Central cannulation for type A acute aortic dissection

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Abstract

We present a simple new method for establishing cardiopulmonary bypass to treat type A acute aortic dissection. Antegrade blood flow in the true lumen is theoretically best to prevent malperfusion and retrograde embolization. Central cannulation can be performed in the true lumen of the dissected ascending aorta using an ultrasonographically guided puncture technique such as ‘Seldinger’s method’.

Keywords: Central cannulation; Acute aortic dissection; Cardiopulmonary bypass; Malperfusion

1. Introduction

In surgical treatment for type A aortic dissection, one of the most important factors influencing the surgical outcome is maintenance of blood flow to end-organs under cardiopulmonary bypass (CPB). As for the arterial cannulation site, the femoral and recently the axillary arteries [1,2] have been commonly used, but central cannulation is better to avoid malperfusion and retrograde embolization. Although right axillary cannulation provides a permanent antegrade perfusion in the aortic network, the artery is often small and not suitable for cannulation especially in the case of a small Japanese woman. Sometimes repair of the arteriotomy is troublesome due to further dissection at the cannulation site. A vascular prosthesis sewn to the axillary artery might be employed for cannulation, but perfusion through a small caliber vessel does not provide sufficient blood supply for the total body. Another cannulation, e.g. femoral, should be added to achieve adequate flow. In the dissected aorta, the dissection rarely involves the entire wall, so a portion of the non-dissected wall remains. Central cannulation can be applied via the non-dissected portion of the wall. Ultrasonographically guided puncture technique is performed. A guide-wire is introduced into the true lumen from the non-dissected wall under ultrasonographical guidance, so that a perfusion cannula primarily used for percutaneous cardio-pulmonary support (PCPS) can be inserted safely and quickly through the guide-wire into the true lumen.

2. Technique

Transesophageal echocardiography (TEE) is routinely prepared. Median sternotomy and pericardiectomy are carried out. The locality of the dissection is inspected in the ascending aorta using epiaortic ultrasonography. The aortic wall just beside the pulmonary artery frequently remains non-dissected. The guide-wire is introduced from the non-dissected wall punctured with an 18G-needle (Fig. 1). After the position of the wire is confirmed in the true lumen by TEE, a perfusion cannula for PCPS (Toyoboseki Co., Ltd, Osaka, Japan) is inserted over the guide-wire (Fig. 2). The cannula is fixed to the retractor and no purse-string suture is applied to the aorta. Venous cannulation is performed with a two-stage right atrial cannula. Once CPB is established, the arterial flow is verified in the true lumen by TEE and systemic cooling is immediately initiated. The ascending aorta, if necessary also the arch, is replaced with a Dacron vascular prosthesis with a side-arm (Gelseal, Sulzer Vascutek, Renfrewshire, Scotland) by the appropriate procedure. The ascending aortic wall is resected including the cannula insertion point. Distal anastomosis is performed by an open technique under hypothermic circulatory arrest. After completion of the distal anastomosis, the perfusion cannula is then inserted into the side-arm and CPB is re instituted. Antegrade pump flow is maintained throughout CPB.
3. Results

Central cannulation was performed in 12 patients during a 1-year period. Ages ranged from 29 to 78 years (mean, 62.3 years). There were seven men and five women. One patient could not undergo the method due to circumferential dissection in the ascending aorta. The case involved coronary ischemia, cardiogenic shock and cardiac arrest before establishment of CPB, which resulted in cerebral ischemia. Transapical cannulation was immediately instituted and the ascending aortic replacement was performed. Although the procedure was successful, severe brain damage remained and resulted in his subsequent death. In another patient with ruptured aneurysm and cardiac tamponade, pericardial drainage and femoral cannulation was performed before sternotomy. Therefore, 12 of 14 patients received central cannulation. In all 12 patients, cannulation into the true lumen was successfully achieved.

In the 12 patients, ascending aortic replacement was performed in 10 patients; total arch replacement in one patient; and Bentall in one patient. Preoperative malperfusion was seen in three patients; spinal ischemia in one and cerebral ischemia in two. Those problems remained after operation. The other nine patients were alive without major complications.

4. Discussion

Central cannulation through the ascending aorta is a new surgical approach for type A acute aortic dissection, which is simpler and quicker than femoral or axillary cannulation. In the point of avoidance of malperfusion and embolism, the ascending aorta is regarded as the most suitable site for arterial cannulation. Lijoi et al. demonstrated dissected aortic cannulation in either the true lumen or false lumen [3], but true cannulation is better in theory.

The key to this method is to insert the guide-wire correctly into the true lumen of the aorta. This is easy to perform and not time-consuming. In the emergent setting, especially combined with coronary ischemia, immediate institution of CPB is mandatory. Although cannulation of the dissected aorta is considered dangerous, it becomes safe by using a guide-wire technique such as ‘Seldinger’s method’ under direct-ultrasonographical examination. The aortic wall just beside the pulmonary artery often remains non-dissected. By dividing the continuity between the aorta and the pulmonary artery, puncture of the true lumen can be done. No purse-string suture is utilized for fixation of the cannula to avoid bleeding and further disruption. The cannula is inserted shallowly so that the side-holes of the tip are positioned inside the aortic lumen, while avoiding further tearing of the aortic arch. The dissected aorta is commonly so fragile that the whole procedure must be performed gently and carefully. However, if the entire circumference of the ascending aorta is involved in dissection and the false lumen occupies most of the aortic lumen, puncture of the true lumen is difficult to achieve and this approach should be abandoned. In the patients with a large amount of clot inside the false lumen, the cannula must not be introduced through the clots, since such a maneuver might mobilize the clots causing a disastrous embolization. In such a situation, transapical cannulation [4,5] may be recommended. Applicability of this technique can usually

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Fig. 1. A guide-wire is introduced from the non-dissected aortic wall into the true lumen with ultrasonographically-guided puncture.

Fig. 2. A perfusion cannula, primarily used for percutaneous cardiopulmonary support, is inserted through the guide-wire into the true lumen of the ascending aorta and two-stage venous cannula in the right atrium.
be judged with enhanced computed tomography (CT) preoperatively.

Central cannulation using the Seldinger’s technique is one option for cannulation into the true lumen of the aorta, as it provides antegrade blood flow and minimizes the risk of malperfusion to the end-organs as well as the risk of cerebral embolism.

References