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The endovascular treatment of traumatic isthmic aortic rupture: three years follow-up

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Abstract. – The isthmic aortic rupture represents the main cause of death in car crash accidents, because of closed chest trauma. Early medical and surgical care and endovascular prosthesis treatment with semi-invasive method can improve short and mid term survival. Nine patients with traumatic isthmic aortic rupture underwent endoprosthesis aortic implantation. All the patients were male, mean age 42.48 ± 17.66 years Operations included 5 acute cases and 4 chronic cases (chance diagnosis) In all cases the diagnosis was performed by tomodensitometric exam. Cloth prostheses were used (self-expansible Goretex- or Dacron-stent). Three years after the endoprosthesis implantation, we obtained the complete thrombosis of the false aortic lumen in all patients, both acute and chronic, as well as the levelling of the false aneurysms without complications of any kind.

Key Words:

Traumatic aortic ruptures, Isthmic aortic rupture, Endoprostheses.

Introduction

The aortic rupture is a dramatic complication due to closed chest injuries. Traumatic aortic ruptures (TAR) are a consequence of car crashes, especially concerning travellers (95%) but sometimes pedestrians (5%)[4].

The classic rupture site is the aortic isthmus, caused by brutal deceleration (90%)[1-3] which causes abnormal movements of the heart on the aorta.

Because of its high mortality, the traumatic aortic rupture is considered a surgical emergency[3,5-8].

The classic surgical treatment with thoracotomy involves a high morbidity/mortality risk, especially in critical clinical conditions, and when complications or important comorbidities are present[10-21].

The possibility of delaying the surgical treatment has primary importance in improving prognosis.

Since the experimental models of Dotter[9] in 1969, the ongoing improvement in endovascular technique is changing the clinical management of these patients, with excellent short- and mid-term survival results.

The aim of our study is the mid-term evaluation of the traumatic isthmic aortic rupture endovascular treatment.

Materials and Methods

Patients

Since February 2003 to February 2005, 9 patients with traumatic isthmic aortic rupture have been operated on at the Service de Chirurgie Cardiovasculaire et Thoracique de l'Hôpital La Pitié-Salpétrière in Paris, with endoprosthesis implantation.

All the patients were male, mean age 42.48 ± 17.66 years.

Operations included 5 acute cases (within 14 days since the accident) and 4 chronic cases (1.5 months to 10 years after the accident). The mean time of treatment was 29.98 ± 27.91 days.

The 5 acute emergency cases were estimated as high risk patients or were not feasible for the traditional thoracotomic surgery (patients with polytrauma and/or major complications like cerebral and abdominal injury and hemorrhagic shock).

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All these patients showed a severe hemodynamic instability.

This group included: (a) a patient with tracheal intubation affected by bilateral hemopneumothorax, drained subsequently; (b) a patient with head trauma, frontal subdural hematoma, left lung contusion, D6 to D10 left ribs fracture, fracture of the lumbar spine and pelvis with associated hemorrhagic shock; (c) a patient with extradural hematoma, spleen injury, pancreatic and hepatic contusion, facial trauma and several peripheral bone fractures; (d) two patients with tracheal intubation affected by several bone fractures, bilateral hemothorax, chronic obstructive pulmonary disease (COPD) with severe respiratory failure, arterial hypertension and previous acute myocardial infarction (AMI).

The 4 chronic patients, admitted because of persistent chest pain resistant to medical therapy, had a diagnosis of traumatic isthmic aortic rupture. This group included: (a) a patient with traumatic isthmic aortic rupture (undiagnosed after head-on car crash) admitted after 2 months because of chest pain caused by subsequent left subclavian artery dissection; (b) a patient with chest pain and dysphagia caused by calcific false aneurysm leading to esophageal compression; (c) two patients admitted because of chest pain after a hypertensive crisis and affected by a post-subclavian calcified false aneurysm.

In all cases the diagnosis was performed by tomodensitometric exam, obtaining high quality images using millimetric thin slices (helpful to choose the lenght of the endoprosthesis to be used) comparing them with digital arteriography. The tomodensitometric exam eased the localization of the Adamkiewicz artery, frequently not so easy to be found.

Technique/Material

Cloth prostheses were used (self-expansible Goretex- or Dacron-stent). The available diameters were on a 2 mm- 2 mm scale, between 18 mm and 46 mm; the stent was closed within an 18-24 French introducer.

In 8 patients, the endoprosthesis was implanted in the surgery room whereas in 1 patient, because of very critical clinical conditions, it was implanted in the vascular radiology room.

The patient was placed on dorsal decubitus, heparin was infused at 0.5 mg/kg; the operating field included both Scarpa's triangles, the lumbosacral region and the thorax. A pig-tail catheter was introduced, for the contrast medium injection, into the left brachial artery.

In relation to the clinical conditions, the access was the right common femoral artery in 3 patients, the left common femoral artery in 4 patients, the external iliac artery in 1 patient.

A soft metallic guide was introduced into the arterial access up to the aorta; subsequently, a pig-tail catheter was introduced and the first soft guide was changed with a stiff one.

Arteriotomy was carried out to introduce the endoprostheses.

The endoprostheses were implanted, on angiographic monitoring, and were opened at the level of the aortic injury in order to exclude the wall lesion and/or the false aneurysm from the blood flow. Subsequently they were extended, to the right width, using an expansible balloon.

In all patients only one prosthesis was used; 24 mm diameter prosthesis in 4 patients, 26 mm diameter in 2 patients; and 30 mm, 34 mm and 37 mm diameter in the other 3 patients. In 8 patients a Talent-prosthesis was used whereas a TAG-prosthesis was used in 1 case.

At the end of the implantation, a new control angiographic exam was carried out.

Results

The average Intensive Care Unit stay time was 53.85 ± 6.89 hours. The preoperative blood creatinine and urea values were 75.56 ± 8.47 and 5,93 ± 0,66 respectively, and 72.67 ± 12.53 and 5,67 ± 1,34 respectively on the first postoperative day. The hospitalization days were 9.33 ± 9.44.

The operative and perioperative mortality was 0. Rupture of the external iliac artery, used as access, occurred in one case, during the endoprosthesis implantation, which lead to perform iliac-femoral venous by-pass. A patient has been intubated for 12 days because of hypoxia due to uncomplicated pulmonary infection. All patients underwent tomodensitometric exam on admittance and before dismissal.

Data are as follows in patients with false aneurysm: mean inner diameter 51.75 ± 16.62 mm, aortic arch 25.76 ± 1.68 mm, left post-subclavian tract 33.25 ± 8.75 mm, suprarenal abdominal aorta 24.38 ± 0.97 mm.

After the operation the mean diameter of thoracic aorta, included the false aneurysm, was 31.56 ± 4.32 mm, with a 45% regression.

Table I.

Internal diameter (mm)	Acute pz N°		Chronic pz N°	
	Before	*Post*	*Before*	*Post*
Aortic arch	24.12 ± 3.57	24.76 ± 2.63	25.76 ±1.68	24.15 ±1.83
Aneurysm	///	///	51.75 ± 16.62	31.56 ± 4.32
Post-subclavian tract	26.55 ± 3.54	27.12 ± 2.21	33.25 ± 8.75	31.25 ± 7.43
Abdominal aorta	25.87 ± 3.65	26.52 ± 3.25	24.38 ± 0.97	23.79 ± 1.23

The endoprosthesis implant resolved the discontinuity in all patients affected by an acute lesion, leaving, only in two patients, a mild regurgitation at prostethic mapping, disappeared 48 hours later.

The 2 years follow-up, performed by tomodensitometric scanner, did not show any significant change in endoaortic diameters, with complete thrombosis of the false lumen and regression of the false aneurysm diameter (Table I).

Discussion

Three different pratices well show the evolution of therapeutic management of TAR: (1) by this time the dogma of urgent surgery is over; (2) the actual accepted strategy of medical treatment deferring surgery; (3) new horizons of treatment with cloth endoprostheses.

For many years TAR has been considered only a surgical urgency[3,5-8].

Recently, due to follow-up and autoptic studies[2,22], a very high mortality rate was shown in the urgently operated patients, whereas survival of patients undergoing delayed operation was considerably higher on a short-mid term[22,25].

Authors suggest a complete medical management[23-24], or the above only in the first period[25-28], in cases of mild rupture risk, delaying the surgical operation if it is obliged by the presence of associated lesions (neurosurgical, abdominal). On the other hand, surgical emergency treatment is warranted in the case of severe lesions or high risk of complete aortic rupture, within 72 hours following the admittance[25,26], and for non-responders to medical treatment.

In practice, it seems justified to operate the patient when there are no other lesions that can compromise the patient's prognosis, and there are no conditions that can worsen themselves owing to extracorporeal circulation. In all the other circumstances the operation should be deferred to treat the associated lesions, with strict control of arterial pressure[27-28].

Vital functions are stabilized and the other lesions threatening the prognosis (neurosurgical and abdominal) are treated.

Conclusions

Traumatic aortic rupture remains an extremely severe lesion. Three years after the endoprosthesis implantation, we obtained the complete thrombosis of false aortic lumen of the patients considered as acute, and the levelling of the false aneurysm in the patients affected by this condition. No endoprosthesis-related complications were shown.

Thus, considering the excellent mid-term results, we can state the endovascular treatment of isthmic aortic lesions can be considered the ideal solution for all patients in whom the traditional thoracotomic surgery is contraindicated or estimated at high risk for morbidity/mortality. Moreover, it can be considered as a valid alternative choice to the traditional surgery for all patiens affected by this disease.

In relation to data about aortic lesions complicated by pleural increasing effusion, the emergency treatment by endoprosthesis implantation can be a valid alternative choice.

References

1) Richens D, Field M, Neale M, Oakley C. The mechanism of injury in blunt traumatic rupture of the aorta. Eur J Cardiothorac Surg 2002; 21: 288-293.

2) Feczko JD, Lynch L, Pless JE, Clark MA, McClain J, Hawley DA. An autopsy case review of 142 nonpenetrating (blunt) injuries of the aorta. J Trauma 1992; 33: 846-849.

3) Bouchart F, Bessou JP, Tabley A, Arrignon J, Mouton-Schleifer D, Redonnet M, Soyer R. Traumatic isthmic ruptures of the aorta during the acute phase. Reevaluation of surgical treatment. Thoughts a propos of 47 cases. Ann Chir 1992; 46: 116-124.

4) Brundage SI, Harruff R, Jurkovich GJ, Maier RV. The epidemiology of thoracic aortic injuries in pedestrians. J Trauma 1998; 45: 1010-1014.

5) de Bakey ME, McCollum CH, Graham JM. Surgical treatment of aneurysms of the descending thoracic aorta: long-term results in 500 patients. J Cardiovasc Surg (Torino) 1978; 19: 571-576.

6) Kouchoukos NT, Dougenis D. Surgery of the thoracic aorta. N Engl J Med 1997; 337: 1475-1476.

7) Moreno-Cabral CE, Miller DC, Mitchell RS, Stinson EB, Oyer PE, Jamieson SW, Shumway NE. Degenerative and atherosclerotic aneurysms of the thoracic aorta. Determinants of early and late surgical outcome. J Thorac Cardiovasc Surg 1984; 88: 1020-1032.

8) Pressler V, McNamara JJ. Aneurysm of the thoracic aorta. Review of 260 cases. J Thorac Cardiovasc Surg 1985; 89: 50-54.

9) Dotter CT: Transluminally-placed coilspring endarterial tube grafts. Long-term patency in canine popliteal artery. Invest Radiol 1969; 4: 329-332.

10) Dake MD, Kato N, Mitchell RS, Semba CP, Razavi MK, Shimono T, Hirano T, Takeda K, Yada I, Miller DC. Endovascular stent-graft placement for the treatment of acute aortic dissection. N Engl J Med 1999; 340: 1546-1552.

11) Dake MD. Endovascular stent-graft management of thoracic aortic diseases. Eur J Radiol 2001; 39: 42-49.

12) Grabenwöger M, Hutschala D, Ehrlich MP, Cartes-Zumelzu F, Thurnher S, Lammer J, Wolner E, Havel M. Thoracic aortic aneurysms: treatment with endovascular self-expandable stent grafts. Ann Thorac Surg 2000; 69: 441-445.

13) Ahn SH, Cutry A, Murphy TP, Slaiby JM. Traumatic thoracic aortic rupture: treatment with endovascular graft in the acute setting. J Trauma 2001; 50: 949-951.

14) White RA, Donayre CE, Walot I, Lippmann M, Woody J, Lee J, Kim N, Kopchok GE, Fogarty TJ. Endovascular exclusion of descending thoracic aortic aneurysms and chronic dissections: Initial clinical results with the AneuRx device. J Vasc Surg 2001; 33: 927-934.

15) Cambria RP, Brewster DC, Lauterbach SR, Kaufman JL, Geller S, Fan CM, Greenfield A, Hilgenberg A, Clouse WD. Evolving experience with thoracic aortic stent graft repair. J Vasc Surg 2002; 35: 1129-1136.

16) Orend KH, Scharrer-Pamler R, Kapfer X, Kotsis T, Görich J, Sunder-Plassmann L. Endovascular treatment in diseases of the descending thoracic aorta: 6-year results of a single center. J Vasc Surg 2003; 37: 91-99.

17) Resch T, Koul B, Dias NV, Lindblad B, Ivancev K. Changes in aneurysm morphology and stent-graft configuration after endovascular repair of aneurysms of the descending thoracic aorta. J Thorac Cardiovasc Surg 2001; 122: 47-52.

18) Criado FJ, Barnatan MF, Rizk Y, Clark NS, Wang CF. Technical strategies to expand stent-graft applicability in the aortic arch and proximal descending thoracic aorta. J Endovasc Ther 2002; 9(Suppl 2): 1132-1138.

19) Criado FJ, Clark NS, Barnatan MF. Stent graft repair in the aortic arch and descending thoracic aorta: a 4-year experience. J Vasc Surg 2002; 36: 1121-1128.

20) Demers P, Miller DC, Mitchell RS, Kee ST, Sze D, Razavi MK, Dake MD. Midterm results of endovascular repair of descending thoracic aortic aneurysms with first-generation stent grafts. J Thorac Cardiovasc Surg 2004; 127: 664-673.

21) Demers P, Miller DC, Mitchell RS, Kee ST, Chagonjian L, Dake MD. Stent-graft repair of penetrating atherosclerotic ulcers in the descending thoracic aorta: mid-term results. Ann Thorac Surg 2004; 77: 81-86.

22) Parmley LF, Manion WC, Mattingly TW. Nonpenetrating traumatic injury of the heart. Circulation 1958; 18: 371-396.

23) Aronstam EM, Gomez AC, O'Connel TJ, Geiger JP. Recent surgical and pharmacological experience with acute dissecting and traumatic aneurysms. J Thorac Cardiovasc Surg 1970; 59: 231-238.

24) Walker WA, Pate JW. Medical management of acute traumatic rupture of the aorta. Ann Thorac Surg 1990; 50: 965-967.

25) Langanay T, Verhoye JP, Corbineau H, Agnino A, Derieux T, Menestret P, Logeais Y, Leguerrier A. Surgical treatment of acute traumatic rupture of the thoracic aorta a timing reappraisal? Eur J Cardiothorac Surg 2002; 21: 282-287.

26) Maggisano R, Nathens A, Alexandrova NA, Cina C, Boulanger B, McKenzie R, Harrison AW. Traumatic rupture of the thoracic aorta: should one always operate immediately? Ann Vasc Surg 1995; 9: 44-52.

27) Lee RB, Stahlman GC, Sharp KW. Treatment priorities in patients with traumatic rupture of the thoracic aorta. Am Surg 1992; 58: 37-43.

28) Warembourg H, Prat A, Roux JP, Soots G. Acute traumatic rupture of the thoracic aorta. Role of delayed surgical treatment. Ann Chir 1989; 43: 121-124.