Triple-Arterial Cannulation Approach for Whole-Body Perfusion in Infant Hypoplastic Aortic Arch and Coarctation Repair

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Abstract

Organ and end-organ protection in aortic arch surgery represents a substantial challenge, especially in infants. Selective antegrade cerebral perfusion has been reported to improve organ function during this procedure. Visceral perfusion can be optimized by cannulation of the descending aorta during infant aortic arch surgery, leading to a decrease in end organ damage. However, it is associated with extensive surgical manipulation and subsequent risk of major vessel and potential organ damage.

In this report, we describe a technique for distal body perfusion in an infant with hypoplastic aortic arch and isthmus stenosis by ultrasound-guided cannulation of the femoral artery using an intra-arterial vascular sheath establishing whole-body perfusion by triple cannulation.

Keywords

► hypoplastic transverse aortic arch
► beating heart
► cerebro-myocardial perfusion
► visceral perfusion

Introduction

Organ and end-organ protection (cerebral, myocardial, and visceral) in aortic arch surgery represents a substantial challenge, especially in infants. Complex aortic surgery including deep hypothermic cardio-circulatory arrest is known to significantly increase operative morbidity. In particular, selective antegrade cerebral perfusion has been reported to improve organ function and patient outcomes. Visceral perfusion can be optimized by cannulation of the descending aorta during infant aortic arch surgery. Previous research has demonstrated that optimized perfusion techniques of the brain and body by cannulation of the descending aorta during infant and congenital aortic arch surgery can be used to guarantee visceral and renal perfusion. This leads to a decrease in end organ damage. However, it is associated with extensive surgical manipulation and subsequent risk of major vessel damage, potential organ damage, and significantly increased operative times. To reduce cannulation of the descending aorta-associated risk factors, we induced peripheral, percutaneous femoral cannulation. This operative instruction tutorial presents a safe and simple technique for intrathoracic and peripheral cannulation to establish whole-body perfusion during complex aortic arch surgery in infants.

Case Description

The patient is a 16-months-old, 9 kg female infant with hypoplastic aortic arch and an aortic isthmus stenosis. Initial symptom was coughing. Examination revealed a systolic heart murmur. Indirect blood pressure measurements (Riva-Rocci) detected significant discrepancy with 150/90 mm Hg on the upper and no measurable blood pressure on the lower
Electrocardiogram (ECG) monitoring during cerebral, myocardial, and distal perfusion was accomplished as presented. The perioperative course of the patient showed no significant increase in creatinine, liver enzymes, or lactate levels, and furthermore no signs of acute kidney injury, limb malperfusion, aggravation of myocardial function, or femoral vessel injury were detected. The intensive care unit stay was 24 hours and the child was discharged without complications on postoperative day 7.
Discussion

Whole-body perfusion using triple-arterial cannulation approach (TACA) is feasible in infant aortic arch reconstruction. This approach enables continuous organ and end-organ perfusion and thus represents significant potential advantages compared with antegrade cerebral perfusion, arrested heart technique, and deep hypothermia without distal body perfusion. As intra- and perioperative results detected lower levels of ischemic end organ markers and shorter ventilation times compared with the conventional approach, it has yet to be determined whether this translates into improved clinical outcomes in a larger patient cohort.  

Conclusion

TACA enables organ and end-organ perfusion in infants undergoing complex aortic arch reconstruction.

Conflict of interest

None declared.

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Fig. 1  Schematic drawing of extracorporeal circulation set-up during “beating heart” aortic arch reconstruction.