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Case Report

Use of Circulatory Arrest to Treat A Large Aneurysm of the Innominate Artery

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Abstract

The aneurysm of the innominate artery (AIA) is a rare entity. It represents only 3% of all aneurysms of the arteries of the body and also represents 3% of aneurysms of the supra aortic arteries. We report a case of 65 year-old man, concerning the cardiovascular risk factors we enumerate age, male gender, active smoking and arterial hypertension. He was admitted in our department for the management of a large pulsatile mass on the right side of the neck with intermittent headache. The computed tomography (CT) angiography showed the presence of an aneurysmal dilatation of the innominate artery (type B) measuring 42 mm, with a large fresh hematoma which comes from the aneurysm and extending to the right cervical region. However the aortography objected an anevrysmal dilatation of the IA which includes even its base. In this case we used the cardiopulmonary bypass with deep hypothermia before sternotomy and right cervical approach. The surgical repair consisted to close the defect above the aortic arch by prosthetic patch after the resection of the AIA under circulatory arrest with deep hypothermia and establishing bypass using a graft between the prosthetic patch and de distal segment of the IA under side clamping.

Keywords: *Innominate Artery; Aneurysm; Surgery; Endovascular*

Introduction

The aneurysm of the innominate artery is a rare entity. It represents only 3% of all aneurysms of the arteries of the body and also represents 3% of aneurysms of the supra aortic arteries [1,2]. The etiology of these aneurysms is dominated by atherosclerosis [3]. In this article we report the surgical management of a huge innominate artery aneurysm which was pre-ruptured.

Case Report

A 65-year-old man, concerning the cardiovascular risk factors we enumerate age, male gender, active smoking and arterial hypertension.

He was admitted in our department for the management of a large pulsatile mass on the right side of the neck (Figure1) with intermittent headache. His medical history goes back 10 years ago, when this mass was very small, initially neglected by the patient. The evolution was marked by the rapidly progressive evolution of the mass in the last nine months. Furthermore there are no signs of compression (dyspnea, dysphagia or dysphonia) and non history of thoracic and cervical trauma.

Figure 1: *Picture showing the mass in the right side of the neck.*

On clinical examination, the patient was apyretic, heart rate was 70 beats per minute, respiratory rate was 18 cycles per minute and blood pressure was 140/60 mmHg.

On cervical examination, the mass measuring 15 cm of long axis. It is pulsatile, fixed in the deep plane and movable in relation to the superficial plane, painless, with no inflammatory signs and no thrill.

Cardiovascular examination and neurological examination were normal. And the rest of the somatic examination was unremarkable.

The electrocardiogram (ECG) found a regular sinus rhythm Transthoracic echocardiography (TTE) showed a left ventricular (LV) hypertrophy, site of akinesia of the inferior and lateral walls, anterior and infra-septal hypokinesia, with severe severe systolic dysfunction of the LV (LVEF of 35%).

The coronary angiogram was normal. The aortography realised in the same time objected an aneurysmal dilatation of the IA which includes even its base (Figure 2).

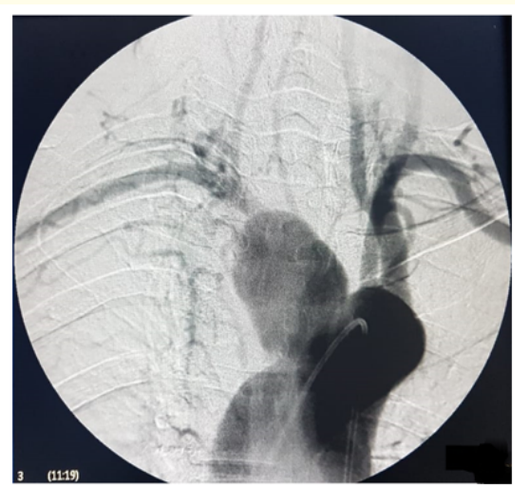

Figure 2: *Preoperative aortography showing the aneurysmal dilatation of the innominate artery and his bas of implantation.*

The whole-body CT scan demonstrated the presence of an aneurysm of the innominate artery (type B) measuring 42 mm, which is thrombosed (Figure 3). We note the presence of a large fresh hematoma which comes from the aneurysm and extending to the right cervi-

cal region. In this case, the right subclavian (RSA) and the right common carotid (RCCA) arteries are permeable. No anomalies in the left common carotid (LCCA) and left subclavian (LSA) arteries. The aorta is normal with no other aneurysmal locations. The circle of willis is normal.

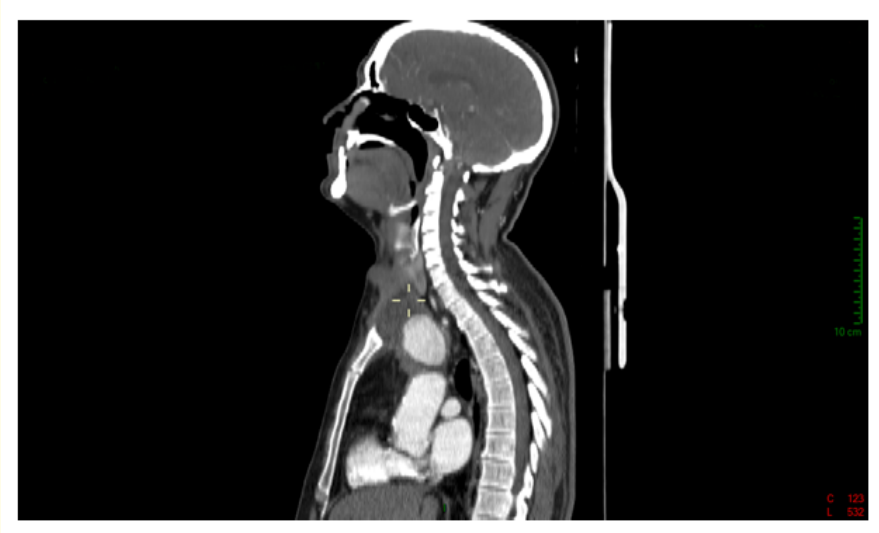

Figure 3: *Preoperative CT angiography in the sagital plane showing the aneurysm of the innominate artery.*

The etiological assessment was unremarkable especially autoimmune antibodies, rheumatoid Factor, mycotic, bacterial and viral tests. Similarly, the rest of the laboratory tests were normal.

The patient was admitted to the operating room. After systemic heparinization, the cardiopulmonary bypass (CPB) is instituted with two arterial cannula introduced in the right femoral and LCCA and the venous cannula was introduced into the left femoral vein. The CPB and cooling is begun. AT a temperature of 30˚C, we performed a median sternotomy with longitudinal opening of the pericardium. The ventricular vent is placed via the right superior pulmonary vein and the cannula of retrograde cardioplegia was introduced in the coronary sinus. The ascending aorta is cross-clamped and the cold blood cardioplegia is infused into the coronary sinus. Careful inspection objected a large AIA, adhering to the right edge of the sternum. The LCCA and LSA will be prepared for clamping. When the esophageal temperature is between 18 and 20˚C, the head is placed down ward after being backed in ice. General perfusion is discontinued, the cross-clamp is removed and the antegrade selective cerebral perfusion (ASCP) was instituted via the LCCA and placing soft clamps in the LSA, LCCA. However the cerebral monitoring was carry out by the Near-infrared spectroscopy (NIRS). The ostia of the IA was opened circumferentially, the highlighting assessment revealed a huge thrombus at the origin of the AIA (Figure 4). The thrombus has been removed (Figure 5 and 6). The incision will be extended into the right neck along the medial edge of the sternocleidomastoid, then the RSA, RCCA was clamped. The resection of the IAA was completed from its origin in the arch to its distal bifurcation. The defect of the aortic arch was closed by Dacron prosthetic patch with continuous 4/0 polypropyline suture, the last few loops of the suture line are left loose (Figure 7). The head is placed in trendelenburg position, to flush all air from the aorta and the suture is tied. Then CPB and rewarming is started. Side-clamping near to the prosthetic patch was achieved; the arterial continuity was reestablished with the prosthetic Dacron (8mm). The proximal bypass graft was anastomosed to the prosthetic patch and after systematic de-airing, the distal bypass graft was anstomosed to the distal segment of the IA (Figure 8). At esophageal temperature to 35°C and the bladder temperature to 30 to 32°C, the patient is weaned from cardiopulmonary bypass.

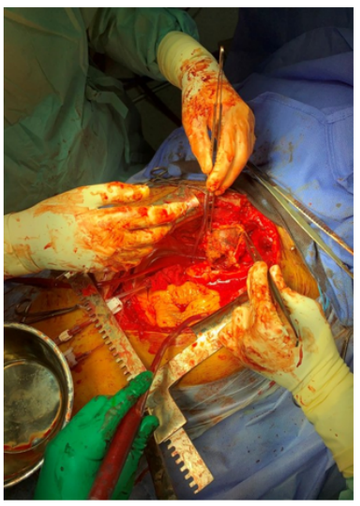

Figure 4: *A perioperative view showing a huge thrombus at the origin of the innominate artery.*

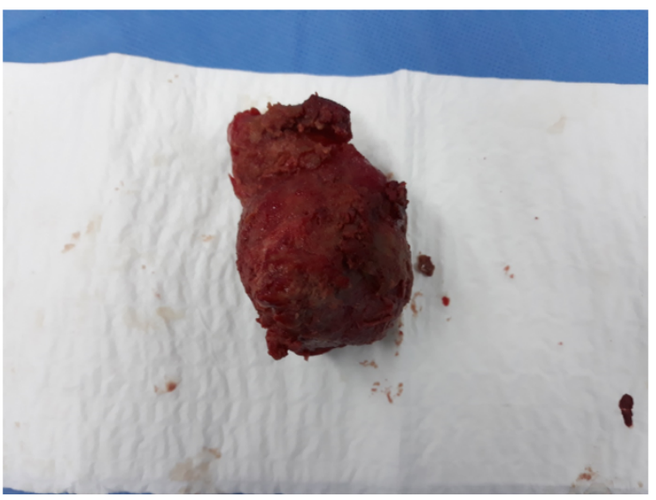

Figure 5: *Perioperative view showing the thrombus after the extraction.*

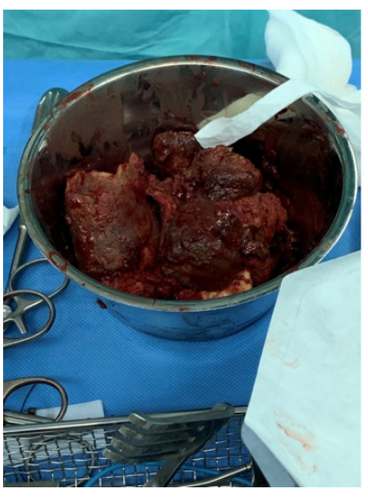

Figure 6: *Perioperative view showing the thrombus after the extraction.*

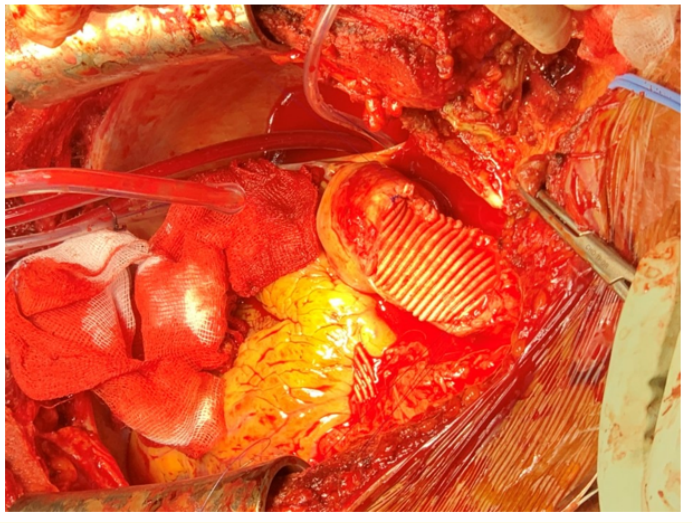

Figure 7: *A perioperative view showing the closure of the aortic arch by prosthetic patch.*

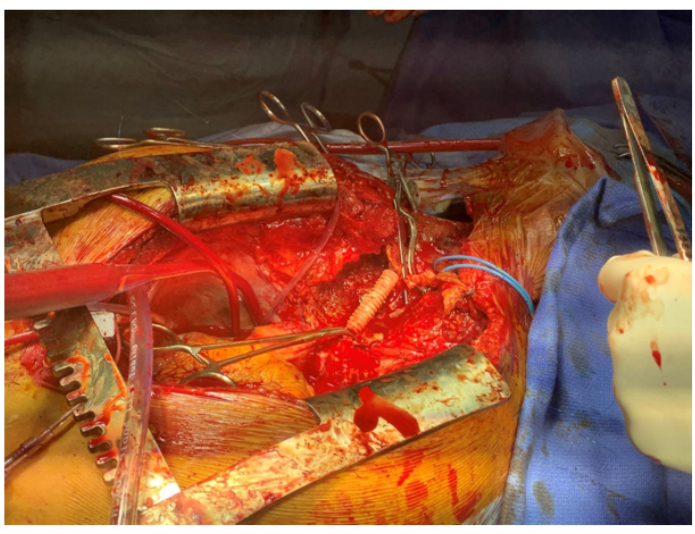

Figure 8: *A perioperative view showing the distal bypass graft anstomosed to the distal segment of the IA.*

The CPB time was 7 hours, Cross clamping time: 40 minutes, lower body circulatory arrest time 44 minutes

Discussion

The aneurysm of the innominate artery is a rare entity. It represents only 3% of all aneurysms of the arteries of the body and also represents 3% of aneurysms of the supra aortic arteries [1,2]. The etiology of these aneurysms is dominated by atherosclerosis; however, the

secondary causes may include syphilis, tuberculosis, Kawasaki disease, Takayasu arteritis, Behçet's disease, connective tissue disorders and angiosarcoma [3].

The AIA can produce many serious complications including thrombosis, distal embolism, compression of surrounding tissue and rupture [3]. The risk of rupture increases in patients with either a post traumatic aneurysm, or a connective tissue disease or when the diameter of the aneurysm exceeds 3 cm [4,5]. Its incidence can reach 11% of all patients [4]. In these patients with a high risk of rupture, surgical or endovascular repair should be recommended as precautiously as possible [4,6].

The clinical manifestations of AIA are non-specific and diverse, including hoarseness, dyspnoea, dysphonia, dysphagia, upper limb and facial edema, headache and embolism (TIA or stroke), chest pain, digital ischaemia, right hemispheric symptoms, amorosis fugax and vertebrobasilar syndrome [7,8]. While the most evocative sign is the presence of a pulsatile mass on one side of the neck [8].

Based on the extent of the aneurysmal involvement, Kierffer and al classified the IAA in three groups:

group A: no involvement of the origin of the IA; group B:involvement of the origin of the IA but not of the aorta; and group C: involvement of both the IA and aorta. therefore the choice of the surgical technique is based on this classification [4]. Our patient had a large type B of the AIA.

Surgical treatment is indicated when the aneurysm is symptomatic or ruptured. Moreover the asymptomatic aneurysms should be operated when they are combined with aortic arch aneurysms and when they are saccular or when their maximum transverse diameter is greater than 30 mm [4].

Currently, the most common approaches used in the surgical treatment of aneurysms are the median hemisternotomy combined with the right anterior thoracotomy in the 3rd intercostal space and the right supraclavicular fossa, median sternotomy with extension in the right side of the neck [9,10]. Furthermore the midline sternotomy with or without the right cervicotomy still the exposure technique of choice [10,11]. However, the sternotomy can be dangerous after rupture or in the case of aneurysms having a close contact with the sternum [4]. In these case, it's mandatory to install a femorofemoral CPB, to decrease the core temperature, and induce deep hypothermic circulatory arrest before opening the chest. In this manner, we can open the sternum without exsanguination [4]. Our attitude was to established the CPB and reduced the core temperature before the sternotomy.

In the literature, several surgical techniques have been developed for the treatment of AI aneurysm, including ligation alone, patch angioplasty, resection with end-to-end anastomosis and bypass with saphenous vein or prosthetic grafts [12,13]. However the choice of the surgical technique depend on the extent of aneurysmal involvement.

Group A aneurysms are a rare entity. Their treatment is easy. The surgical technique consists to establishing a bypass using a graft between the ascending aorta and the right common carotid-right subclavian arteries, and then the origin of the AIA is closed with a ligature [4].

Group B aneurysms are the most common entity. The surgical technique consists to establish the revascularization of the supra aortic trunks from the ascending aorta and the aortic defect was closed either by lateral suture under side clamping or by prosthetic patch under cross clamping without CPB. However when we have a common trunk for the IA and the LCCA, the best technique is to establish a sequential revascularization from the ascending aorta to the LCCA and IA [4].

Our patient had a large type B aneurysm adhering to the right edge of the sternum and which was fissured inducing a massive hematoma in the right side of the neck. In order to avoid exsanguination we preferred to install the CPB before the sternotomy and to carry out the gesture of resection of the aneurysm and the patch angioplasty of the aortic cross under circulatory arrest with deep hypothermia.

Besides the treatment of group C aneurysms requires cardiopulmonary bypass for the replacement of the ascending aorta. In addition, we use deep hypothermia at 18°C to 20°C and circulatory arrest for the replacement of the transverse aortic arch [4].

During the last years, there has been an increase in the number of cases of AIA treated by endovascular approach [10,11]. Despite the fact that used less frequently than open surgical repair, the endovascular repair and minimal invasive access seems to give similar short- and long- term mortality to open surgery with fewer early complications and short hospital stay [14]. However no case of type B aneurysm has been treated by endovascular approach [15].

Moreover the endovascular treatments can be challenging in cases when the distal innominate artery is involved or where the aneurysmal neck is inadequate for attachment of the graft [16,17], or when the arch is of bovine morphology [18].

Currently the minimal invasive strategies and endovascular repair represents an emerging alternative to conventional surgery of AIA. Therefore further research is needed to defined the optimal patient selection criteria and determine the long term outcomes of these new techniques [19].

Conclusion

The AIA is a rare entity. the diagnosis is based on CT scan imaging. The surgical repair is currently the standard approach with good prognostic outcomes.

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