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Experiences of 20 cases treatment of aortic stent for De Bakey III aortic dissection

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The objective was to observe and analyze clinical feasibility and clinical efficacy of aortic stent for De Bakey III aortic dissection. Clinical data of 20 patients with De Bakey III aortic dissection was reviewed after aortic stent, focusing on analyzing surgical methods, surgical outcomes, complications and postoperative follow-ups etc. All operations were successful. The average stent diameter was 34 ± 6 mm. 16 patients were partially covered with stent graft or the left subclavian artery. Obvious postoperative psychiatric symptoms caused by cerebral ischemia were not accompanied, nor were death, paraplegia or respiratory failure and other complications. Postoperative follow-up rate of 91.67% and 2 patients had internal hemorrhage, with one closure through 6 months regular medical treatment after stent internal hemorrhage surgery. Another one underwent stent implantation again. Aortic stent seems to be effective, safe and minimally invasive for De Bakey III aortic dissection with fewer complications and fast recovery etc.

Key words: Aortic stent, aneurysm, aortic dissection, minimally invasive surgery.

INTRODUCTION

Aortic dissection is a kind of fatal aortic disease, in which circulating blood goes to aortic wall through clefts after aortic tunica intima tear that leads to vascular wall stratification. It is a kind of extremely dangerous cardiovascular disease. Most patients died in short period without treatment (Apostolakis and Akinosoglou, 2007). In recent years, with progress of interventional techniques and improvement of equipments, satisfactory clinical effects for aortic stent in treatment of De Bakey III aortic dissection has been achieved. 20 patients from February, 2008 to 2013 were treated by it, and resulted in satisfied effects. Experiences are as described.

MATERIALS AND METHODS

General information

We analyzed clinical and imaging data of the inpatients with De Bakey III aortic dissection during February, 2008 to 2013 from our cardiac surgery. We monitored blood pressure, heart rate etc., combined with vasodilator sodium nitroprusside and β-blocker propranolol to control systolic blood pressure at 100 ~ 110 mmHg (1 mmHg = 0.1333 kPa), heart rate at 60 to 80 times/min, and perthidine or morphine hydrochloride was used for sedation. All patients accepted enhanced CT angiography (CTA) consisted of ascending aorta, aortic arch, descending aorta, abdominal aorta, bilateral iliac artery and double femoral artery to confirm the position of aortic dissection cleft and the involving area. Patients under the following conditions could accept aortic stent: cleft at the beginning of the left subclavian artery, retrograde dissection not involving brachiocephalic, no serious tortuous iliac artery, and at least one side of iliac artery dissection not existed. Total of 20 patients accepted aortic stent, 14 males and 6 females between the age of 27 and 72 (averaging 53.5 ± 10.41 years). True lumen becomes smaller when compressed, false lumen is generally bigger than true lumen. Major organs vessel branches in most abdominal cavity are opened in the true lumen. 3 patients with celiac artery and 8 with left renal artery were opened in the true lumen, but near egresses. 16 patients with hypertension (16/20，80%), 6 pneumonia (6/20，30%), 3 renal dysfunction (3/20，15%), 1 Marfan syndrome (1/20， 5%), 2 trauma (2/20， 10%), 1 superior mesenteric

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embolization (1/20，5%), 3 patients (3/20，15%) with retrograde dissection involving the distal opening of brachiocephalic underwent ascending aorta - brachiocephalic artery - the left subclavian artery grafts connection operation under general anesthesia before aortic stent.

Experimentals

Stents and conveyor types: 2 types of stent grafts and conveyor systems were used in this study, including 5 domestic Yu Hengjia stents, and 15 McroPort, operated in the Digital Signature Algorithm (DSA) room, except 3 patients who underwent ascending aorta - brachiocephalic artery. The left subclavian artery grafts connection operation was used for general anesthesia, other 17 were selected partial anesthesia and preoperative analgesic perthidine hydrochloride for sedation. With puncture of left branchial artery, 5F pigtail catheter was put into aortic arch through the left subclavian artery to mark the left subclavian artery opening and aortic angiography. Aortic angiography was performed first to confirm cleft position, then measured the diameter of aortic arch. We chose stent graft in which the diameter was 15 ~ 20% larger than aortic arch (Kieffer, 2000). Taking dissections that did not involve the side of femoral artery, the femoral artery was isolated layer by layer under 2% lidocaine infiltration anesthesia after regular disinfection towel.

Femoral artery was punctured by 5F sheath and tubed into 5F pigtail catheter through the sheath. Tube was up conveyed gradually under the guidance of loach guide wire after backing off the sheath. Angiography was discontinued to confirm the tube in true lumen, but it was done again at the 12th thoracic vertebra to clarify the position of three branches of abdominal aorta artery and the opening in true lumen. The loach guide wire was backed off to insert a long and hard guide wire specially for stent, until the guide wire tip reached new room. Pigtail catheter was backed off to push stent graft to descending aortic arch cleft along hard wire after the cut femoral artery. Sodium nitroprusside controls systolic pressure at 80 ~ 100 mmHg after stent pre-released bony location mark was confirmed. Systolic pressure will be elevated to more than 100 mmHg immediately after the stent completely released under fluoroscopy. When stent release system backed off, reviewing angiography firstly, observing whether clefts closed and the left subclavian artery was affected or not, with or without internal hemorrhage was done，as well as blood supply condition after three branches of abdominal aorta surgery. Then, suturing femoral artery and incision layer by layer was carried out. Patients would be sent to intensive care unit (ICU) after surgery, to monitor lower extremity surgery brake with blood pressure, heart rate and other vital signs. Blood pressure was controlled around 100 ~ 120/80 mmHg. The general anesthesia patients were extubated when in conscious, with oxygen saturation monitored. Postoperatively routine use of antibiotic 3d was carried out. The time of using antibiotic should be extended for patients who had long history of smoking, pneumonia, were older and had long time in bed.

RESULTS

Effects

12 patients in 20 were with single cleft, with multiple clefts for others. Dissection of false lumen involving the abdominal aorta was done for all. False lumen involving unilateral renal artery was carried out in 1 patient, another involved celiac. All surgeries were successful, and approached from femoral artery without postoperative internal hemorrhage.16 patients were implanted with one stent. 4 were implanted with 2, while one was bifurcation stent, with diameters of 28 mm for 1 stent, 30 mm for 2, 40 mm for 1 and 42 mm for 1 (Averaging 32 ± 5mm). 16 patients were with partially covered stent graft or the left subclavian artery, without obvious postoperative psychiatric symptoms caused by cerebral ischemia and death, paraplegia or respiratory failure and other complications. 2 patients had postoperative mild internal hemorrhage and were offered medical treatment and follow-ups.

Complications

No infarction occurred during hospitalization but 5 patients had aortic stent syndrome after treatment which showed fever, increase of C-reactive protein and neutrophils. The temperature returned to normal in 5 to 7 days after treated by non-steroidal anti-inflammatory drug. 6 patients had wound fat liquefaction due to obesity, the wound healed after offered drainage and regular dressing. 1 patient of surgical infection, which surgical area healed well after offered surgical dressing, extended antibiotic usage time and improved antibacterial strength, sutured out smoothly. 4 patients with postoperative mild to moderate non-specific back pain were not specially treated, but relieved themselves.

Follow-ups

All patients were followed up for 3, 6 and 12 months, with annually checked CTA in descending thoracic aorta to observe false lumen thrombosis, if any internal hemorrhage, displacement, stent collapse and aortic dissection increases as well as distal dissection etc. Patients were followed-up by telephone inquiry and outpatient clinic image reading.15 patients in the 20s were followed-up (5%), averaging 36.3 months (3 to 96 months). Thrombus was formed after 3 months in 90% (18/20) patients' false lumen along graft area. In 5% of patients were found blood perfusion (internal hemorrhage) in the distal false lumen where graft was fixed. One was not completely covered in the left subclavian artery by graft after stent was released due to cleft being close to the left subclavian artery opening. But internal hemorrhage was accompanied and false lumen was not closed when reviewing the aortic angiography after 6 months, angiography was done again. Short stent graft was implanted with the left subclavian artery covered by stent and the confirmation of blood supply of vertebral artery was not affected by the block of the left subclavian artery. Internal hemorrhage disappeared after 3 months but internal hemorrhage for another patient was reduced obviously after regular medical treatment during follow-up after 3 months, which continued with medical treatment and disappeared after 6 months without stent migration.

DISCUSSION

The annual incidence of AD in Anglo-American countries is up to 3 ~ 4 in a hundred thousand. 20% for sudden death, 30% for death rate during hospitalization (Olsson et al., 2006). Data from the International Registry of Aortic Dissection (IRAD) of global 12 medical centers shows that 68% of aortic dissection (AD) is male, 79% is caucasion ethnic groups (Januzzi et al., 2004). AD may occur at any age, 27% for 17 ~ 59 years old, 40% for 60 ~ 74 years old, and 33% is older than 76 (Hiratzka et al., 2010). Aortic dissection is divided into I, II, III Debakey according to intimal rupture location and scope. Type III refers to intimal tear and dissection limited to the side of the left subclavian artery. That limited to thoracic descending aorta is type IIIa and type IIIb is extended to the lower diaphragm, involving abdominal aorta or iliac arteries.

The main cause of Debakey III was hypertension. With continuous rising of hypertension incident rate in the last two decades, aortic dissection incident rate rose year by year. Traditional treatment was thoracotomy mainly, but the rate of complications and mortality were high, a certain number of patients could not be operated due to merged vital organs lesion. Dangerous aortic dissection was a main aortic lethal disease, with 10% survival rate per year. Such patients took conservative treatment mostly before, with high mortality and poor quality of life. Moreover, traditional abdominal surgery was costly and with big trauma, the incident rate of serious complications and mortality was up to 17 and 26%. Compared to surgical therapy, stenting of aortic dissection has significant advantages, not only with small trauma and low complication rate, but also high success rate.

Since stenting of aortic dissection was carried out, prospective studies have shown that 1-year mortality and complication rate of Stanford B type endovascular treatment of aortic dissection are obviously lower than traditional thoracotomy and 1-year survival rate of endovascular treatment is clearly higher than traditional one (Nienaber et al., 1999). There is no unified standard for active stenting indications of aortic dissection yet. Someone thinks it is not suitable for stent placement in dissection acute phase due to aortic wall edema (Kato et al., 2001; Palma et al., 2002). Nienaber et al. (1999) thinks that distances between proximal crevasse and opening of the left subclavian artery should be greater than 15 mm. Mr. Zaiping Jing etc. advocates active endovascular treatment for diagnosed chronic phase Standford B aortic dissection without the diameter expanded to 5 cm. Surgery could be postponed for patients in the acute phase and dissection false lumen is too small to become aneurysm or false lumen is a blind end, but can be observed until reviewing CTA or MRA after 2 months, under condition of blood pressure smoothly controlled.

It is possible for some patients to have false lumen autistic. But those whose false lumen in acute phase expanded to be aneurysm should be operated as soon as possible. With the technology advances and experience accumulations, range of indications has been widened continuously. It is reported in some literature about the internal hemorrhage problem after aortic stenting that small leak mouth may not be rushed into dealing with, closely monitored first, it can be self-closing in 3 to 6 months usually. We found 2 patients of internal hemorrhage, one with bigger leak mouth which was not closed after 3 months regular medical treatment until stent implantation again. Another was reduced by regular medical treatment after 3 months, and closed after 6 months. We achieved a higher success rate of surgery from the group of patients, mainly because of strictly followed surgery indications, improved preoperative preparation, chose the right time and stent, and skilled operative procedures. In selection of patients, we strictly followed the indications. Some patients had clefts at the opening distal end of the left subclavian artery, but retrograde dissection involving left common carotid artery and brachiocephalic opening distal end underwent ascending aorta - brachiocephalic artery - the left subclavian artery grafts connection operation under general anesthesia before endovascular surgery. Even those that retrograde dissection involving ascending aorta, equivalent to Standford A chose thoracotomy and treatment of “three branches of vascular stents implant-tation to finish aorta arch reconstruction and descending aorta stent implantation (Chen and Dai, 2010).

Good preoperative preparations: All patients should undergo CTA or MRI before surgery to make correct assessment of cleft positions, numbers, if there is retrograde dissection, and thickness of vertebral artery to clarify if stent graft needs to cover the left subclavian artery and the situation of main branch arteries of aortic arch and abdominal aorta, whether started from true lumen. The comparison of preoperative and postopera-tive blood supply was a method to judge true lumen catheter in angiography. The diameter and distortion degree of iliac and femoral artery was measured to control the operating force and timely adjustment techniques during aortic stent delivery. Preoperative blood and heart rate were strictly controlled for primary disease and complications. Intraoperative blood pressure was also monitored and controlled, stent displacement was caused by increased impact of blood flow which was due to hypertension during stent release and should be avoided especially. Proper anesthesia with analgesia and sedation was carried out to avoid blood pressure fluctuation and arteriospasm etc.

Skilled interventional procedures and stent release technology could help to shorten operation time, reduce the amount of bleeding, avoid stent displacement and stent collapse as well as internal hemorrhage caused by technical issues etc. Gentle movements was carried out to avoid damage of femoral artery or femoral nerve, no

violence when artery spasm is in the process of arterial stent delivery especially so as not to tear artery and rupture dissection to cause hemorrhoea, or even life danger. Vasodilators like nitroglycerin may be used when artery spasm occurs, but blood pressure must be monitored, strong vasodilators like sodium nitroprusside is prohibited in case of sudden drop in blood pressure. Aseptic operation is required for avoiding serious complications like nosocomial infection and high incidence rate of postoperative complications. Preoperative measurement of max diameter of normal aorta of proximal aorta dissection is needed; the max diameter, length and involving area of the tumor, is essential for calculating the diameter and length of the needed stent.

Intraoperative measurement of the diameter of proximal aorta dissection and involving area according to angiography for further confirming the diameter and length of the stent was carried out. In summary, aortic stent can be an ideal method for De Bakey III type aortic dissection, with advantages of simple and minimally invasive, safe and effective, fewer complications and fast recovery, which may achieve satisfactory recent mid-term efficacy. Due to small sample amount and lack of difficult cases in this study, we need further exploration in the future from clinical practices on the techniques of endovascular stent for De Bakey III type aortic dissection. There will be broader prospects for endovascular in this area with continuous developments and improvements.

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