Cannulation of the right atrium via left thoracotomy

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Abstract

Described here is a technique of right atrial cannulation to establish cardiopulmonary bypass for repairing descending thoracic/aortic arch aneurysms via left thoracotomy. This technique provides satisfactory venous return and can be used for retrograde cerebral perfusion during aortic surgery. The technique is safe and has been extensively used by the authors.

Keywords: Aortic surgery • Cardiopulmonary bypass • Cerebral protection

Left thoracotomy or thoraco-abdominal incision is used for the repair of aneurysms of distal aortic arch, descending thoracic aorta (DTA) and thoraco-abdominal aortic aneurysm (TAAA). Safe and effective cannulation is an integral part of the operative repair. The femoral vein is generally cannulated for venous drainage during these operations. We describe a technique of cannulation of the right atrium via a left thoracotomy.

TECHNIQUE

Left postero-lateral thoracotomy or thoraco-abdominal incision is made depending on the planned operative repair. The diaphragm is divided from its attachment on the chest wall in a circular fashion in patients with thoraco-abdominal aortic aneurysms. The pericardium in opened vertically posterior to the left phrenic nerve from the level of the left inferior pulmonary vein to the diaphragm. Pericardial stay sutures are applied. Intrapericardial portion of the inferior vena cava (IVC) is exposed. Heparin is administered. Direct cannulation of the aorta is carried out. The heart may need to be retracted cranially using a sponge-on-a-holder to expose the IVC. A 3-0 Prolene pledgetted suture (Ethicon, Inc., Somerville, NJ, USA) is used for placing one diamond-shaped purse-string suture on the posterior aspect of the IVC. Ventilation is occasionally discontinued as the expansion of the contralateral lung may interfere during cannulation. A right-angled wire-reinforced venous cannula (Edwards Lifesciences, Irvine, CA, USA) is placed via the IVC purse string, with the tip directed cranially, in such a way that the tip of the single-stage cannula lies in the mid-portion of the right atrium. The purse string is tightened, and the cannula is secured to the snagger with a heavy silk tie (Fig. 1A and B). Cardiopulmonary bypass (CPB) is established. A vent is placed in the left ventricle via the base of the left inferior pulmonary vein.

DISCUSSION

Cannulation forms an important part of operative planning during aortic surgery via a left thoracotomy. Femoral venous cannulation can be difficult at times due to the size of vessel, especially in females. Smaller size cannula may need to be used to negotiate the pelvic brim. Our technique allows placement of a large-sized cannula for effective venous drainage. The current technique is not difficult even during reoperations once the surgeon becomes familiar with it. Gentle retraction of the heart towards the right side exposes well a suitable length of the posterior IVC. Ventilation is occasionally discontinued as the expansion of the contralateral lung may interfere during cannulation. A right-angled wire-reinforced venous cannula (Edwards Lifesciences, Irvine, CA, USA) is placed via the IVC purse string, with the tip directed cranially, in such a way that the tip of the single-stage cannula lies in the mid-portion of the right atrium. The purse string is tightened, and the cannula is secured to the snagger with a heavy silk tie (Fig. 1A and B). Cardiopulmonary bypass (CPB) is established. A vent is placed in the left ventricle via the base of the left inferior pulmonary vein.

A short segment of bypass tubing can be used to connect the arterial and venous lines using suitable connectors if deep hypothermic circulatory arrest (DHTCA) is planned. During circulatory arrest, the patient is placed in the Trendelenburg position, arterial line is clamped and the bridging line opened to establish retrograde cerebral perfusion at a flow rate of near 1.0 l/min maintaining central venous pressure at <15 mmHg (Fig. 1C). The right atrial cannula is removed following weaning off CPB. The purse-string suture is tied, and often an additional reinforcing suture applied.
Figure 1: (A) Position of various cannulae including venous cannula in the right atrium placed via the IVC during operative exposure from the left thoracotomy incision. (B) Cross-sectional view of the heart demonstrates the cannulation details. (C) Schematic diagram of retrograde cerebral perfusion. Ao: aorta; IVC: inferior vena cava; LIPV: left inferior pulmonary vein.
the IVC below the cannula limits retrograde flow superiorly and requires lower flows during the circulatory arrest period. Most of the time, the IVC is not snared, as it may be technically more demanding, and retrograde perfusion of the abdominal organs may be of benefit and/or has never been shown to be detrimental. In fact, there is ample evidence that significant retrograde cerebral perfusion is achieved with a cannula in the right atrium without any caval snaring [2, 3].

We have summarized the results of 119 patients who underwent repair of aortic arch/TAAAs or aortic dissections, operated on by the senior author (Alberto Pochettino) (Table 1) via the described cannulation strategy. There have been no specific complications related to IVC cannulation.

To conclude, right atrial cannulation via the posterior IVC through a left thoracotomy approach provides safe and satisfactory venous drainage for full CPB for surgical repair of distal aortic arch, DTA or TAAA. This method also allows the use of retrograde perfusion for shorter periods of DHTCA.

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**Conflict of interest:** none declared.

### REFERENCES


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**Table 1:** Overall outcomes of patients who underwent left thoracotomy and DHTCA for the repair of aortic arch or thoraco-abdominal aortic aneurysm

<table>
<thead>
<tr>
<th>Number of patients</th>
<th>Age mean (SD) years</th>
<th>Sex M: F</th>
<th>Postoperative CVA</th>
<th>Postoperative paraparesis/paraplegia</th>
<th>In-hospital mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>119</td>
<td>56.2 (15.7)</td>
<td>73: 46</td>
<td>6 (5%)</td>
<td>10 (8.4%)</td>
<td>15 (12.6%)</td>
</tr>
</tbody>
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F: female; CVA: cerebrovascular accident; M: male; SD: standard deviation.