Journal of the American College of Cardiology Vol. 50, No. 8, 2007

Published by Elsevier Inc.
ISSN 0735-1097/07/$32.00
doi:10.1016/j.jacc.2007.04.072

EDITORIAL COMMENT

Dissection of the Descending Thoracic Aorta

Looking Into the Future*

Eric M. Isselbacher, MD, FACC

Boston, Massachusetts

In this issue of the *Journal*, Song et al. (1) report a retrospective analysis of the midterm outcomes of 100 patients with an acute aortic dissection involving the descending thoracic aorta. Of the 100, 51 had a DeBakey type I (involvement of both the ascending and descending thoracic aorta) aortic dissection and underwent early repair of the ascending thoracic aorta, and 49 had a DeBakey type III (no involvement of the ascending aorta) aortic dissection. The subjects were followed longitudinally with serial computed tomography (CT) scans for a mean of 31 months, and were followed clinically for a mean of 53 months. Among a subset of 53 subjects who had aortic imaging repeated beyond 2 years, an aortic aneurysm developed in 28%, with the majority of aneurysms involving the proximal segment of the descending thoracic aorta. The proximal segment also grew most rapidly, at rate of 3.4 ± 3.6 mm/year. There was a trend toward slightly faster rates of aortic growth among those with type I versus type III dissection, at 3.8 ± 3.5 mm/year versus 3.1 ± 3.1 mm/year, respectively.

See page 799

The authors measured both total aortic diameter and the diameter of the false lumen alone at multiple levels in the aorta. Although overall aortic diameter was a predictor of aortic aneurysm formation, it was not found to be an independent predictor on multivariate analysis. Instead, they found that Marfan syndrome and large false lumen diameters at the upper and mid-descending thoracic aorta were independent predictors of late aneurysm formation. Dividing their populations into those with a small false lumen diameter (<21 mm) and those with a large false lumen diameter (≥22 mm) in the upper descending thoracic aorta, they demonstrated that those with a large false lumen had a markedly greater risk of late aneurysm formation (42% vs. 5%, $p < 0.001$), with a trend toward increased mortality (17% vs. 5%, $p = 0.09$) as well.

So why are these findings so important? To put these findings into clinical perspective, it is best to step back and consider our current understanding of the management and outcome of distal aortic dissection.

It is well established that those with aortic dissection involving the ascending thoracic aorta (DeBakey types I and II, or Stanford type A) are at high risk of early death, as the dissected ascending aorta has a propensity to rupture into the pericardial space. Consequently, such patients are managed with early surgical repair of the ascending thoracic aorta, as decades of data have validated the advantage of surgery over medical therapy for this group.

Conversely, those with aortic dissections involving the descending aorta but not the ascending aorta (DeBakey type III, Stanford type B) have a relatively low risk of aortic rupture and, thus, have a significantly lower early mortality. Moreover, surgery to repair the descending thoracic aorta in this setting is associated with substantial mortality and morbidity, including the dreaded complication of paraplegia. Therefore, since surgery was shown to confer no survival advantage over medical therapy for uncomplicated type III aortic dissection, medical therapy became (2), and remains, the treatment of choice. Early surgery to repair the descending thoracic or abdominal aorta is, in turn, reserved for those patients in whom vascular complications of dissection (rupture, malperfusion syndromes, and so on) arise.

But even when patients survive an acute aortic dissection, they remain at long-term risk of midterm and late aortic complications (i.e., aortic aneurysm formation, aortic rupture, extension or recurrence of dissection) and death. This applies to both those with unrepaired type III aortic dissection and those with type I aortic dissection who have undergone successful ascending aortic repair but have persistent dissection of the distal aortic segments; in essence, after ascending aortic repair, the type I aortic dissection becomes anatomically equivalent to a type III aortic dissection. Nevertheless, the long-term outcomes of aortic dissection remain somewhat poorly defined. Challenges in assessing risk have included the relatively low numbers of patients in single centers, marked variations in aortic anatomy among dissection patients, the age and comorbidities of the dissection population, and the fact that both treatments and imaging techniques are rapidly evolving. Indeed, whereas once patients with chronic aortic dissection were followed with serial chest radiography, we now have readily available spiral CT scanning that permits close surveillance of aortic anatomy. Moreover, in the last 2 decades, we have seen the more consistent and aggressive use of long-term antiimpulse and antihypertensive therapies in these patients.

Not surprisingly, then, the modern prognosis for survivors of acute aortic dissection appears to be somewhat more favorable than in historical reports. For example, in a series

*Editorials published in the *Journal of the American College of Cardiology* reflect the views of the authors and do not necessarily represent the views of *JACC* or the American College of Cardiology.

From the Thoracic Aortic Center and Cardiology Division, Massachusetts General Hospital, Boston, Massachusetts.

JACC Vol. 50, No. 8, 2007
August 21, 2007:805–7

of patients with repaired type I aortic dissection, survival rates were 78% at 5 years and 66% at 10 years, compared with approximately 93% and 80%, respectively, for an age- and gender-matched control population (3). With regard to medically managed type III aortic dissection, in the experience of the International Registry of Acute Aortic Dissection (IRAD), the 3-year survival was 77% (4). Alternatively, in a prospective study, medically managed acute type III aortic dissection in Sweden, the 10-year survival was higher at 82% at 5 years and 69% at 10 years, and only slightly below that of the age- and gender-matched general population, and most of the patients actually died of causes unrelated to their dissections (5).

Given the reasonable outcomes associated with chronic distal aortic dissections, there seems little reason to revisit the role of prophylactic "open" surgery to prevent the potential late complications of dissection. However, the last decade has witnessed remarkable advances in minimally invasive approaches to repair of distal aortic dissection using endovascular stent-graft techniques. After reports in 1999 of the successful endovascular stent-grafting repair of both acute, complicated (6) and chronic, stable (7) type III aortic dissections, the technique has become used more and more widely in place of open surgery for the treatment of the vascular complications of acute dissection. Although randomized trials have not been conducted, the available data suggest that among those with vascular complication of type III aortic dissection, the early mortality is considerably lower for stent-grafting than for open repair (8).

Still unknown, however, is whether or not prophylactic stent-grafting can reduce the risk of late surgery or death among patients with initially uncomplicated distal aortic dissection. The mechanisms by which stent-grafting might improve late outcomes is hypothesized to be as follows: the stent-graft is deployed in the proximal descending thoracic aorta, reapposing the dissected layers of the aorta and covering over the site of intimal tear (entry site); this prevents blood flow into the false lumen, resulting in decompression and thrombosis of the false lumen, which should be favorable as numerous reports have found that a thrombosed false lumen predicts lower aortic event rates (4,9) and a reduction in aortic diameter (5). Additionally, covering over the intimal tear could potentially reduce the risk of retrograde extension of a type III aortic dissection into the ascending aorta.

But stent-grafting is not without risks. In a recent meta-analysis of 39 studies involving 609 patients with distal dissection treated with stent-grafts, major complications occurred in 11%, with stroke or paraplegia in 3% (8). Moreover, the complication rate rose to 21% when treating acute rather than chronic dissection. A recently completed randomized European trial (INSTEAD [INvestigation of STEnt grafts in patients with type B Aortic Dissection]) was designed to compare the 2-year outcome of endovascular stenting versus medical therapy for uncomplicated subacute and chronic (2 weeks to 12 months) type III dissection (10). The preliminary trial results revealed that, surprisingly, there was no survival benefit from stent-grafting after the first year of the 2-year follow-up (Dr. C. Nienaber, personal communication, March 2007). The lack of benefit may be because the duration of follow-up is still too short, or perhaps it is related to the fact that the procedures were performed beyond the acute phase of the aortic dissection, so the dissected aortas had lost the capacity to remodel favorably. This limitation should be overcome by another soon-to-be-launched randomized prospective European trial, the ADSORB (Acute Dissection Stent-grafting Or Best Medical Treatment) study, which will investigate the impact of stent-grafting on uncomplicated type III aortic dissection in the acute phase.

Clearly, while endovascular stent-grafting still holds the promise of improved long-term outcomes for uncomplicated distal aortic dissection, that promise has yet to be realized. Indeed, before one considers routine use of stent-grafts in patients with uncomplicated type III aortic dissection, one must recognize that, per the mortality data above, the majority of patients actually fare quite well with medical therapy alone. Consequently, identifying a population of patients with distal dissection that may benefit from prophylactic stent-grafting requires improved methods of risk stratification.

Some clinical predictors of increased risk include Marfan syndrome, female gender, history of atherosclerosis or a prior aortic aneurysm, and the presence of pleural effusion (4). A number of anatomic features of the dissected aorta have also been found to be predictive of increased risk: a patent false lumen (3); those with a maximal aortic diameter of >4 cm at presentation (3,5); and those who have an intramural hematoma with localized dissection and/or ulcer-like projections on CT scan. Conversely, those with pure intramural hematoma and no evident communication with the aortic lumen are at very low risk (5).

A recent report from Immer et al. (11) concluded that a large false lumen was the strongest predictor of distal aortic expansion among patients with chronic type I aortic dissection. However, these investigators identified a large false lumen by measuring the cross-sectional area of the false lumen divided by the area of the whole aorta (both lumens) at that level, to provide a ratio. They concluded that a ratio of ≥ 0.7 is predictive of progressive aortic enlargement. Although their findings are provocative, this method of sizing the false lumen is cumbersome in clinical practice. Fortunately, Song et al. (1) have now proposed a simpler method of measuring false lumen size that is a powerful predictor of future aneurysm development. Since clinicians can measure such false lumen diameters on standard workstations, the method could be widely adopted and routinely reported.

In conclusion, among patients with acute distal aortic dissection, the finding of a large false lumen diameter may identify a high-risk group in whom prophylactic stent-grafting could prove beneficial. Indeed, since as of this writing enroll-

ment in the ADSORB trial has not yet commenced, it may be prudent for the investigators to add to their protocol, prospectively, a subgroup analysis that compares outcomes of those with false lumen diameters of <21 mm versus ≥22 mm. Doing so would maximize the likelihood that this pivotal trial will succeed in identifying, at the very least, a subgroup of acute distal aortic dissection patients that significantly benefit from prophylactic aortic stent-grafting.

Reprint requests and correspondence: Dr. Eric M. Isselbacher, Thoracic Aortic Center, Massachusetts General Hospital, YAW-5800, 55 Fruit Street, Boston, Massachusetts 02114. E-mail: eisselbacher@partners.org.

REFERENCES

1. Song J-M, Kim S-D, Kim J-H, et al. Long-term predictors of descending aorta aneurysmal change in patients with aortic dissection. J Am Coll Cardiol 2007;50:799–804.
2. Glower DD, Fann JI, Speier RH, et al. Comparison of medical and surgical therapy for uncomplicated descending aortic dissection. Circulation 1990;82 Suppl V:IV39–46.
3. Halstead JC, Meier M, Etz C, et al. The fate of the distal aorta after repair of acute type A aortic dissection. J Thorac Cardiovasc Surg 2007;133:127–35.
4. Tsai TT, Fattori R, Trimarchi S, et al. International Registry of Acute Aortic Dissection. Long-term survival in patients presenting with type B acute aortic dissection: insights from the International Registry of Acute Aortic Dissection. Circulation 2006;114:2226–31.
5. Winnerkvist A, Lockowandt U, Rasmussen E, Radegran K. A prospective study of medically treated acute type B aortic dissection. Eur J Vasc Endovasc Surg 2006;32:349–55.
6. Dake MD, Kato N, Mitchell RS, et al. Endovascular stent-graft placement for the treatment of acute aortic dissection. N Engl J Med 1999;340:1546–52.
7. 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.
8. Eggebrecht H, Nienaber CA, Neuhauser M, et al. Endovascular stent-graft placement in aortic dissection: a meta-analysis. Eur Heart J 2006;27:489–98.
9. 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.
10. Nienaber CA, Zannetti S, Barbieri B, et al. INvestigation of STEnt grafts in patients with type B Aortic Dissection: design of the INSTEAD trial—a prospective, multicenter, European randomized trial. Am Heart J 2005;149:592–9.
11. Immer FF, Krahenbuhl E, Hagen U, et al. Large area of the false lumen favors secondary dilatation of the aorta after acute type A aortic dissection. Circulation 2005;112 Suppl I:I249–52.