

MEET

MULTIDISCIPLINARY EUROPEAN
ENDOVASCULAR THERAPY

Thoracic Combo From theory to practice Thoracic aortic dissections & their endovascular treatment

| Didactic Manual & Procedures

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When to use endografts on chronic dissection and which endograft?

Nadia Mollicelli, M.D, Luigi Inglese, M.D.

IRCCS Policlinico San Donato, Milan, Italy

Abstract

Endovascular stent-graft placement for the treatment of patients with aortic dissection is emerging as an attractive alternative to conventional cardiac surgery. The most common indication of interventional treatment in type B chronic aortic dissection is the formation of false lumen aneurysm.

One month can be considered as clinical turning point between acute and chronic dissection. Stent graft repair for acute type B dissection is indicated in complicated cases, without complication it is very questionable although it could restore a normal aortic anatomy. In chronic type B dissection when the overall aortic diameter exceeds 5 cm there is indication for surgery or endovascular treatment. EndoFit Tapered stent graft (LeMaitre Vascular, Burlington, MA, USA) can be very useful in treating chronic type B aortic dissection because it can cope with the wide discrepancy of diameter from proximal to distal aorta that is usually present with a very thick intimal flap.

Incidence and indications for treatment

Acute aortic dissection is most often a catastrophic event which, if untreated, has a mortality rates of 22.7%, 50%, and 68% within 6 hours, 24h and first week, respectively; open surgical repair is also associated with high morbidity and mortality (up to 39%).^{1,2}

Patients with non complicated type B aortic dissection are conventionally managed with anti-hypertensive treatment,^{3,4,5} but there is evidence that up to 20% of these medically treated patients will suffer in the mid term follow up of a rupture of the aneurysmatic false lumen or a retrograde progression of the dissection with possible involvement of the proximal aorta and consequent higher mortality.^{6,7} Surgery or endovascular stent graft are recommended in complicated cases: patients who present recurrent pain and persistent hypertension, progression of aneurysm size despite maximal medical therapy or serious organ malperfusion (bowel, kidneys or the lower extremities).^{8,9,10}

Endovascular stent graft treatment of patients with thoracic aortic disease was introduced in 1992 at Stanford University and in 1994 Dake reported the results of their initial experience.¹¹ It was initially indicated for the treatment of descending thoracic aortic aneurysm with home made devices for high surgical risk patients, subsequently also in patient with aortic dissection and penetrating atherosclerotic ulcers.^{12,13} Over the last ten years endovascular treatment of thoracic aortic disease has emerged more and more as an attractive alternative with a low periprocedural mortality and morbidity, especially in elderly patients with severe comorbid conditions. In fact the endovascular therapy may offer, in

| Address for correspondence: **Luigi Inglese, M.D**

Centro E. Melan, Radiologia Cardiovascolare, Via Morandi 30, 20097 San Donato Milanese, Italy

E-mail: luigi.inglese@grupposandonato.it

selected patients with suitable aortic anatomy, both short and midterm advantages when compared with open surgery, because it avoids a thoracotomy and thoracic aortic clamping^{14,15} and is associated with less morbidities, including respiratory failure, renal failure and spinal ischemia.

Peripheral vascular ischemia

Peripheral vascular ischemia is generally a complication of acute type B aortic dissection and can be present in approximately 30% of patients,^{16,17} renal or visceral ischemia are independent risk factors of higher operative mortality.¹⁸ The ischemic complications are generally related to a compression of the true lumen by the pressurized false lumen. In this case percutaneous balloon fenestration of the intimal flap and endovascular stenting are an effective treatment because will relief pressure gradients and allow flow between the two lumens with better target organ perfusion.¹⁹ Another option for these patients is the deployment of a endovascular stent graft (EVG) to seal the proximal intimal tear and give better true lumen flow. In a recent study Dialetto showed that 5 years survival in the group of patient with complicated type B dissection treated with EVG was similar to that of patients with uncomplicated type B aortic dissection treated with medical therapy, suggesting a possible advantage of EVG on medical treatment alone.²⁰ It's actually ongoing the INSTEAD trial (Investigation of Stent Grafts in patients with type B aortic dissection), that is a multicentre randomised trial that compares the outcomes of patients with type B aortic dissection treated with EVG versus medical treatment alone.²¹

False lumen aneurysm

The formation of false lumen aneurysm may be observed in 30-40% of patients with type B chronic aortic dissection²² at 3 years of follow up. An initial diameter of more than 4 cm and a persistent perfusion of the false lumen have been identified as determinants for chronic expansive aortic dissection²³. These aneurysms have the same tendency to rupture as atherosclerotic aneurysms so they have to be treated along similar or more aggressive guidelines. The growing of the false lumen represents the most common indication for an endograft in chronic aortic dissection. The anatomic suitability for endovascular grafting are the same of atherosclerotic aneurysm: a proximal neck > 1.5 cm and a distal aortic neck > 2 cm in length. In patients, with a short proximal neck It may be necessary to cover the origin of left subclavian artery, in these patients a careful examination of extra and intracranial circulation has to be performed (*Fig.1*).

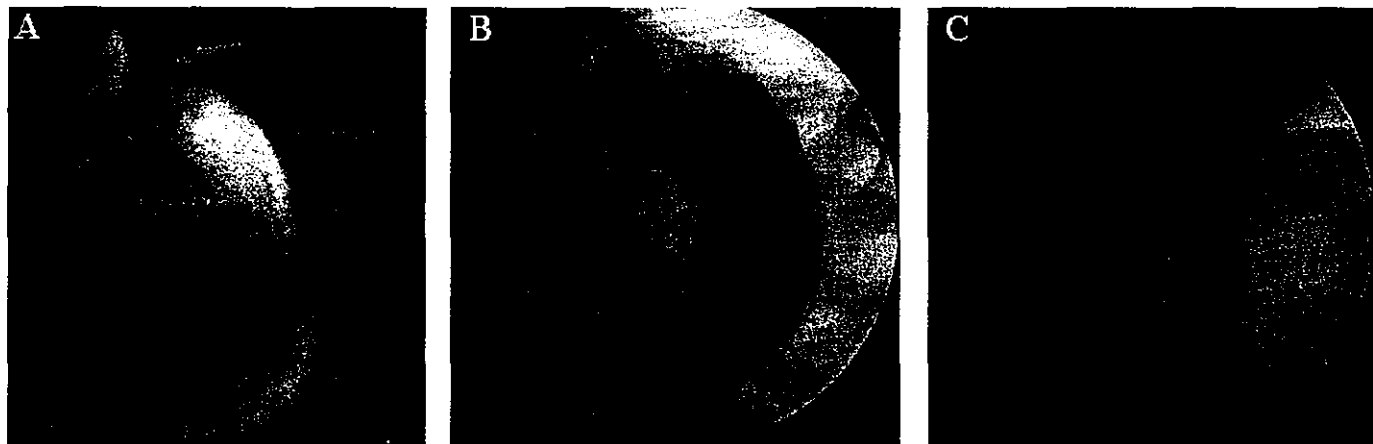


Fig. 1 - (A) Chronic type B aortic dissection. 7 cm aneurysm three years after the acute episode. (B) Endovascular treatment with three EndoFit stent graft, (C) the last one was a tapered graft.

Spontaneous thrombosis of the false lumen has been identified in < 4% of patients. Persistent perfusion of the false lumen is a major predictor of adverse longterm outcome.^{24, 25} Our strategy in treating of patients with chronic type B dissection is to cover the proximal entry point, but we believe that the aortic remodelling, induced by thrombosis of the false lumen, is promoted by an extensive endograft coverage up to celiac artery, usually necessary because of the reentry tears in the descending aorta (*Fig.2*) This can reduce the persistent flow in the false lumen promoting its thrombosis.^{26,27} A possible limitation for the efficacy of stent graft placement in patients with chronic aortic dissection is the presence of mul-

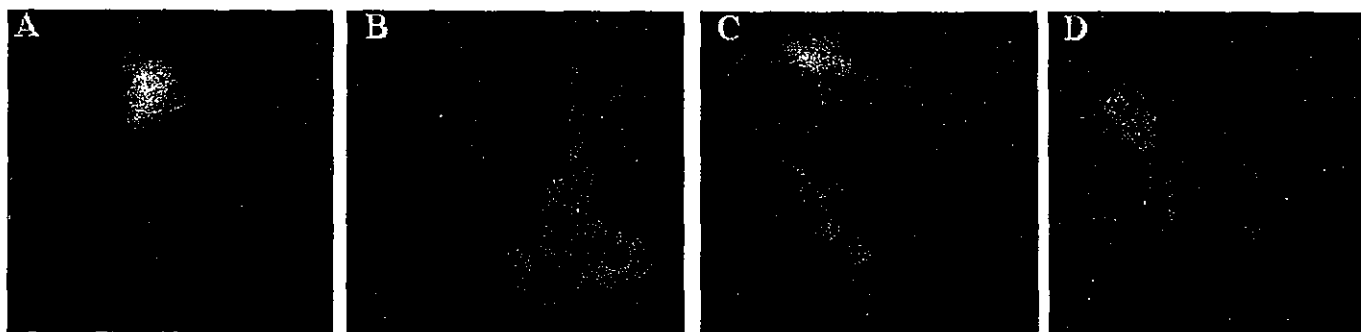


Fig. 2 - (A) Chronic type B dissection with entry point very proximal to left subclavian artery. (B) Significant reduction of distal aortic true lumen. (C) Endovascular treatment with covering of left subclavian artery. (D) Tapered distal stent graft.

multiple tears in the descending and abdominal aorta that cannot allow an adequate exclusion of the aneurysm. Transesophageal echocardiography is fundamental during the procedure to monitor the correct positioning of the stent graft into the true lumen and to evaluate the immediate thrombosis of the false lumen (smoke effect). Nevertheless, despite an adequate sealing of the proximal tears and a complete thrombosis of the thoracic false lumen an abdominal aortic aneurysm progression with late rupture is described in several studies.^{28, 29, 30, 31}

If the visceral arteries are supplied from the false lumen, stent grafting of descending aorta can be performed, provided there is a reentry distal to the end of stent graft. The dynamic or fixed obstruction as a result of extension of the dissection into the lumen of an aortic branch (usually renal artery) can be also treated with a stent implantation.

We can consider one month as the clinical turning point between acute and chronic dissection. In acute phase the intimal flap and the adventitia are extremely fragile and mobile, after few week they become more stable and can better tolerate the stretch on the wall. In chronic type B dissection the intimal flap is usually very thick, more resistant to be stretched and the true lumen is usually restricted, so should not be stressed with an oversized EVG for the possible risk of free aortic wall rupture. This may suggest that if endovascular stenting of acute dissected aorta is indicated, it requires dedicated stent grafts (very soft, no oversizing, no free flow). For the chronic ones a soft graft, possible without free flow, and a tapered end is indicated.

In his study Kato observed a significant increase of early and late complications and mortality rates in patients with acute aortic dissection compared with patients with chronic dissection.³²

Retrograde progression of type B dissection

There is also a small number of patients with chronic type B aortic dissection in which the entry tear in the descending aorta can propagate up to ascending aorta in a retrograde manner, in these patients the replacement of both ascending aorta and the aortic arch is required^{33,34} and an hybrid approach with EVG of descending aorta can be considered.³⁵

Disseminated intravascular coagulation

Another infrequent indication of stenting in type B dissected aorta is when aortic dissection is accompanied by disseminated intravascular coagulation (DIC). DIC associated with chronic dissection may be caused by turbulent flow in the false lumen, in these patients surgical intervention is necessary but is associated with high mortality owing to excess blood loss during surgery.³⁶ When medical treatment is ineffective, the stenting of the proximal entry point can resolve the DIC.³⁷ Nienaber et al. compared stent graft repair with surgical graft replacement for the treatment of chronic aortic dissection. In their series no deaths or major complication were observed in the group undergoing stent graft repair, whereas there were 4 deaths (33%) and 5 serious adverse events (42%) in the surgical repair group.³⁸

A recent meta-analysis of Eggebrecht encompassing 609 type B dissection patients demonstrated that endovascular stent graft treatment of aortic dissection is feasible and can be performed with technical success rate of 95% with two years survival of about 90%.³⁹ In this group of patients 1% was the incidence of paraplegia that is remarkably low if compared of risk of paraplegia after surgical repair of descending thoracic aorta (7 to 36%).⁴⁰

Type of endograft for chronic type B ortic dissections

The newer commercially available stent graft devices are less rigid and fit better to a dissected aorta, the most commonly used are: Talent (AVE/Medtronic, Santa Rosa, CA), Excluder (W.L.Gore & Associates, Flagstaff, AZ, USA), Zenith (William Cook, Europe, Bjaeverskov, Denmark), and, since 2002, the EndoFit device (LeMaitre Vascular, Burlington, MA, USA). Also available is a true tapered stent graft (EndoFit device, LeMaitre Vascular, Burlington, MA, USA) in sizes ranging from 42 mm at proximal end down to 24 mm distally over a length of 24 cm. We found this type of stent graft very useful in treating chronic type B aortic dissection where a wide discrepancy of diameter from proximal to distal aorta is usually present with a very thick intimal flap (Fig.3). The EndoFit Stent Graft is composed of self-expanding nitinol stents which are encapsulated in two layers of ePTFE (expanded polytetrafluoroethylene) fabric using a thermal process that avoids the need for fixation sutures. The EndoFit sutureless design is an important benefit for optimal long term graft patency as the sutureless design eliminates the potential for suture breakage and graft material tearing. There is no interface of the metallic stents with blood or the aortic wall in the encapsulated section of the stent graft. Deployment is effected using the push and pull technique. The FlexiTip design is very usefull in enabling exact and precise deployment adjacent to left subclavian artery.

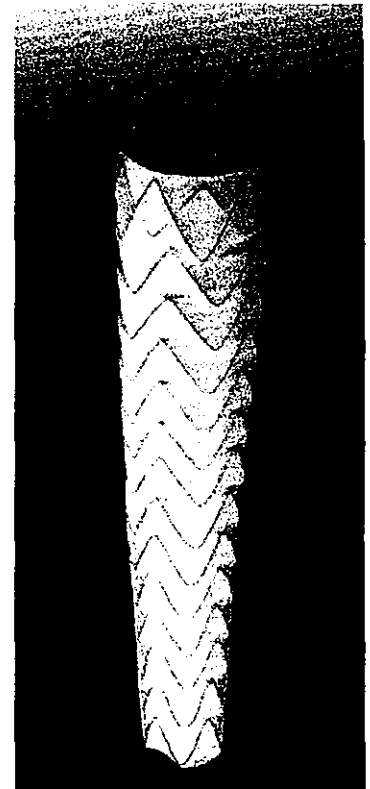


Fig. 3 - (A) Tapered Stent Graft (EndoFit-LeMaitre Vascular)

Conclusion

Stent-graft repair of chronic type B aortic dissection with aneurysmatic evolution (aortic diameter >5 cm) may be a safe and effective in selected patients, having a good (>1.5 cm) proximal landing zone and covering all the entries and re-entries in the descending thoracic aorta. Transesophageal echocardiography or IVUS control are mandatory. Dedicated tapered stent graft is also advisable to cope with the particular anatomy of chronic aortic dissection where a small elliptical distal true lumen is present with an important proximal-distal discrepancy of aortic lumen diameter and a very thick intimal flap.

References

1. Meszaros I, Morocz J, Szilavi J, Schmidt J, Tomoci L, Nagy L, et al. Epidemiology and clinicopathology of aortic dissection. *Chest*. 2000; 117:1271-8.
2. Fann JJ, Smith JA, Miller DC, Mitchell RS, Moore KA, Grunkemeier G, et al. Surgical management of aortic dissection during a 30-year period. *Circulation* 1995; 92 (9 Suppl): II 113-21.
3. Elefteriades JA, Lovoulos CJ, Coady MA, Tellides G, Kopf GS, Rizzo JA. Management of descending aortic dissection. *Ann Thorac Surg* 1999;67:2002-5.
4. Schor JS, Yerlioglu E, Galla JD, Lansman SL, Ergin MA, Griep RB. Selective management of acute type B aortic dissection: long-term follow-up. *Ann Thorac Surg* 1996;61: 1339-41.
5. Neya K, Omoto R, Kyo S, et al. Outcome of Stanford type B dissection. *Circulation* 1992;86(suppl II):II-1-II-7.
6. Marui A, Mochizuki T, Mitsui N, Koyama T, Kimura F, Horibe M. Toward the best treatment for uncomplicated patients with type B acute aortic dissection. *Circulation* 1999;100(Suppl II):II275-II280.
7. Griep RB, Ergin MA, Galla JD, Lansmann SL, McCullough JN, Nguyen KH, Klein JJ, Spielvogel D. Natural history of descending thoracic and thoracoabdominal aneurysms. *Ann Thorac Surg* 1999;67:1927-1930.
8. Elefteriades JA, Hartleroad J, Gusberg RJ, Salazar AM, Black HR, Kopf GS et al. Long term experience with descending aortic dissection: the complication-specific approach. *Ann Thorac Surg* 1992; 53:11-21.
9. Bortone AS, Schena S, D'Agostino D, et al. Immediate versus delayed endovascular treatment of post-traumatic aortic pseudoaneurysms and type B dissections: retrospective analysis and premises to the upcoming European trial. *Circulation* 2002;106(Suppl I):I-234-I-240.
10. Rousseau H, Soula P, Perreault P, et al. Delayed treatment of traumatic rupture of the thoracic aorta with endoluminal covered stent. *Circulation* 1999;4:498- 504.
11. Dake MD, Miller DC, Semba C, Mitchell RS, Walker PJ, Liddell RP. Transluminal placement of endovascular stent grafts for the treatment of descending thoracic aortic aneurysm. *N Engl J Med* 1994; 331: 1729-34.

12. Dake MD, Miller DC, Mitchell RS, Semba CP, Moore KA, Sakai T. The first generation of endovascular stent graft for patients with aneurysm of the descending thoracic aorta. *J Thorac Cardiovasc Surg* 1998; 116: 689-704.
13. Murgo S, Dussaussois L, Golzarian J, et al. Penetrating atherosclerotic ulcer of the descending thoracic aorta: treatment by endovascular graft. *Cardiovasc Intervent Radiol* 1998; 21: 454-8.
14. Mitchell RS, Dake MD, Semba CP, Fogarty TJ, Zarins CK, Liddell RD. Endovascular stent graft repair of thoracic aortic aneurysm. *J Thorac Cardiovasc Surg* 1996; 111: 1054-1062.
15. Ehrlich M, Grabenwoeger M, Cartes-Zumelzu F, Grimm M, Petzl D, Lammer J, Thurnher S, Wolner E, Havel M. Endovascular stent graft repair for aneurysms on the descending thoracic aorta. *Ann Thorac Surg* 1998; 66: 19-25.
16. Frank J, Criado MD, Omran R, Abul-Khoudoud, et al. Endovascular Repair of the Thoracic Aorta: Lessons Learned. *Ann Thorac Surg* 2005; 80: 857-63.
17. Farm JJ, Sarris GE, Mitchell RS, et al. Treatment of patients with aortic dissection presenting with peripheral vascular complications. *Ann Surg* 1990; 212: 705-13.
18. Miller DC, Mitchell RS, Oyer PE, Stinson EB, Jamieson SW, Shumway NE. Independent determinants of operative mortality for patients with aortic dissections. *Circulation* 1984; 70(3 Pt 2): 1153-64.
19. Suzanne M, Slonim MD, Ulf Nyman MD, Charles P, Semba MD, D. Craig Miller MD, R. Scott Mitchell MD, and Michael D. Dake MD, Stanford, Calif. Aortic dissection: Percutaneous management of ischemic complications with endovascular stents and balloon fenestration. *J Vasc surg* 1996; 23: 241-53.
20. Dialetto G, Covino F, Scognamiglio G. Treatment of type B aortic dissection: endoluminal repair or conventional medical therapy? *European Journal of cardiothoracic surgery* 27 (2005). 826-30.
21. INvestigation of STEnt grafts in patients with type B Aortic Dissection: Design of the INSTEAD trial-a prospective, multicenter, European randomized trial. Nienaber C. A., Zannetti S., Barbieri B., et al. on behalf of the INSTEAD study collaborators I Rostock, Germany, and Maastricht, The Netherlands. *Am Heart J* 2005; 149: 592-9.
22. Neya, K., Omoto, R., Kyo, S. et al., Outcome of Stanford type B acute aortic dissection. *Circulation*. 1992, 86(Suppl. III), III-117.
23. Kato M, Bai H, Sato K, Kawamoto S, Kaneko M, Ueda T, et al. Determining surgical indications for acute type B dissection based on enlargement of aortic diameter during the chronic phase. *Circulation*. 1995; 92 (Suppl): 11107-12.
24. Erbel R, Oelert H, Meyer J, Puth M, Mohr-Katoly S, Hausmann D, Daniel W, Maffei S, Caruso A, Covino FE. Effect of medical and surgical therapy on aortic dissection evaluated by transesophageal echo-cardiography. Implications for prognosis and therapy. The European Cooperative Study Group on Echocardiography. *Circulation* 1993; 87: 1604-1615.
25. Bernard Y, Zimmermann H, Chocron S, Litzler JF, Kastler B, Etievent JP, Meneveau N, Schiele F, Bassand JP. False lumen patency as a predictor of late outcome in aortic dissection. *Am J Cardiol* 2001; 87: 1378-1382.
26. Cambria RP, Brewster DC, Gertler J, et al. Vascular complications associated with spontaneous aortic dissection. *J Vasc Surg* 1988; 7: 199-209.
27. Bernard Y, Zimmermann H, Chocron S, et al. False lumen patency as a predictor of late outcome in aortic dissection. *Am J Cardiol* 2001; 87: 1378-82.
28. Dake MD, Kato N, Mitchell RS, et al. Endovascular stent graft placement for the treatment of acute aortic dissection. *N Engl J Med* 1999; 340: 1546-1552.
29. Palma JH, Marcondes de Souza JA, Rodriguez CM, Carvalho AC, Buffolo E. Self-expandible aortic stent grafts for treatment of descending aortic dissection. *Ann Thorac Surg* 2002; 73: 1138-1142.
30. Won JY, Lee DY, Shim WH, et al. Elective endovascular treatment of descending thoracic aortic aneurysm and chronic dissection with stent grafts. *J Vasc Interv. Radiol* 2001; 12: 575-582.
31. Lambrechts D, Casselman F, Schroeyers P, De Geest R, D'Haenens P, Degrieck I. Endovascular treatment of the descending thoracic aorta. *Eur J Vasc Endovasc Surg* 2003; 26: 437-444.
32. Kato N, Shimono T, Hirano T, Suzuki T, Ishida M, Sakuma H, Yada I, Takeda K. Midterm results of stent-graft repair of acute and chronic aortic dissection with descending tear: the complication-specific approach. *J Thorac Cardiovasc Surg* 2002; 124: 306-312.
33. Lansman SL, McCullough JN, Nguyen KH, et al. Subtypes of acute aortic dissection. *Ann Thorac Surg*. 1999; 67: 1975-8.
34. Kazui T, Tamiya Y, Tanaka T, et al. Extended aortic replacement for acute type A dissection with the tear in the descending aorta. *J Thorac Cardiovasc Surg*. 1996; 112: 973-8.
35. Antona C., Vanelli P., Petullà M., Gelpi G., Danna P., Lemma M., Inglese L. Hybrid technique for total arch repair: aortic neck reshaping for endovascular graft fixation. *Ann Thorac Surg* 2007; 83: 1158-61.
36. Miyata T., Tada Y., Takagi A., et al. Disseminated intravascular coagulation caused by abdominal aortic aneurysm. *J Cardiovascular Surg (Torino)*. 1988; 29: 494-497.
37. Sakamoto I., Matsuyama N., Fukushima A., et al. Chronic aortic dissection complicated by disseminated intravascular coagulation: successful treatment with endovascular stent grafting. *J Endovascular Ther* 2003; 10: 953-957.
38. Nienaber CA, Fattori R, Lund G, et al. Nonsurgical reconstruction of thoracic aortic dissection by stent-graft placement. *N Engl J Med*. 1999; 340: 1539-45.
39. Eggebrecht H., Nienaber C.A., Neuha M., Baumgart D., Kische S., Schmermund A., Herold U., Rehdér T. C., Jakob H.G., Erbel R. Endovascular stent-graft placement in aortic dissection: a meta-analysis *European Heart Journal* (2006) 27, 489-498.
40. Umana JP, Miller DC, Mitchell RS. What is the best treatment for patients with acute type B aortic dissections-medical, surgical, or endovascular stent-grafting? *Ann Thorac Surg* 2002; 74: S1840-S1843.