How-to-do-it
Deltoido-pectoralis approach to axillary vessels for full-flow cardiopulmonary bypass

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Abstract
Axillary artery has been proposed as a safe and effective alternative for arterial cannulation in surgical procedures involving ascending aorta and/or aortic arch, and is nowadays the site of choice in many centres. Advantages of axillary artery cannulation include antegrade flow and the possibility of selective mono-hemispherical brain perfusion during circulatory arrest. Experiences with the axillary vein cannulation, however, are scarce. Here we report our preliminary experience with axillo-axillary cardiopulmonary bypass, through both axillary artery and vein cannulation (using echo-guided Seldinger technique) at deltoido-pectoralis groove. We have used such an approach in 5 cases of redo surgery on ascending aorta and we have not had any inconvenience during cardiopulmonary bypass. Full flow was maintained in all patients (in 2 with vacuum assisted drainage) including 2 cases with deep hypothermic circulatory arrest. In conclusion such an approach seems to be feasible and effective and can be safely performed providing that accurate TE echo monitoring is provided.

1. Background
Axillary artery has been proposed as alternative for arterial cannulation in surgical procedures involving the thoracic aorta and/or aortic arch, and is nowadays the site of choice in many centres. Advantages of such an approach include antegrade flow during cardiopulmonary bypass (CPB) and a mono-hemispherical brain perfusion, in case of circulatory arrest, without additional selective cannulation. Axillo-axillary CPB using a subclavicular approach has been described in 1997, but limited further experiences have been reported so far [3]. Deltoido-pectoralis groove approach seems to carry relevant advantages compared to subclavicular approach and has become the first choice for axillary artery cannulation in many centres. Here we report our promising preliminary experiences using the deltoido-pectoralis groove approach for axillary artery and vein cannulation and total axillo-axillary CPB.

2. Technique description
We report the technique used in 5 cases redo surgery on ascending aorta through minimally invasive approach. In all cases, before approaching the sternum, the axillary artery and vein were exposed at the deltoido-pectoralis groove using a 5–7 cm skin incision and gentle dissection of pectoralis major muscle fibres and the clavipectoral fascia, according to a previously described technique [1]. Brachial plexus was identified and gently retracted. Axillary artery was isolated and suspended. Axillary vein was then identified and suspended, but not fully isolated. Heparin was given at standard dose and 5-0 polypropylene (Prolene, Ethicon, New Jersey, USA) purse strings were made on both axillary artery and vein. Following arterial puncture, a guide-wire was inserted inside the axillary artery and, once TEE monitoring excluded vascular complication a Baxter arterial cannula (Baxter cardiopulmonary products, Irvine, CA – USA), sized according to the patient’s BSA, was inserted (Fig. 1). A 20 Fr cannula was routinely used while an 18 Fr cannula was used in patients with BSA <1.6 m². Once more TEE was used to confirm the safe introduction of the cannula. Thereafter using a similar technique (TEE monitoring and guide-wire insertion) a long peripheral venous cannula (Medtronic HP venous cannula, Medtronic Inc, Minneapolis, Minnesota – USA or Baxter peripheral venous cannula) was inserted in axillary vein. CPB was then started and targeted full flow (2.5 l/min/m²) and was reached in all patients, using vacuum support in 2 cases. Two patients, undergoing redo Bentall procedure, required deep hypothermic circulatory arrest. In both cases cooling and rewarming phases were managed without technical problems achieving a pump flow...
Although a side-graft technique has been suggested by some complex procedures on ascending aorta and/or aortic arch, ministernotomy has become a routine approach for redo therefore, axillary artery cannulation combined with upper technical concerns previously reported [4]. At our division, technique for arterial cannulation have satisfactory addressed in obese patients) and the use of a TEE controlled Seldinger approach at the deltoido-pectoralis groove (usually easy even at 120% compared to calculated target. Both cases received, furthermore, selective cerebral perfusion, which was monolateral (only through axillary artery) in 1 case and bi-lateral (with accessory internal cannulation of left carotid artery) in 1 case.

3. Discussion

In complex procedures involving the thoracic aorta axillary artery cannulation allows clear advantages related to the antegrade flow and the continuous perfusion of right carotid artery during circulatory arrest [1,2]. Moreover surgical approach at the deltoido-pectoralis groove (usually easy even in obese patients) and the use of a TEE controlled Seldinger technique for arterial cannulation have satisfactory addressed technical concerns previously reported [4]. At our division, therefore, axillary artery cannulation combined with upper ministernotomy has become a routine approach for redo complex procedures on ascending aorta and/or aortic arch. Although a side-graft technique has been suggested by some authors [4], in order to reduce potential vascular complications we routinely used a direct cannulation and, thanks to an accurate TEE monitoring, we did not experience any major vascular complications so far. Venous return is usually obtained either peripherally, via femoral vein cannulation, or centrally, via a direct right atrial cannulation. Peripheral cannulation, however, requires an accessory groin incision and therefore, especially in severely obese or diabetic patients, an accessory potential source of postoperative morbidity such as lymphorhea, infection, pseudoaneurysm formation and arteriovenous fistula [5]. Percutaneous femoral vein cannulation is, conversely, influenced by the anatomy of the venous system and is not always easily accomplished. On the other hand, central cannulation does not initiate CPB before sternotomy and also reduces surgeon comfort when a minimally invasive approach is used. Preliminary experience with axillo-axillary CPB has been previously described using subclavicular approach [3]. However technical problems and complications [4] related to the subclavicular approach have probably limited the diffusion of such technique. We, therefore, decided to test the feasibility of axillo-axillary CPB using the deltoido-pectoralis groove approach, which is in our opinion much easier to manage. Our preliminary experience confirms that the axillary vein can be easily cannulated using a Seldinger technique and a peripheral venous cannula of appropriate size. Mandatory accurate TEE control, performed by an experienced anaesthesiologist, must confirm the right placement of the guidewire and cannula. Satisfactory full flow CPB can be obtained even in the case of obese patients, frequently without vacuum assisted drainage, and a comfortable surgical view can be obtained, even using a ministernotomy approach. Our experience also confirms recent findings from von Segesser et al. [6] who showed feasibility of full-flow CPB using a subclavian venous drainage in 7 patients. Using their original self-expanding venous cannula, which could be an excellent option for axillo-axillary CPB, they achieved 111% of calculated target pump flow, without reporting any major vascular complications. In conclusion we feel that full-flow CPB through axillo-axillary cannulation at the deltoido-pectoralis groove is feasible and could offer relevant advantages if compared to standard femoral peripheral CPB in complex redo procedures on ascending aorta.

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References