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Femoral artery versus right axillary artery cannulation in various cardiac procedures, a single center experience: The quest for the holy grail

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ABSTRACT

Background: There are many arterial cannulation sites to establish cardiopulmonary bypass (CPB). Each site has its advantages and disadvantages. Organ malperfusion especially the cerebral malperfusion during CPB is the most critical outcome in comparing different arterial sites. We aim to evaluate safety and efficacy of axillary and femoral arterial cannulation in various situations.

Methods: This retrospective observational study, included 75 patients underwent redo valve surgery or denovo thoracic aorta surgery. Patients were reviewed in terms of organ malperfusion namely brain and kidney; and cannulation site related complications. Patients were divided into two groups Femoral group (n = 46) and Axillary group (n = 29).

Results: The mortality in the femoral group was 4.35%, while the axillary group showed a 3.45% mortality; without statistically significant difference. The axillary group had a significantly lower total hospital stay (p value 0.002), and highly significant lower ventilation hours (p value < 0.001). Other post-operative complications were lower in the axillary groups, without reaching statistical significance.

Conclusions: Both axillary and femoral artery cannulation provide a safe quick route for establishing CBP support in critical conditions before opening the chest. The axillary route is more technically demanding while the femoral route is handier in such cases. Individual arterial cannulation strategy should be done for each patient with a backup plan.

1. Introduction

Introduction of cardiopulmonary bypass (CPB) and antegrade ascending aortic cannulation has been considered “the golden standard” of the arterial cannulation strategies in different open-heart interventions. This is usually achieved by setting the pump flow on 2.4 L/min/m^2 of body surface area (BSA) [1]. However, achieving an adequate tissue perfusion during CPB is not a simple science and it is dependent on many other factors besides BSA, these includes the acid-base balance, hemodilution and oncotic pressure, the degree of hypothermia and the depth of anesthesia [2]. Thomassen and colleagues

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concluded that a range of blood flows from 1.9 to 3.1 L/min/m^2 has the ability to preserve adequate systemic and cerebral oxygenation [3].

Many authors advocate other routes for arterial cannulation: common carotid, innominate, axillary, and femoral arteries as well as apex of the heart. Primarily falling into two main categories in terms of flow in the descending aorta being antegrade or retrograde perfusion. [4,5].

In this study we aimed to present our experience in two arterial cannulation modalities "the early adopted" femoral and "recently adopted" right axillary artery cannulation in diverse cardiac interventions.

2. Patients and methods

After the approval of medical ethical committee of Ain Shams University and department of cardiothoracic surgery in Ain Shams University, a retrospective study was designed through previously consented patients' registry including redo cases of valve replacement and denovo patients of thoracic aorta disease. The age ranged from 20 to 50 years while excluding all those showing previous neurological deficit preoperatively. This study was carried out in Cardio-thoracic surgery Academy, Ain Shams University, Cairo, Egypt, between July 2014 and September 2017.

All procedures were carried by one surgical team. According to the initial presentation of the patients, the arterial cannulation strategy was implemented as all those presented with hemodynamic instability were femorally cannulated from the start and later median sternotomy or concomitant femoral cannulation and median sternotomy by two surgeons simultaneously operating in cases of thoracic aortic pathology associated with life threatening cardiac tamponade.

All patients with thoracic aorta pathology had multislice CT angiography performed preoperatively and were thoroughly examined for subclavian, axillary or innominate artery dissection.

After general anesthesia induction, a right internal jugular central venous line and bilateral radial artery line were inserted. If a difference of gradient >15 mmHg was found, axillary artery cannulation was aborted. Core body temperature was monitored by nasopharyngeal thermometer. Transesophageal echocardiography was performed when feasible. The patients were prepped and draped in supine position exposing 2 cm above the clavicle bilaterally and both groins.

2.1. Axillary artery cannulation

The junction between middle and lateral thirds of the clavicle was identified and a 5-cm incision was made 2 cm below it. This gave access to the deltopectoral groove where the pectoralis major was dissected using electrocautery till the clavipectoral fascia which was incised exposing the pectoralis minor muscle. The axillary artery was then properly identified and palpated and sharp dissection was solely was used to gently mobilize its local branches applying a very gentle traction to the axillary vein inferiorly along it. A self-retaining retractor was best suited for traction or using two Langenbeck assistant held retractors. Our team prefers retracting the pectoralis minor muscle rather than dividing it.

The artery was then looped using a tape, and systemic administration of 5000 IU of heparin. 2 vascular Debakey clamps were used to clamp the artery from both sides, a longitudinal arteriotomy was done and a size 8 mm Dacron graft tube was sutured end to side using a 6/0 poly propylene suture. After completion of the anastomosis, the clamps were removed and the graft was let to bleed in a bowl to remove any clots before attaching it to the arterial line circuit securing the connection with 1 or 0 silk tie.

In cases where more antegrade perfusion is needed we applied distal clamp to the axillary artery. Unexplained high arterial line pressure should rise the suspicions of undiagnosed proximal dissection or stenosis and may result in malperfusion due to reentry, thus requiring an alternative cannulation strategy.

Whenever circulatory arrest was mandated, a systemic cooling of the body was done, followed by clamping the innominate artery (before stopping the circulation) and reaching an antegrade flow of 10–15 ml/kg/min.

After completion of the procedure, administration of protamine was started with taking down of the tube graft by leaving few millimeters to be sutured by running 4/0 poly propylene suture. Ensuring proper hemostasis and closure in layers were finally done.

2.2. Femoral artery cannulation

A 5-cm incision was made in the skin crease over the femoral pulse, followed by blunt dissection down till the femoral artery. Systemic administration of 5000 IU of heparin was started, followed by a longitudinal arteriotomy incision with end to side anastomosis of a size 8 mm Dacron graft in the same fashion as the axillary artery. In extreme emergency cases a transverse arteriotomy was done and direct femoral cannulation was achieved. In both scenarios taking down of the tube was required and direct repair of the arteriotomy by 6/0 poly propylene suture was done at the end.

2.3. Statistical analysis

Statistical presentation and analysis of the present study were conducted using the mean, standard deviation. Unpaired student t-test was used to compare between two groups in quantitative data and chi-square were computed for 2×2 tables in qualitative data by (***IBM SPSS*** *Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.).*

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