

Original Article / Özgün Araştırma

Cannulation of Innominate Artery During Proximal Aortic Aneurysm Repair

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Received: 12.10.2018; Revised: 15.10.2018; Accepted: 25.10.2018

DOI: 10.5798/dicletip.474696

Abstract

Objective: There are many debates for cannulation sites during aortic surgeries. The cannulation technique which is providing antegrade flow is associated with better survival and neurological outcomes than retrograde flow. For this purpose, innominate and axillary artery cannulation have been increasingly used for cardiopulmonary bypass recently. We aimed to present our experience with innominate artery cannulation for cardiopulmonary bypass and antegrade selective cerebral perfusion during proximal aortic aneurysm repair.

Methods: A total of eighteen patients with proximal aortic aneurysm underwent surgical repair were included into the study. Pre-operative patient's characteristics, surgical details and postoperative outcomes were investigated.

Results: The mean age was 58.8 ± 10.2 and majority of the patients were male (72%). Bicuspid leaflet was found in 9 patients (50%). Two patients died in postoperative period. No stroke or new neurological deficit was seen after procedure.

Conclusions: This study emphasizes that cannulation of innominate artery can be used in safe and effective during aortic surgery.

Key words: Innominate artery, aortic surgery, cardiopulmonary bypass, aortic aneurysm.

Proximal Aort Cerrahisinde Innominate arter kanülasyonu

Öz

Giriş: Aort cerrahisi uygulamalarında kardiyopulmoner bypass için arteryel kanülasyon bölgesi hala tartışma konusudur. Son yıllarda antegrade akım sağlayan kanülasyon tekniklerinin retrograde akım sağlayan bölgelere göre sağ kalım ve nörolojik sonuçlar açısından daha faydalı olduğunun gözlenmesi

üzerine innominate arter ve axiller arter kullanımını artırmıştır. Bu çalışmada aort cerrahisinde innominate arter kanülasyonu üzerine olan tecrübelerimizi paylaşmayı amaçladık.

Yöntemler: Çalışmaya proximal aort cerrahisi nedeniyle cerrahi tamir yapılan 18 hasta dahil edilmiştir. Hastaların preoperatif , operatif özellikleri ve post-operatif sonuçlar değerlendirilmiştir.

Bulgular: Çalışmaya dahil edilen hastaların ortalama yaşları 58.8 ± 10.2 iken hastaların çoğunluğunu erkekler oluşturmaktaydı (%72). Eşlik eden bicuspid art kapak patolojisi 9 hastada bulundu (%50). Postoperatif mortalite iki iken hiçbir hastada cerrahi sonrası inme veya nörolojik defisit gelişmemiştir.

Sonuçlar: Çalışma sonrasında aort cerrahisinde kardiyopulmoner bypass için innominate arter kullanımının güvenli ve etkili olduğunu savunmaktayız.

Anahtar Kelimeler: Innominate arter, aort cerrahisi, kardiyopulmoner bypass, aort anevrizması

INTRODUCTION

The cannulation technique has been changed in aortic surgery over the time¹. Femoral, innominate and axillary arteries are the most common options for arterial cannulation in proximal aortic surgery including ascending and arch of aorta². Recent studies have indicated that antegrade flow provides better neurological outcome and reduces the mortality on these complex procedures. For this purpose, preference of femoral artery which is providing retrograde flow have been decreased recently³. Another advantage of axillary and innominate artery cannulation is that antegrade cerebral perfusion can be performed during total circulatory arrest. Several studies have shown that excellent postoperative outcomes were obtained with using the innominate artery cannulation during aortic surgery⁴.

In this study we described our cannulation technique with innominate artery during proximal aortic surgery.

METHODS

Between January 2019 and July 2018, eighteen patients with ascending and/or arch of aortic aneurysm underwent open surgical repair with innominate artery cannulation were included this study. Demographic characteristics, surgical detail and post-operative outcomes were obtained from the patients' charts.

The study complies with the Declaration of Helsinki and was approved by the ethics committee of the author's institute. Written Informed consent was obtained from all patients.

Before surgery, transthoracic echocardiography was performed in all patients for evaluation of the LVEF, end diastolic left ventricular diameter (LVEDD), aortic, mitral and tricuspid valves. Coronary angiography was also performed in patients older than 40 years of age or under risk for coronary artery disease. Decision was made for surgical plan after CT angiogram.

All surgeries were performed under general anesthesia with standard median sternotomy. After heparin administration, innominate artery was cannulated with 8 mm dacron tubular graft with end to side configuration (Figure 1). Cardiopulmonary bypass (CPB) was used in all operation with cross-clamped aorta under cardioplegic arrest and hypothermia. Multidose cold blood cardioplegia was administered intermittently in all patients through the aortic root in all the patients and retrogradely through the coronary sinus for myocardial protection.

CPB was initiated through the innominate arterial graft and innominate artery was then clamp and cerebral flow rate of 10–15 ml/kg/min was institute for the unilateral antegrade cerebral perfusion if

systemic circulatory arrest necessary. After completing the circulatory arrest, the clamp was removed and after de-airing CPB was reinstated in an antegrade fashion through the same artery. When complete the procedure, protamine was used for the neutralization of the heparin and the graft was trimmed and sawn near the anastomosis.

The patient's demographic characteristics including age, gender, history of diabetes mellitus (DM), hypertension (HT), chronic kidney disease, cerebro-vascular accident, chronic pulmonary obstructive disease (COPD), coronary artery disease (CAD), left ventricular ejection fraction (LVEF), maximum aneurysm diameter and aortic valve pathology (severe aortic insufficiency, stenosis and bicuspid aorta); operative details including cardiopulmonary bypass (CPB) time and cross clamp (X-Clamp) time and total circulatory arrest time were collected.

Post-operative outcomes were recorded: mortality, renal failure which is requiring dialysis and neurologic deficits (stroke). Additionally post-operative length of stay and length of post-operative mechanical ventilation times were calculated.

RESULTS

Preoperative patient characteristics are listed in Table 1. A total of 18 patients were included in this study. The mean age was 58.8 ± 10.2 and majority of the patients were male (72%). Ten patients (55%) had hypertension and concomitant aortic valve pathology including severe aortic stenosis, insufficiency and bicuspid leaflets was found in 9 patients (50%).

Operative details are presented in table 2. Various aortic procedures were performed according to the underlying pathology. A supra-coronary ascending aortic replacement in 8 (44%) patients, and bental procedure in 5 patients (27%). 4 patients (22%) underwent aortic valve replacement and supracoronary ascending aortic replacement, and 1 patient had total arch repair. Two patients had concomitant coronary bypass grafting and 1 patient had mitral valve replacement with aortic procedure. Mean CPB and X-Clamp times were 146.2 ± 25 and 84.6 ± 15.7 minutes respectively. Total circulatory arrest was performed in 7 patients during distal anastomosis.

Clinical outcomes are summarized in Table 2. Two patients were death in post-operative early period due to multiple organ failure. Two patients had acute renal injury which is requiring dialysis after surgery. No stroke or new neurologic deficit was seen in postoperative period.

Additionally mean mechanical ventilation time was 14.3 ± 19.2 hours and length of hospital stay was 7.5 ± 2.1 days.

DISCUSSION

Reconstruction of the proximal aortic aneurysm is associated with higher mortality and morbidity rate⁵. Neurological complication is common with this procedure. Recent studies have shown that antegrade flow provides more effective brain protection during CPB⁶. Over the past two decades, while femoral artery cannulation has been decreased in use, axillary and innominate artery cannulation is progressively increase due to providing antegrade flow. Axillary and innominate artery are also facilitates the antegrade cerebral perfusion in the case of total circulatory arrest⁷. Compare with the axillary artery, innominate artery is easily accessible through median sternotomy and does no need an additional incision, which may be complicated by local infections, brachial plexus injuries or vascular injuries⁸. It is always easy and fast to prepare the innominate artery even in obese patients. Furthermore, the innominate artery has lower flow resistance than axillary artery, and it facilitates to achieve full CPB flow more easily.

In our study we have cannulated innominate artery without any complication such as bleeding, dissection and hematoma. Compare with previously reported studies by others^{9,10}, in our experience, cannulation of the innominate artery was associated with similar hospital outcomes. Hospital mortality was 11%, and renal failure was 11%. These outcome rate was slightly higher than previously reported studies and we think that the reason may be our small patient population. On the other hand, we don't have any neurological complication in our patients postoperatively.

In conclusion, the innominate artery represents a valuable site for arterial cannulation, during repair of the proximal aortic aneurysm. This cannulation site allows surgeon to prevent time waste for incision another site and also providing more effective braion protection. it allowed complex aortic interventions to be performed with excellent results in terms of mortality and neurological outcomes.

Declaration of Conflicting Interests: The authors declare that they have no conflict of interest.

Financial Disclosure: No financial support was received.

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Table 1: Demographic charecteristics

Demographic Variable	N(%)/Mean±SD
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Age	58.8±10.2
Gender (Male)	13 (72%)
HT	10 (55,5%)
DM	4 (22%)
CKD	1 (5%)
COPD	2 (11%)
CVA	0
CAD	2 (11%)
Aortic Valve Pathologies (AI-AS-Bicuspid Aorta)	9 (50%)
LVEF	54.1±6.1
Maximum Ascending Aortic Diameter (mm)	58.5±8.1

Abbreviation:

HT: HipertensioC, DM: Diabetes Mellitus, CKD: Chronic Kidney Disease

CVA: Cerebro vascular accident, COPD: Chronic obstructive pulmonary disease

CAD: Coronary artery disease, AI: Aortic,insufficiency AS: Aortic stenosis

LVEF: Left ventricular ejection fraction

Table 2: Operative details and Postoperative Outcome

Operative Detail Post-operative Outcome	N(%) / Mean±SD
Bentall Op	5(27%)
AVR+Supra Coronary Ascending Aortic Replacement	4(22%)
Supra Coronary Ascending Aortic Replacement	8(44%)
Ascending Aortic and Total Arch Repair	1(5%)
Total Circulatory Arrest (Open Clamp)	7(38%)
Concomitant CABG	2(11%)
Concomitant MVR	1(5%)
CPB Time (minute)	146.2±25
X-Clamp Time (minute)	84.6±15.7
TCA Time (minute)	28.7±10.6
Mortality	2 (11%)
ARF	2(11%)
New stroke or CVA	0
Mechanical Ventilation Time (hour)	14.3±19.2
Lenght of Hospital stay (day)	7.5±2.1

CPB: Cardiyopulmoner bypass, AVR: Aortic valve replacement

MVR: Mitral Valve replacement, CABG: Coronary artery bypass grafting

ARF: Acute renal failure

Figure 1: Innominate artery cannulation with 8 mm dacron graft