Abstract

We describe an alternative technique for aortic arch cannulation that can be used during the repair of Stanford type A aortic dissection. In order to minimize the risk of complications and malperfusion associated with retrograde flow during cardiopulmonary bypass, we avoided femoral artery cannulation and used antegrade flow via a direct cannulation of the aortic arch in an area free of dissection. Transesophageal echocardiography is used peri-operatively to guide the cannulation of the true lumen in the distal aortic arch.

Keywords: Aortic dissection; Aortic cannulation; Transesophageal echocardiography

1. Introduction

Ascending aorta remains the preferred site of arterial cannulation for cardiopulmonary bypass but this approach may be risky in the presence of aortic aneurysm, aortic dissection or severe arteriosclerosis. Femoral artery cannulation with retrograde flow is the usual alternative under these circumstances. However, aorto-iliac aneurysm, occlusive disease, or distal extension of the aortic dissection may preclude the use of femoral arterial cannulation [1,2]. Alternative cannulation sites include the axillary or innominate arteries and the apex of the left ventricle [1–5]. This report describes an innovative technique for cannulation during repair of acute type A aortic dissection, which permits direct aortic arch cannulation and antegrade flow. Transesophageal echocardiography (TEE) is used to identify the true lumen of the distal arch and to guide arterial cannulation.

2. Technique

TEE is used peri-operatively to delineate the aortic dissection and to identify the true lumen. Classically, the true lumen is smaller than the false lumen and expands in systole. Color Doppler imaging usually shows higher flow in the true lumen, and can sometimes identify entry tears. Median sternotomy and exposure of the vessels are performed in the standard fashion. Two concentric pledget reinforced purse string sutures are placed through the adventitial layer on the lesser curvature of the aortic arch, in an area free of dissection (confirmed by TEE). Transesophageal echocardiography is used peri-operatively to guide the cannulation of the true lumen in the distal aortic arch. TEE confirms the accurate positioning of the cannula into the true lumen. Venous cannula is inserted into the right atrium in a standard fashion. Cardiopulmonary bypass (CPB) is initiated and TEE validates the perfusion of the true lumen and the supra-aortic trunks. Flows with cardiac
indices up to 2.5 l/min per square meter are easily obtained. Surgical repair of the aortic dissection is performed in the usual way. After the patient is weaned from the CPB, the cannula is removed and the double purse-string is tied.

3. Comment

For type A aortic dissection surgery, the choice of arterial inflow for CPB is influenced by many factors and depends on the surgeon’s experience. Femoral arterial cannulation, a common method of cannulation for CPB, has some drawbacks [1]. The complex anatomy of the false lumen may exclude peripheral vessels, making femoral arteries unsuitable sites. Inappropriate perfusion of the false lumen during CPB may be catastrophic leading to ischemia of the brain and spinal cord, as well as aortic wall rupture [2]. Retrograde perfusion can lead to dislodgment and retrograde embolization of debris resulting in stroke and organ failure [5]. Alternatives to femoral cannulation include the axillary artery and the apex of the left ventricle [1–5]. Although the cannulation of an axillary artery has recently become the gold standard in arch surgery, it is not always safe, and may cause intraoperative aortic dissection [6]. The vessel’s small diameter may limit flow and make cannulation troublesome [3,4]. Cannulation of the apex of the left ventricle may cause serious injury resulting in global impairment of ventricular function. The presence of a cannula in the proximal ascending aorta makes cross-clamping and cardioplegia administration technically difficult [3] and repair of the aortic root or valve cannot be performed until the cannula is removed and relocated in the graft [4].

3.1. Limitations and indications

Although attractive, this technique is not convenient for every patient. It does not apply to patients in whom the aneurismal dilation extends beyond the brachiocephalic artery. Aortic dissection presenting with a large hematoma, impending or contained rupture in the pericardium are contraindications. Technically, the distal arch has to be freed up to the origin of the left carotid in order to allow the surgeon to visualize the distal arch. The positioning of the guide wire has to be confirmed by TEE prior to the cannulation otherwise the procedure has to be aborted. Nevertheless, when the anatomy is suitable, the technique allows rapid and safe cannulation especially in patients with unstable hemodynamic in whom subclavian artery dissection would cause life-threatening delay. Our experience is still limited with this technique. We have used it in two cases of acute dissection and three cases on chronic type ‘A’ dissection. All patients had double lumen extending down to the distal thoracic aorta but none distal malperfusion syndrome. However, for the last 3 years this has been our routine way of aortic cannulation in ascending aortic, arch as well as redo surgery. We have used it in more than 120 circumstances with success. The only occasions where we could not use it were in dilated ascending aorta with verticalized arch, where basically a perpendicular plan to the transverse aorta is almost impossible to reach.

4. Conclusion

We described an innovative technique of aortic arch cannulation for the repair of type A aortic dissection. In our experience, this technique was also successful in circumstances such as redo coronary artery surgery to minimize dissection and aortic root and arch surgery. The use of intraoperative TEE is always mandatory to assist and secure the cannulation.
References


Appendix A. ICVTS on-line discussion

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Message: An alternative site for arterial cannulation for ascending aortic aneurysm and aortic arch aneurysm even in course of acute type A aortic dissection is proposed. As is well known, in chronic phases of type A aortic dissection, the aortic wall is fibrous and thicker than in acute presentation, permitting more save management and maneuvering on the vessel. I have some concerns about acute type A aortic dissection (De Bakey’s type I). Inserting a cannula in the distal part of an acute dissected aortic arch may result in the vessel walls laceration with massive bleeding and potential need to reconstruct an aortic tract that otherwise we would not substitute. This would lead to the necessity of protective adjuncts for brain (DHCA, anterograde or retrograde cerebral perfusion), longer total pump time and cardiac ischemic time with higher mortality and morbidity risk. We routinely use right axillary artery for arterial cannulation in the case of ascending aorta replacement both for acute and chronic type A aortic dissection, ascending and/or aortic arch substitutive surgery for atherosclerotic pathology via median sternotomy, in order to perform anterograde cerebral perfusion in moderate HCA: through a single cannula inserted in the left common carotid artery and the arterial line, after clamping the innominate artery, the brain perfusion is achieved. This provides anterograde perfusion during cooling and rewarming time and reduces risk of the air/particles embolisms during open cannulation of supra aortic vessels by means of using one cannula.

Aortic arch remains an attractive site of cannulation for type II De Bakey’s aortic dissection, atherosclerotic ascending aortic aneurysm and right aortic arch aneurysm.