Axillary artery cannulation in surgery of the ascending aorta and the aortic arch

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Abstract

Potential advantages of axillary artery perfusion instead of femoral perfusion are antegrade aortic flow with decreased risk of atheremboli, low risk of false lumen perfusion in aortic dissections, avoidance of groin manipulation, and a possibility of antegrade cerebral perfusion during cardiocirculatory arrest. In 20 patients undergoing proximal aortic surgery, perfusion via the axillary artery was performed with direct cannulation or with an end-to-side anastomosed Gore-Tex graft. In two patients conversion to femoral artery cannulation was necessary. There were no axillary complications, hospital mortality was three out of 22, and no stroke occurred.

Keywords: Axillary artery; Cardiopulmonary bypass; Cannulation; Thoracic aorta; Aneurysm; Stroke

1. Introduction

The femoral artery is the most common alternative cannulation site for cardiopulmonary bypass, when cannulation of the ascending aorta is unsuitable or contraindicated. This is the case when aneurysms, dissections or severe atherosclerosis of the ascending aorta make it a dangerous cannulation site. But in femoral artery cannulation big disadvantages exist, such as retrograde aortic flow with the increased risk of atheroembolization into the brain, the danger of false lumen perfusion in aortic dissections, and the danger of lower extremity ischemia especially in the presence of peripheral vascular disease [1-4].

2. Patients and methods

Between July 2000 and February 2002, axillary cannulation was performed in 22 patients, aged 63 (range 22–77) years, undergoing ascending aortic surgery. Seventeen of the 22 patients were male (77%). The indication for operation was acute aortic dissection type A in 16/22, aneurysmal disease of the ascending aorta in 5/22 and aortic regurgitation grade III after replacement of the ascending aorta in 1/22. Sixteen of the operations were performed as acute cases and six as elective cases. The procedures are listed in Table 1.

2.1. Surgical technique

A small skin incision is made 1 cm below and parallel to the middle and lateral parts of the clavicle. The pectoralis major muscle is partly separated from the clavicle. In cases of disturbing muscle contractions additional muscle relaxant is given. The cephalic vein is mobilized in the deltopectoral groove and retracted to gain access to the deeper subclavian space. The axillary artery, identified by palpation, is freed from connective tissue and separated from lateral pectoral nerve branches. The thoraco-acromial artery is clamped with a micro-bulldog clamp or snared. An umbilical tape with a tourniquet is passed around the axillary artery and the cannula, which is additionally sutured to the skin close to the infraclavicular incision. For venous cannulation we use a two-stage cannula in the right atrium (Fig. 1). After decannulation the axillary artery is closed longitudinally using a 6/0 Prolene running suture or with a patch if vessel narrowing is expected.

During the first cases of axillary artery cannulation an 8-
mm Gore-Tex graft was sutured to the artery in an end-to-side fashion. Due to time concerns and bleeding from the anastomosis we switched to direct axillary artery cannulation which proved to be technically easier.

3. Results

In two of 22 cases a conversion to femoral artery cannulation was necessary. In one case cannulation of the axillary artery was impossible because of significant resistance in the artery during advancement of the cannula. In another case cardiopulmonary bypass (CPB) flow was insufficient (below 2.1 l/m² per min). During all the other procedures (20/22) good CPB flows with 2.4 l/m² per min were achieved. Median CPB time was 209 (range 87–320) min. According to clinical examination no complications related to axillary cannulation, such as brachial plexus injury, axillary artery thrombosis or local wound infection, were observed. No patient had a new postoperative stroke.

Axillary cannulation via an end-to-side anastomosed 8-mm Gore-Tex prosthesis was performed in seven of the 22 patients.

Deep hypothermic cardiocirculatory arrest (DHCA, median duration 35 (range 17–79) min at ≤ 18 °C as determined by urinary bladder thermocatheter) was used in 19/22 patients, retrograde cerebral perfusion in 10/22 and antegrade cerebral perfusion via the axillary artery under occlusion of the innominate artery in 3/22. The length of postoperative stay at the intensive care unit was 5 (range 1–28) days, postoperative stay at our department of cardiac surgery was 11 (range 4–66) days. The hospital mortality was three out of our 22 patients; all deaths occurred in acute aortic dissections.

4. Discussion

Our experience demonstrates that this method of arterial cannulation is technically feasible in the majority of our cases, but also that switches to femoral cannulation are necessary in certain cases such as resistance in the artery.

<table>
<thead>
<tr>
<th>Operation</th>
<th>No. of patients</th>
</tr>
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<tbody>
<tr>
<td>Ascending aortic replacement</td>
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</tr>
<tr>
<td>Ascending aortic replacement and partial arch replacement</td>
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<td>Ascending aortic replacement and total arch replacement</td>
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<tr>
<td>Aortic root replacement with stentless biological valve and ascending aortic replacement</td>
<td>1</td>
</tr>
<tr>
<td>Bentall procedure</td>
<td>5</td>
</tr>
<tr>
<td>Bentall procedure and total arch replacement</td>
<td>1</td>
</tr>
<tr>
<td>Total no. of patients</td>
<td>22</td>
</tr>
</tbody>
</table>

Fig. 1. Cannulation of the axillary artery in a patient with acute aortic dissection type A via a right infraclavicular incision (black arrow). The sternotomy is spread and venous cannulation is performed via the right atrial appendage (white arrow). A coronary sinus catheter is additionally placed.
during cannula advancement or in cases of extreme arterial line pressure or too low CPB flow. These reasons for changes of the axillary arterial cannulation site have not been described in literature. Possible other reasons for a change in cannulation site could be a too short distance of the cannula to the innominate artery wall, stenosis of the vessel, small vessel diameter or an arterial kinking after introduction of the cannula. As arterial wall damage [5] and even a case of dissection of a severely calcified ascending aorta [6] have been observed after axillary artery cannulation, we regard it as very important that forced cannulation is absolutely avoided. In all our successful cases cardiopulmonary bypass flows of 2.4 l/m² per min were easily obtained.

The main complications of axillary artery cannulation which are described in the literature are brachial plexus injury and axillary artery thrombosis, none of which occurred in our series [3,4].

A significant danger of femoral perfusion is false lumen perfusion in acute aortic dissections, which leads to malperfusion [1]. It is unusual for the right axillary artery to be involved in acute dissection and it has not been noted in our experience.

In summary, axillary artery cannulation seems to be a feasible and safe alternative to femoral cannulation in surgery of the ascending aorta.

References