Transatrial left-ventricular cannulation in acute aortic dissection type A: a novel cannulation technique

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Abstract
Despite improvements in surgical and perfusion techniques, surgery for acute aortic dissection type A (AADA) remains associated with high mortality rates. All cannulation techniques currently used to establish arterial flow are associated with a varying but considerable risk of organ malperfusion, neurological complications or additional access site trauma. We introduce Rahimi’s transatrial cannulation of the left ventricle via the right upper pulmonary vein as an innovative alternative for antegrade, arterial return in AADA.

Keywords: Aortic dissection • Neurologic injury • Cardiopulmonary bypass • Perfusion

INTRODUCTION

Acute aortic dissection type A (AADA) is a life-threatening emergency that is associated with adverse outcomes without surgical treatment. Despite relevant improvements in surgical techniques and perioperative management, surgery for AADA remains associated with high mortality rates [1]. In this regard, establishing a fast, safe and effective arterial return for cardiopulmonary bypass (CPB) in patients undergoing surgery for AADA is vital but can be challenging depending on dissection extent, surgical experience and individual, vascular anatomy. Several cannulation techniques have successfully been implemented throughout the last decades and include antegrade and retrograde systemic perfusion. Nevertheless, a distinct risk of organ malperfusion, access site trauma, embolization and neurological injury is associated with each of these methods [2]. Until today, no consensus could be reached in order to standardize and/or simplify arterial cannulation approaches in AADA. Instead, cannulation preferences are based on the individual centre experience and, thus, may not only limit treatment options in some cases but also, ultimately, influence patient outcome. We here describe Rahimi’s transatrial cannulation of the left ventricle via the right upper pulmonary vein as a novel alternative for antegrade, arterial return in patients with AADA.

TECHNIQUE

After a median sternotomy and longitudinal pericardiotomy, the patient was fully heparinized. The right atrium was cannulated with a common two-stage venous cannula. Using normal single purse-string sutures, an incision was made close to the interatrial groove into the right upper pulmonary vein. Using transoesophageal echocardiography (TOE), the arterial cannula (Sams™ Soft-Flow™, Terumo®, Eschborn, Germany) was inserted into the left ventricle passing the mitral valve (Video 1, Fig. 1). Insertion into the left ventricle was preferred over positioning the cannula into the aortic root in order to ensure maximal, antegrade, true lumen return. CPB was then established at 2.5 l/m²/min. A retrograde cardioplegia cannula was placed. Once deep hypothermic circulatory arrest was established at 18°C, the systemic arterial flow was totally arrested. The transatrial cannula was replaced by a left ventricular vent. Cardioplegic solution was retrogradely infused, establishing cardioplegic arrest. In complex cases requiring arch or hemiarch replacement, antegrade cerebral perfusion with oxygenated cold blood (18°C) was commenced at 15% of the normal systemic perfusion rate through the innominate artery and the left carotid artery. Once the distal anastomosis was complete, the Dacron graft (Vascutek™, Inchinan, UK) was de-aired by restarting retrograde perfusion via the venous cannula with ~10–15% of 2.5 l/m²/min and a central venous pressure not exceeding 8–10 mmHg followed by slow antegrade perfusion. Furthermore, continuous CO₂ insufflation was used for the cardiac de-airing. The de-airing efficiency was assessed by TOE. CPB was restarted with the perfusion cannula directly inserted into the graft. A cross-clamp was applied to the graft. During rewarming, appropriate procedures for the aortic root and the aortic valve were performed.

COMMENTS

In this report, we describe a novel cannulation technique to establish antegrade, arterial return for CPB in patients with AADA. Compared with our experience with the cannulation methods previously used at our department—predominantly retrograde...
systemic perfusion via the femoral vasculature and antegrade, direct aortic cannulation—transatrial cannulation proved to be fast and easy to perform. So far, we have not encountered clinically overt left ventricular distension caused by complete arterial return directly into the left ventricle during CPB. Technically, this approach mimics the placement of a left vent under echocardiographic control. Thereby, manipulation of dissected areas is avoided and, possibly, the risk of organ malperfusion, embolization or further expansion of the dissection can be reduced. In contrast to femoral or axillary cannulation, transatrial cannulation can be used independently of the extent of aortic dissection [3, 4]. Furthermore, no additional trauma with the associated possible complications is necessary to prepare the access site.

Both, direct aortic and transapical cannulation also provide the advantage of antegrade arterial return. In particular, the transapical cannulation may reduce neurological complications, as true lumen perfusion can be established in most cases. However, in contrast to transatrial cannulation, the arterial cannula is placed into the ascending aorta. Thus, a residual risk of direct perfusion of the false lumen exists. Moreover, this technique has been linked to severe bleeding complications and left ventricular muscle injury [5, 6]. Direct cannulation of the ascending aorta is successfully used in several centres, but has not found widespread use yet [7].

The limitations of transatrial cannulation include the fact that circulatory arrest is mandatory in this approach. In addition, this technique can be implemented only after sternotomy and, therefore, is not suitable in patients with free rupture.

To summarize, transatrial cannulation is a new method for antegrade, arterial return in patients with aortic dissection type A that may provide technical advantages. Further studies have to show whether this technique may also reduce the possible complications associated with established cannulation methods in these high-risk patients.

Conflict of interest: none declared.

REFERENCES