents an easy and cheap technique for occluding both caval veins, avoiding dissection of adhesions. This technique was applied in three patients undergoing re-do surgery when a right atrial incision was mandatory for tricuspid surgery. All patients were operated on under ventricular fibrillation for combined mitral/tricuspid surgery. Tricuspid surgery was usually performed first, and the right atrium sutured at the end of this step.

We encountered no specific complications related to the technique, and the caval occlusion was complete in all cases. Use of a Foley catheter does not worsen surgical vision because the catheter can be moved away from the area of surgical vision. We had no cases of interference of the Foley catheter with the stitches used for the mitral or tricuspid surgery.

The following are speculations about the internal snaring:

- The filling of the balloon must be slow and gentle to avoid vascular injuries because acute and excessive distension of the veins may induce sudden injuries (not reported in our series).
- The volume of saline solution needed to fill the balloon differs among patients, depending on the diameter of the veins, and is usually <10 ml. In cases of blood regurgitation despite balloon inflation, the location is likely to be incorrect; it is recommended that the balloon then be deflated, pushing the catheter towards the lumen of the vein (2–3 cm over the atrio caval junction).
- We had no cases of displacement during CPB, and the Foley catheter did not impair surgical vision, even though it must be moved with caution when the balloon is filled to avoid laceration of the veins.
• The line for urine output (at the proximal tip of the Foley catheter) must be occluded to avoid aspiration of air.
• In case of a fall in blood drainage, gentle retraction of the venous cannula may improve the aspiration.

There are several possible pitfalls of our technique:
• The right atrium must be opened to push the Foley catheter toward the caval veins. In cases of isolated mitral surgery, incision of the right atrium for internal snaring is not recommended.
• We had no experience of patients with pacemaker wires.
• The central venous line should be retracted away from the SVC to avoid interference with the occlusion.

4. Conclusions

In conclusion, internal snaring may represent a ‘trick’ in some specific situations in lieu of external dissection. The technique appears to have particular utility in reoperations where it is desirable to avoid extensive external dissection of the atrio caval junctions. However, the number of patients treated in this way has been small, and the risk of pitfalls is certainly an issue for further debates, to be clarified by increased experience with this approach.

References


eComment: Right thoracotomy for mitro-tricuspid valve redo surgery

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I think the concept proposed by Sansone et al. [1] is very interesting. The maneuver with two Foley catheters into the right atrium can adequately control a very delicate situation such as the proper drainage of both venae cavae during a mitral/tricuspid reoperation. As the authors mention [1], this maneuver is only applicable for cases in which a tricuspid surgical procedure is needed. My experience is limited to 13 cases operated on for redo mitral valve surgery through a right thoracotomy with unclamped aorta and ventricular fibrillation [2]. Of these, only 5 cases have required tricuspid surgery. Dissection of both venae cavae has been without problems. However, when there was need for cardiopulmonary bypass quickly, we used special clamps to occlude the vena cava with the venous cannula included. So, minimal or no dissection around the vena cava is employed. But note that the scenario described here by Sansone et al. [1] is slightly different to the traditional approach used by me to cannulate the venae cavae through the same thoracotomy. Over the course of my practice, I have found that the inferior vena cava is sometimes difficult to occlude completely from inside because of its great diameter. However, in this discussion, I take a broader view and assume that the Foley catheter introduced into the inferior vena cava was uneventful. I hesitate to draw profound conclusions, per se, from these data other than to emphasize the diversity of the actual surgical armamentarium in order to address these special situations.

References