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Case Report
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Stroke after Acute Type-A Aortic Dissection Repairment Surgery with Dual Arterial Cannulation: A Case Report

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Abstract

Background and Aim: The severity and extent of the aortic dissection, the patients' ages and physical conditions, and the surgical team's possibilities identify the case's prognosis. Cannulation strategy in surgery for acute type A aortic dissection is controversial. This article appraised the advantages and drawbacks of the selected cannulation technique in our patient who had a stroke after thriving aortic dissection repairment surgery.

Methods: An 83-year-old female diagnosed with hypertension, diabetes mellitus, chronic renal failure and asthma was admitted to our clinic with back and chest pain, hypotension, weak pulse in the left arm and loss of consciousness. She had acute type A aortic dissection on CT angiography imaging and required surgical intervention. We operated on the patient via cardiopulmonary bypass established with dual arterial cannulation by using femoral and subclavian arteries.

Results: Supracoronary ascending aorta replacement operation was performed for the patient who had acute type A aortic dissection which was extending from the aortic root to the right brachiocephalic truncus. There was no spontaneous awakening in the postoperative intensive care follow-ups. The patient was consulted by neurology. In the MR imaging, subacute infarcts were observed in the areas supplied by the right middle cerebral artery and posterior cerebral artery. About two months after ascending aortic replacement surgery, the patient died of sepsis and multiple organ failure.

Conclusion: Although studies show that dual arterial cannulation technique is advantageous over single arterial cannulation in terms of stroke and mortality, single subclavian or axillary and femoral cannulation can be considered in the foreground in selected patients.

Keywords: Aortic dissection; Double arterial cannulation; Complications; Cerebrovascular disease; Stroke

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Introduction

Aortic dissection is a disease of the aortic wall. Early diagnosis is vital. Emergency surgical intervention should be performed in patients with proximal dissection, type-1 and 2, type-A and intramural hematoma [1]. ATAAD surgery has a high risk of perioperative mortality and morbidity. Sixty percent of patients die within 30 days if they do not undergo surgery [2]. Establishing an efficient and safe cardiopulmonary bypass to maintain adequate systemic perfusion is essential in ATAAD surgery [3]. Various cannulation techniques may be preferred to establish CPB during surgery. Each cannulation strategy has different benefits and drawbacks during CPB [4]. Femoral artery cannulation, axillary or subclavian artery cannulation, and central aortic cannulation are the major cannulation strategies in surgery for ATAAD. The most commonly ones are the right axillary and common femoral arteries. For more than 40 years, the femoral artery has been used as the primary cannulation site for CPB during cardiac surgery [5]. Femoral cannulation in a patient in hemodynamically unstable condition allows rapid intervention, decompression and cooling [6]. Femoral cannulation allows retrograde cerebral perfusion. The axillary artery has been used as the cannulation site for more 20 years [7]. Axillary cannulation providing antegrade flow, which theoretically reduces the risk of malperfusion or embolization. On the other side it is time-consuming and not always an anatomically feasible or lower risk. However, both of these access vessels provide different advantages and drawbacks during CPB.

The other cannulation technique is double arterial cannulation, which is performed in the past decades. Studies show mortality and malperfusion-related complication rates of DAC technique is lower than femoral cannulation and single axillary cannulation [4]. In this report, we discussed

the postoperative stroke and process management in our patient, who preferred double arterial cannulation due to its advantages for CPB during surgical intervention.

Case Presentation

An 83-year-old female patient with known hypertension, diabetes mellitus, chronic renal failure, and asthma was admitted to the emergency department with complaints of back and chest pain. There was a difference in blood pressure between the bilateral upper extremities: Right arm - 108/64 mmHg, left arm - 89/56 mmHg. Transcutaneous oxygen saturation was 94%. Electrocardiography showed normal sinus rhythm of 77/min, normal axis, minimal ST depression in leads v1-v4, and Q wave in lead d3. In her anamnesis, we learned the patient applied to another hospital with the same complaint 20 days ago; and aortic dissection was detected. Emergency medicine specialist told her that surgical operation was required, but the patient did not accept surgical intervention. The patient was discharged after being followed up in the intensive care unit.

In echocardiography taken at emergency service, ejection fraction was 66%, heart chambers were standard in width, 1-2+ aortic valve insufficiency, 1+ mitral valve insufficiency, 2-3+ tricuspid valve insufficiency, pulmonary artery pressure: 35 mmHg, aortic flow rate 166 cm/sec, the aortic leaflet opening 1.5 cm, aortic root: 2.1 cm, left atrium: 4.0 cm, ascending aorta: 4.1 cm, no pericardial effusion, no apparent wall motion defect, aortic and mitral valve calcific and degenerative changes were observed.

Drugs used by the patient were acetylsalicylic acid, oral antidiabetics, candesartan, proton pump inhibitor, atorvastatin and metoprolol.

After detecting aortic dissection extending from the aortic root to the right brachiocephalic truncus (Stanford type A) in the computerized tomography taken under emergency conditions, it decided to undergo surgical intervention. Supracoronary ascending aorta replacement operation was planned for the patient whose coronary lesion was not detected in her Coronary-CT Angiography. The patient was operated on urgently after obtaining her consent (Figure 1, 2).

Surgical Techniques

The patient was placed supine position, and arterial pressure was monitored *via* one arterial line. Nasal temperature probes were placed to control temperature. Neurological monitoring was done with NIRS (near-infrared spectroscopy) to maintain brain perfusion. We permanently checked her irises' sizes and reflexes during operations. We cooled her head with topical ice packages. We dissected the subclavian artery and vein through the right infraclavicular incision. The subclavian artery was clamped. Arteriotomy was performed on the subclavian artery, and the 8 mm PTFE graft, which is suitable for cannulation, was anastomosed end to side, and the graft was clamped. At the same time the femoral artery was found and prepared through a right oblique femoral incision. It was prepared for cannulation with pledgeted sutures. We passed the skin, subcutaneous and skeletal structure with the median sternotomy incision and reached the pericardium. We did pericardiotomy and saw the dissected part of ascending aorta. Following systemic heparinization, arterial cannulation from the right femoral and subclavian artery and the right atrium was cannulated, and CPB with deep hypothermia was initiated.

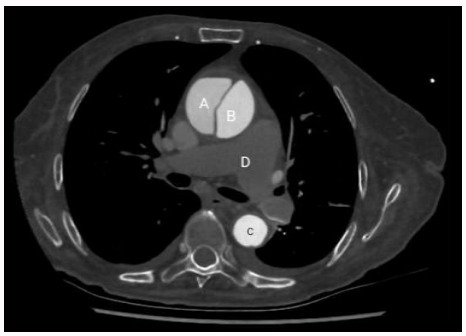

Figure 1: Axial section of CT-Angiography, Ascending aorta dissection. A: False lumen; B: True lumen; C: Descending aorta; D: Pulmonary bifurcation

Figure 2: Coronal section of CT-Angiography, Ascending aorta dissection. A: False lumen; B: True lumen

Aortotomy was performed after cross-clamp. Cardiac arrest was achieved by applying antegrade blood cardioplegia through the coronary orifice of the aortic root with osteal cannulas. The aortic valve, aortic root, and coronary ostium were found intact. It was determined that the patient had isolated ascending aortic dissection. The dissected part of ascending aorta was excised. False and true lumen were combined into a single lumen with the modified Safi technique. The ascending aorta was repaired using a 21 mm composite graft. During the replacement, low-pressure continuous cardioplegia was applied with antegrade blood cardioplegia cannula. After air evacuation, the cross-clamp was removed, and the CPB stopped under the appropriate hemodynamic conditions (Figure 3, 4).

Postoperative Period

The patient who had cardiac tamponade on the first postoperative day was taken to emergency operation. There was no spontaneous awakening in the postoperative intensive care follow-ups. In the physical examination of the patient who was consulted to the department of neurology, the patient who was followed up intubated was unconscious and had no response to audible and painful stimuli. Bilateral pupils were isochoric, and light reflex was weak bilaterally. Eye movements did not cross the midline with the ocular counter roll test, and corneal reflex could not be obtained. The extremities are motionless, not pulling with painful stimuli. Deep tendon reflexes could not be taken globally. Bilateral extensor response was detected with plantar reflex, and no response was obtained on repeated examination. Upon the neurologist's recommendation, the patient underwent cranial CT without contrast. As hypodense areas were noted in the areas supplied by the right Anterior Communicating Artery-Middle Cerebral Artery (ACA-MCA) on CT, it was decided to undergo MR Angiography with contrast. In the MR imaging, diffusion

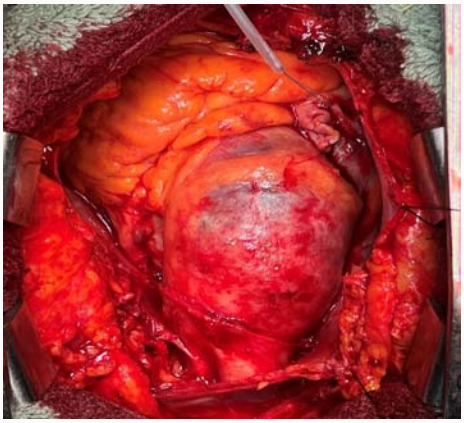

Figure 3: Perioperative view before supracoronary ascending aorta replacement.

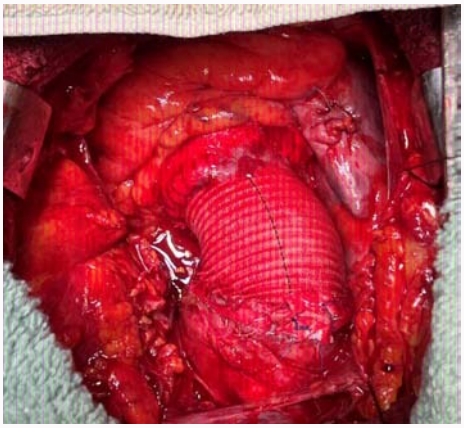

Figure 4: Perioperative view after supracoronary ascending aorta replacement with Dacron graft (No:21).

and apparent diffusion coefficient hyperintense lesions consistent with subacute infarct were observed in the areas supplied by the right Middle Cerebral Artery and Posterior Cerebral Artery (MCA-PCA). MR angiography could not be evaluated due to artefacts. Cranial CT Angiography was planned for the angiographic evaluation, and no significant stenosis lesion was detected. In the recurrent neurological examination of the patient on the twentieth postoperative day, she is conscious, uncooperative, and has no voice. There are light reflexes in her eyes and pupillary isochoric. Eye movements are complete with the ocular counter roll test. The patient is left hemiplegic. She can move her right side, arm and leg. The plantar reflex was taken as weak bilaterally. The patient was tracheostomized, followed up, and treated in the intensive care unit.

Discussion

ATAAD requires rapid surgical intervention. It has a high risk for perioperative mortality and morbidity, despite the latest improvements in diagnostic and surgical techniques [8]. According to the results of International Registry of Acute Aortic Dissection, the in-hospital mortality rates had fallen from 31% to 22%, the operative mortality ranged from 25% to 18% [9].

One of perioperative risks is malperfusion. Malperfusion may involve any of the major aortic branches [10]. Stroke, myocardial infarction and malperfusion are important causes of perioperative death.

We thought our patient had stroke because of the cannulation strategy. Because we know that cannulation strategy is one of the reasons for complications. Several comparative studies shows that the cannulation strategy performed is related to higher or lower perioperative complication. The evidence is inadequate to make a strong advice regarding cannulation strategies. Each one has different advantages and drawbacks.

The femoral artery and axillary artery are the most common used cannulation approaches for ATAAD. Femoral arterial cannulation can be constructed instantaneously; thus, it is considered to be advantageous in patients with unstable hemodynamic condition. However, this cannulation strategy increases the incidence of stroke due to retrograde perfusion [3,11]. Additionally femoral artery cannulation has a high rate of false lumen perfusion and limb malperfusion [12].

Axillary artery cannulation is commonly performed. This technique can provide antegrade perfusion, which may supply for brain but may cause end-organ malperfusion because it has limited flow rate. Many surgeons who favor axillary cannulation and central cannulation believe that the antegrade perfusion strategy is advantageous in preventing brain malperfusion [2]. Axillary artery cannulation was adequate for acute aortic dissection. Its results is satisfying as dual arterial cannulation [3].

We established CPB with DAC which subclavian artery was combined with femoral artery. DAC has trustworthy circulatory support, which provides anterograde and retrograde blood flow at the same time. Double flow achieves the best systemic perfusion stability. When we look at Lin et al. study DAC had considerably lower in-hospital mortality rates and less incidence of malperfusion-related complications than patients who underwent single axillary cannulation in 10-year experience. Our patient had chronic renal failure but she had been no on dialysis. DAC has a lower incidence of postoperative acute kidney injury [4]. It was the best strategy for her to keep her kidney from dialysis. Lin et al. study shows that the incidence of postoperative stroke was higher in the DAC group than in the RAC group. They thought addition of the femoral artery was the reason. Our patient also had stroke in the postoperative period.

Conclusion

DAC for establishing CPB was safe for our patient about postoperative acute kidney injury, but she had stroke which was most probably related to cannulation. Whichever cannulation type is preferred, there are advantages and disadvantages. In many studies, DAC has lower incidence of malperfusion-related complications than single arterial cannulation. In our case, although DAC was preferred according to the literature and close follow-up with NIRS in the perioperative period, diffusion restriction in the areas supplied by the right MCA-PCA and apparent diffusion coefficient hyperintense subacute infarction in our patient caused neurological dysfunction in the postoperative period. Cannulation techniques should be specifically evaluated for each patient and their drawbacks should be carefully considered.

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