Superior vena cava cannulation in aortic valve surgery: an alternative strategy for a hemisternotomy approach

Steffen Pfeiffer, Theodor Fischlein, Ferdinand Vogt and Giuseppe Santarpino*

Department of Cardiac Surgery, Cardiovascular Center, Klinikum Nürnberg, Paracelsus Medical University, Nuremberg, Germany

* Corresponding author. Department of Cardiac Surgery, Cardiovascular center, Klinikum Nürnberg, Paracelsus Medical University Nuremberg, Breslauer Strasse 201, 90471 Nuremberg, Germany. Tel: +49-911-3985441; fax: +49-911-3985443; e-mail: g.santarpino@libero.it (G. Santarpino).

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Abstract

Minimally invasive aortic surgery is increasingly being utilized, in particular, through ministernotomy. The choice of the cannulation site is problematic. Venous cannulation may result in wound complications if the femoral vein is used, or may be bulky if the right atrial appendage is used. Our technique of superior vena cava cannulation not only avoids the risk of complications related to the groin but also provides good visualization of the aortic valve making valve implantation easier, especially when using sutureless bioprosthesis valves.

Keywords: Surgical procedures • Minimally invasive • Cardiopulmonary bypass • Superior vena cava

INTRODUCTION

Minimally invasive approaches (MISs) for aortic valve surgery are increasingly being utilized with good clinical outcomes and patient satisfaction. The procedures are most commonly performed through a partial sternotomy or, less frequently, a right lateral thoracotomy [1]. Both the site of cannulation and the size of access incision often depend upon the surgeon’s preference and expertise. Most commonly, arterial cannulation procedures have been depicted when compared with venous cannulation strategies [2], though complications may arise also when using the latter technique [3, 4]. The aim of this study was to describe our experience with superior vena cava cannulation as an alternative to peripheral venous procedures for ministernotomy incision at the level of the third intercostal space.

TECHNIQUE

In all the patients selected for this new surgical approach, a J-shaped sternotomy was performed with a right incision between the third and fourth rib. The decision to use this technique was made on the basis of preoperative chest X-ray findings. In this surgical procedure, it is very important to prevent a low aortic exposure that would not allow good visualization of the aortic root. Avoiding a wide opening of the retractor that would generate lacerations and ischaemia, the right atrial appendage is often low and distal, practically impossible to cannulate. Our alternative to avoiding femoral venous cannulation consists of performing a gentle traction on the left of the aorta manually or using a blunt tool (Fig. 1B, Video 1). With this movement, exposure of the medial aspect of the superior vena cava can be easily achieved (Fig. 1A, Video 1). At this point, a purse-string suture is created with a 4/0-polypropylene stitch (Fig. 1B, blue circle). Inside the suture, regardless of the patient body weight, a 29-Fr Optiflow venous cannula (Sorin Group, Saluggia, Italy), armed with a stylet, was passed subcutaneously through the aorta root using a vented cannula as patients were mainly affected by aortic stenosis. In case of prolonged cross-clamp time (>30 min), an additional dose of cardioplegia was delivered selectively into the coronary ostia. None of the 23 patients who received a sutureless prosthesis required a second run of cardioplegia. In this surgical approach, the Perceval aortic bioprosthesis (Sorin Group, Saluggia, Italy) is the most commonly used sutureless valve because it makes a high aortotomy easier compared with standard procedures.

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Among the 78 patients who underwent J-sternotomy, a femoral venous cannulation was used in only 1 case (making an incision in the fourth intercostal space) without intraoperative or postoperative complications. Patients who underwent J-sternotomy in the third intercostal space did not require vacuum-assisted venous drainage during cardiopulmonary bypass, though this may be the case if an MIS is adopted. The cannula was inserted and removed without difficulties, and no patient needed a second stitch or any other tool to control bleeding from the cannulation site.

**DISCUSSION**

MIS can often be technically challenging for the preparation and institution of cardiopulmonary bypass through small accesses.

**Figure 1:** (A) Figure showing the purse-string suture in the superior vena cava. (B) The purse-string suture in the medial aspect of the superior vena cava (blue circle). (C) The venous cannula in situ, exiting the surgical field with a right and upward arch.

**Video 1.** Superior vena cava cannulation.

**Figure 2:** (A) The 29-Fr Optiflow venous cannula (total length 38 cm, length of the section with the drainage holes 14 cm) armed with a stylet for the orotracheal tube and gently curved at the extremity. (B) Final positioning of the 29-Fr Optiflow venous cannula.
Most frequently, peripheral arterial or venous cannulation, or both, are used [1]. Although this approach is preferred in many centres, it is still debated if arterial blood flow during retrograde perfusion may cause neurological complications [5]. A great bulk of the literature has focused on arterial cannulation procedures, though complications may arise also when using venous cannulation strategies. More recently, percutaneous femoral cannulation has been described in MIS [6], but it is associated with the risk of acute bleeding, requiring conversion to surgery, formation of arterio-venous fistulas or groin lymphocele with the need for drainage [7]. Although groin lymphocele is not a life-threatening lesion, it can markedly prolong hospitalization and, thus, offset the advantage of a shorter hospital stay after MIS.

Another important issue concerns the depth of partial sternotomy, regardless of J-, L- or inverted Y-sternotomy. The majority of available literature data refer to sternotomy performed in the third or fourth intercostal space in an interchangeable way. In our opinion, an important distinction should be made when using the fourth (or fifth) intercostal space, in that this approach allows both arterial and venous cannulation to be performed without complications as in conventional full sternotomy, making our strategy strictly not necessary as the right atrial appendage can be easily cannulated. Conversely, in MIS with an incision in the second or third intercostal space, a different approach should be adopted. In addition, our strategy may be a viable alternative when using a right lateral thoracotomy. Recently, a MIS with double venous cannulation of the superior vena cava has been described to favour complete drainage [8]. However, in our experience, the innovative small-sized, 29-Fr Optiflow cannula provides high-flow drainage across the entire cannula inserted into the right atrium without the need for double cannulation and with no increase in central venous pressure. Besides the advantages of avoiding peripheral cannulation with its inherent risks, an incision in the third intercostal space may favour sternal closure stability, with a lower rate of wound complications and a cosmetically more acceptable postoperative scar. None of our 23 patients developed superficial or deep wound complications. In addition, the venous cannula output directed upwards and to the right (Fig. 2B) is less bulky during intraoperative aortic exposure compared with the cannula in the right atrial appendage inserted downwards and to the right of the surgical access. Therefore, this approach allows one to maintain one advantage of peripheral cannulation (only one cannula was used in a limited space), avoiding the risks related to femoral access. In conclusion, this cannulation technique is simple, safe, reproducible and free of complications. In addition, it provides effective venous drainage, is less bulky and simplifies the surgical view in an MIS.

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REFERENCES