Successful Repair of a Giant Thoracic Aortic Aneurysm with De Bakey IIIB Dissection Using Hybrid Surgical Approach. A Clinical Case

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Thoracic aortic aneurysms account for about 20% of all aortic aneurysms. Their incidence is 6 per 100000 of patients per year (5). Aneurysm development is connected with media degeneration resulting from the insufficiency of all layers of the aortic wall. The risk of rupture is related to the increase of aortic diameter (7). In 33-50% of cases the rupture leads to death (5,8).

Aortic dissection is a complex emergency situation, occurring twofold more frequently than abdominal aortic ruptures. The dissection of the aortic walls can cause dynamic or permanent obstruction, rupture or thrombosis of the aortic branches.

Open surgical intervention is a traditional standard treatment for this condition. The mortality associated with open interventions in the leading world centers is about 5-14% (for III type dissections) (10,11). The complications involve pulmonary, renal and cardiovascular systems and abdominal organs, thus significantly increasing the risk of death. Herewith the rate of complications is directly related to the size and the extension of the aneurysm. Concomitant diseases existing in many patients cause many problems related to open surgical interventions.

With the account of open surgery-related risks, endovascular minimally invasive approach seems attractive and advantageous. The aim of endovascular aneurysm repair (EVAR) consists in the prevention of aneurysm rupture and aortic dissection by the way of aneurysmatic sac exclusion from the circulation, decreasing of the tension of aneurysmatic sac's walls or of the pressure in the false lumen with its subsequent closure.

In order to illustrate the up-to-date possibilities of the aortic dissection repair we present a clinical case of successful repair of a giant thoracic aortic aneurysm with De Bakey IIIB dissection and a parietal thrombosis using hybrid surgical method.

Keywords: *hybrid surgery, thoracic aortic aneurysms, aortic dissection, open surgery, endovascular interventions, endoprosthesis, EVAR.*

Introduction

According to expert data, thoracic aortic disease is diagnosed yearly in over 16,000 European patients (1,6). The development of aneurysms is related to media degeneration as a result of insufficiency of all aortic wall's layers. Dissection occurs in about 50% of thoracic aortic aneurysms. In fact, these are false aneurysms, as the process of dissection does not involve all aortic wall's layers.

The incidence of thoracic aortic aneurysms rupture is 3.5-5 / 100,000 patients per year. The risk of rupture is related to the increase of aortic diameter (7). The rupture leads to death in 33-50% of cases (5, 8). Population studies have shown that 5-year survival in patients with untreated thoracic aneurysms of various genesis is only 13% (5), while 3-year survival in patients with degenerative aneurysms is 35% (8,9).

The dissection of thoracic aorta is a complex emergency situation occurring twofold as often as abdominal aortic aneurysms. Atherosclerotic degeneration of the aortic wall in hereditary diseases, such as Marfan and Ehlers-Danlos syndromes, and arterial hypertension is a predictor for dissection. Local intimal rupture or intramural hematoma leads to abrupt blood inflow into the aortic media layers which ends by aortic dissection and the development of a false lumen. The dissection can extend proximally as well as distally to the site of initial lesion, thus creating aortic branches' obstruction (dynamic or permanent), rupture or thrombosis.

Aortic dissections can be classified by their location, duration and presence of ischemic complications. According to one of the most often used Stanford classification, type A includes the dissection of the ascending aorta, type B — the dissection of the descending aorta. De Bakey's type I includes the dissection of the whole aorta, type II — the dissection of the ascending aorta, type III — the dissection of the descending thoracic aorta and of the abdominal aorta.

Pharmacological therapy and regular diagnostic studies are indicated in most cases. Surgical interventions for asymptomatic aneurysms are recommended if aneurysmatic sac attains 5.5-6 cm in diameter, while acute symptomatic aneurysms irrespective of

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their diameter and dissecting aneurysm should be operated immediately.

Open surgical intervention is the traditional standard treatment. Mortality rate in open surgery in the leading world centers is about 5-14% (for type III dissections) (10,11), the rate of paraplegia is 5% (12, 13). Other major complications involve pulmonary, renal and cardiovascular systems and abdominal organs, which contribute to a significant rise of mortality risk. Herewith the incidence of complications correlate with the size and the extension of the aneurysm and the dissection.

Concomitant diseases present in many patients create a lot of problems related to open surgical intervention. The decision making is complicated by the following factors connected with increased risk of surgical mortality: the patients' age over 70 years, preoperative shock / hypotension, multifocal atherosclerosis (in about 1/3 of patients), partial thrombosis of the false lumen, signs of periaortic hematoma, descending aortic diameter > 6 cm, right ventricular dysfunction. One also has to keep in mind relative contraindications for open surgery: ACVA, marked LV failure, coagulopathy, pregnancy, myocardial infarction (< 6 months), marked arrhythmia, elderly age, valvular apparatus diseases.

Taking into account the risks of open interventions, the endovascular minimally invasive interventions in aortic aneurysms (EVAR — endovascular aneurysm repair) are advantageous and attractive in comparison with traditional surgery. As a result, the patients with contraindications for open surgery have gotten a chance for correction. The use of endovascular endoprosthesis allows for the closure of fenestrations, the thrombosis of the false lumen with the reconstruction of the true lumen, the decreasing of pressure in the false lumen and the increasing of distal perfusion (14, 15, 16). As a rule, short term mortality indices (30-day mortality, 3- and 6-months mortality and 1 year mortality) after endovascular interventions on aortic aneurysms and type B dissections are significantly lower than after open surgery (17,18). Endovascular repair of thoracic aortic aneurysms is associated with lower complications rate, shorter ICU and hospital stay, lower blood loss and lower percentage of paraplegia in comparison with open surgical intervention (19, 20,21). The complications associated with this technique include: incomplete exclusion of the aortic arch from the circulation due to the gaps between the endoprostheses, the endoleaks of the 1st and other types.

Fig. 1. MHCT-aortography of patient A

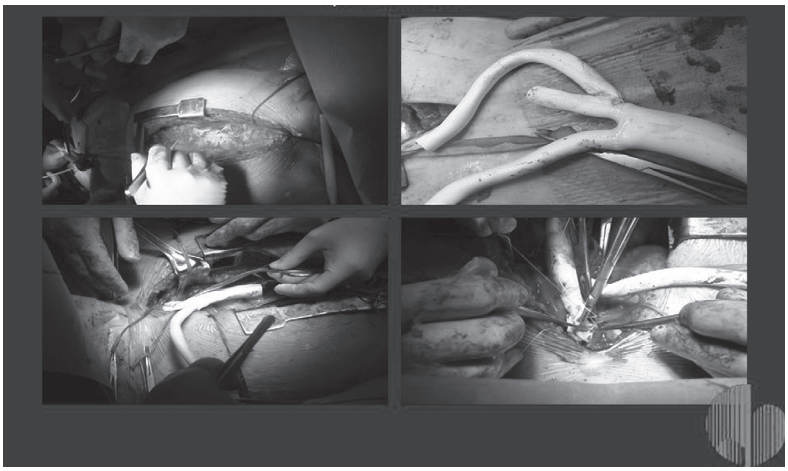


Fig. 2. The stage of open surgical intervention: the grafting of the brachiocephalic trunk, the left common carotid artery, the left subclavian artery with a trifurcating Gore prosthesis

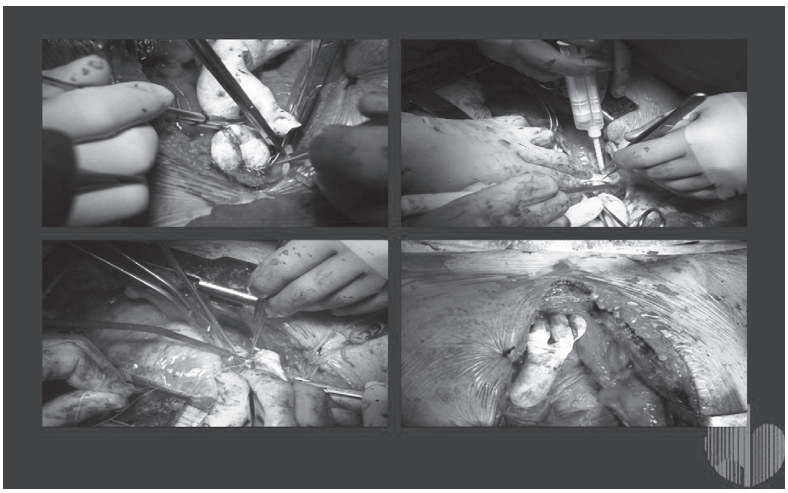


Fig. 3

A significant number of patients with acute and chronic pathology have thoracic aortic lesion involving aortic arch branches (the brachiocephalic trunk, the common carotid and the subclavian arteries). In

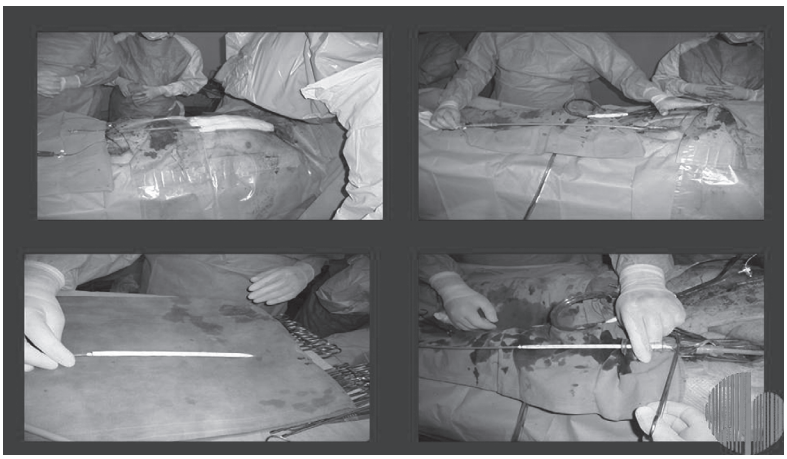


Fig. 4. Endovascular grafting of the thoracic aorta using Gore endoprosthesis

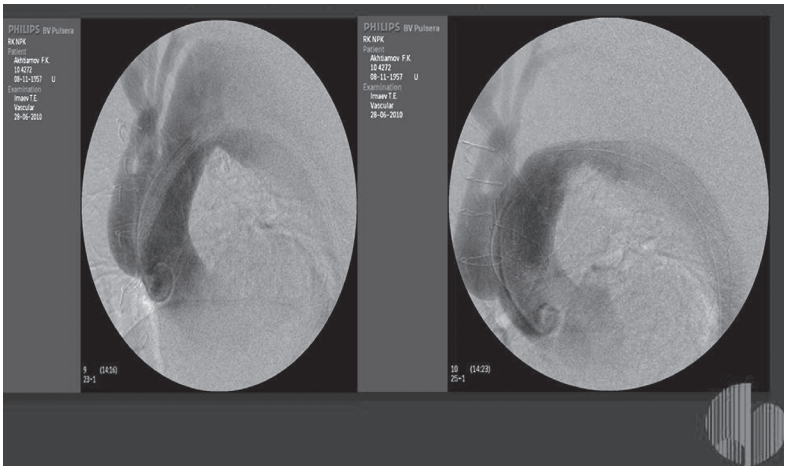


Fig. 5 Intraoperative aortography of patient A

such cases in order to enlarge the proximal area of endoprosthesis deployment during endovascular interventions it can be necessary to cover the aortic arch branches. The occlusion of supraaortic vessels by endoprosthesis can be a severe, sometimes even fatal complication of endovascular interventions on the ascending aorta and aortic arch. In such case it would be reasonable to find some balance between the "traditional open surgery" and the endovascular interventions. The so-called "hybrid" operations, combining minimal invasiveness of the open access, the providing of visceral perfusion, the minimization of ischemia duration, the creation of a safe terrain for endoprosthesis implantation and endovascular grafting for aortic aneurysm exclusion, as such, can offer this balance (22). Many innovative methods, including the reimplantation of the major aortic arch branches (rebranching), shunting operations and "elephant trunk" reconstructive surgery have been presented rather recently (23-28).

Case report

In order to illustrate the current possibilities in the treatment of aortic dissection we would like to present a clinical case of successful correction of a giant thoracic aortic aneurysm with De Bakey IIIB dissection using hybrid surgical approach.

The 52-years old patient A, male, was admitted to the Department of Cardiovascular Surgery in June 04, 2010, with chest pain syndrome, complaints of arterial hypertension, neurological disturbances and impossibility to urinate. The analysis of his history revealed 3rd degree arterial hypertension of many years duration (maximal BP 220/160 mm HG) despite regular hypotensive therapy. MHCT performed in September 2009 revealed aortic arch aneurysm with III type dissection. After acute development of lower paraplegia on May 25, 2010, the patient was diagnosed with acute impairment of spinal circulation and paradoxical ischuria ((neurogenic bladder)

EchoCG: the aorta is indurated, with descending segment diameter of 3,7 cm, significantly dilated (up to 9 cm) in the descending thoracic segment, where intimal dissection can be seen. An area filled with up to 3 cm thick thrombus is visualized at the external contour of the descending aorta. The cardiac cavities are not enlarged. The LV EF > 55%, there are no areas of local contractility impairment. There are insignificant valvular regurgitations.

Coronary angiography: the left main coronary artery without changes. Irregular contours of the LAD, the CxB and the RCA.

MHCT-angiography (Fig.1): the walls of the ascending aorta are not thickened, there are no calcification. Maximal diameter of the aortic root -– 3,9 cm, the aortic arch and the descending segment are enlarged up to 9 cm, a massive parietal thrombosis can be seen at the external contour. The intimal dissection starts from the left subclavian artery ostium, the true lumen is several times smaller than the false one. The aortic dissection can be found up to the celiac axis (arising from the true lumen), below the celiac axis there is no dissection.

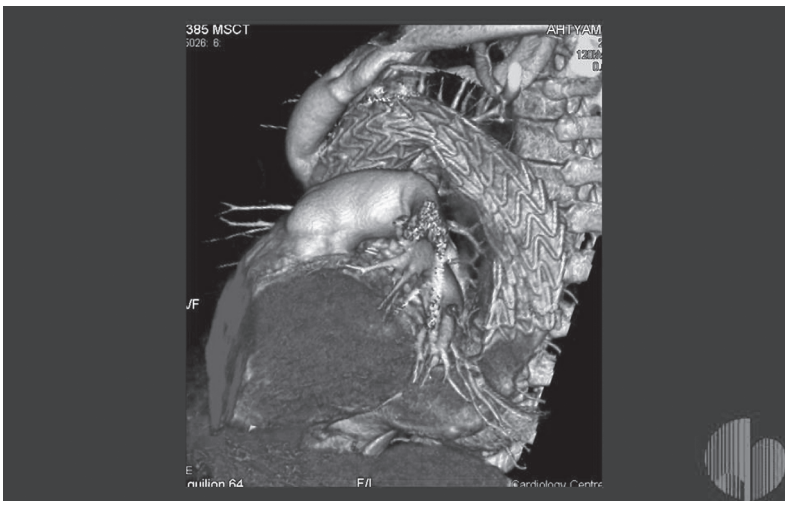
Consultation of a neurologist: the episode of acute impairment of the spinal circulation was caused by intima dissection in the ostium of an intercostal artery at the level of Th X-XI (proximal to the end of aortic dissection) with subsequent restoration of the collateral circulation.

The patient was diagnosed with a giant thoracic aortic aneurysm with De Bakey IIIB dissection, with parietal thrombosis; the impairment of the spinal circulation with the development of transient lower paraplegia and urination disturbances; arterial hypertension.

On June 28, 2010, the patient underwent hybrid surgical intervention: endovascular repair of the thoracic aorta with the grafting of the brachiocephalic trunk, the left common carotid artery and the left

subclavian artery using a trifurcation Gore prosthesis.

The access to the heart and aortic arch branches was achieved through median sternotomy. Simultaneously the common femoral artery was approached through the left thigh. Three distal prosthetic anastomses were performed — to the left subclavian artery (LSA), the left common carotid artery (CCA) and an "end-to-side" anastomosis to the brachiocephalic trunk (BCT) using lateral dislocation of the aorta (Fig. 2). After that a proximal "end-to-side" Gore anastomosis to the aorta was performed (Figs. 2, 3). The CCA, LSA and BCT were ligated. The anastomoses were patent and non-leaking. An introducer was inserted through a puncture to the CFA, and a diagnostic catheter was advanced into the ascending aorta via the stiff guide. Diagnostic aortography was performed. Simultaneously a delivery system was inserted through the left CFA. A Gore Tag 45x20 endoprosthesis (Fig. 4) was delivered through this system into the ascending aorta and deployed from the level of distal edge of the trifurcating Gore prosthesis anastomosis with the aorta (Fig. 5). Control opacification of the aorta demonstrated effective grafting of the proximal aortic dissection, no endoleak signs were revealed.



Firg. 6. Postoperative MHCT-aortography of patient A

Results of study

The patient's rehabilitation was achieved within the shortest term. The patient was discharged at day 5. Postoperative course was uneventful. The patient has been followed in the long-term (1 month — 1 year), no complications were revealed. According to control MHCT aortography (Fig. 6), the false lumen did not opacify, there were no signs of endoleak. The aortic arch arteries opacified through the trifurcating prosthesis from the ascending aorta.

Discusson

In view of latter achievements in endovascular therapy, endovascular aortic repair (EVAR) is being used more frequently for the treatment of aneurysms and aortic dissection with satisfactory initial results.

In accordance with the existing indications for EVAR, the necessary zone of endoprosthesis fixation should be at least 20 mm and the diameter of the aorta less than 40 mm. For this reason, from the viewpoint of surgical indications, the anatomical factors, the character and the length of arterial injury, as well as aneurysm morphology play an important role in the choice of the tactics of treatment, and EVAR should not become the method of choice if the aneurysm / dissection is located in the close proximity of the main aortic branches. Fenestrated and multi-branched endoprosthesis have been developed just for such cases — in order to provide the blood flow to the branches in aortic aneurysms / dissections, but at present they are submitted to detailed clinical testing in single clinical centers, and the accumulated information will be carefully analyzed by the experts. These endoprostheses are made by hand, adjusted for the anatomy of each patient and necessitate a precise sizing as well as 6 to 8 weeks to be manufactured.

Hybrid procedures combining traditional surgical approach and EVAR, are being developed and introduced with the aim of enlarging the indications for endovascular interventions in high-risk patients. This approach is minimally invasive, associated with low rate of complications and mortality. Hybrid approaches for the treatment of aortic arch pathology will continue to develop, the methods and the techniques will be elaborated and brought to perfection. The future role of these procedures will be determined by their long-term results.

Hybrid surgery is a particular transition to eventual primacy of endovascular multi-branch grafting in the future and represents a real alternative for patients with contraindications to endovascular or open surgical intervention.

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