

Dilatation of Aortic Grafts: Is It a Clinically Important Problem?

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Dacron has been the material of choice for aortic grafts since first introduced half a century ago. The first types were tightly woven resulting in a low porosity and little intraoperative bleeding through the graft. Reduced compliance, less desirable handling, and poor tissue incorporation led to more porous fabrication. However, the more porous structure of knitted grafts necessitates preclotting or better coating to reduce the operative blood loss related to transgraft bleeding. A common drawback with knitted grafts is the propensity to dilate—some more than others. Also ePTFE have been shown to dilate.

During the 1990s, a huge number of observational studies were reported,¹⁻²³ of which few were randomized.¹⁶

Literature Review

Though data vary substantially, it seems fair to conclude that graft dilatation is a predictable phenomenon following aortic graft replacement, whether for an abdominal aortic aneurysm (AAA) repair or a reconstruction for occlusive disease. Dilatation seems more pronounced in Dacron grafts as compared to ePTFE grafts,^{2,5,9,12} and it is more pronounced in knitted Dacron grafts than in woven grafts.^{1,2,10,16,22} Also, the knitting technique seems to play a role, as warp-knitted grafts dilate more than lock-knit grafts.^{6,20}

Those studies that included an early imaging indicate that an initial dilatation occurs within the first weeks after implantation^{1,6,7,8,10,17}; diameter increases in the order of 10% for woven and 20% for knitted Dacron grafts were reported. A significant dilatation has also been noted in patients with direct graft diameter measurements taken immediately after declamping: a mean increase of 1.7 mm (11%) has been reported.³ Utoh and colleagues measured the external and the internal diameter of knitted and woven grafts.²² They found the inner diameter in accordance with the package size (manufacturer's recorded box size), whereas the external diameter of a knitted, gel-sealed graft and a woven graft was 120% and 113% of the package size, respectively. After implantation, the external diameter was 122% and 113% (immediately after declamping, determined with slide calipers) and 129% and 118% (4 weeks later determined with CT) of the package size, respectively. A similar study by the same group performed a few years earlier compared package size of gel sealed knitted grafts with external diameter before (120%), immediately after (120%), at 1 month (128%), and at 3 years (145%) after implantation.²¹ Thus, it seems that some immediate stretching occurs especially in knitted Dacron grafts, (ie, the grafts measure more than the manufacturers box size). Also methodologic problems related to the measurement of external/internal diameter may play a part. Moreover, Dacron grafts seem to become invisible with CT, both with and without contrast medium injection, at least after some time; in contrast to the ePTFE grafts.¹⁹ Thus, measurement of Dacron grafts may not be accurate.

Dilatation beyond 1 month is consistently more modest irrespective of the material examined. Woven grafts dilate but a few percent over the next 1 to 2 years,^{1,5,10,16,18} for example, from 112% at 1 month to 115% at 2 years, 1 or from 106% at 2 weeks to 108% at 1 year. Knitted grafts were found to dilate somewhat more, but again most of the difference to woven graft occurred very early,^{1-8,10,13-23} for example, from 128% at 1 month to 134% at 2 years, 1 or from 127% at 1 week to 129% at 6 months, or from 119% at 2 weeks to 131% at 2 years.¹⁰ Few studies have reported quantitative data: 106 to 130% at 5 to 8 years and 160 to 170% at 10 to 15 years.

Clinical Implications

The existing studies tell us little about the causes of graft dilatation, though a number of reasons have been suggested, such as mechanical fracture of yarn fibers, damage to the material during manufacturing or perioperative handling, and repeated or inappropriate sterilization procedures. Though Dacron and ePTFE are considered biologically stable, biodegradation may occur over time owing to the degenerative effect of tissue fluids and enzymes.

The clinical impact of graft dilatation remains uncertain, though it is of concern. It has not been possible to relate dilatation to surgical indication (aneurysm vs occlusive disease). Data on hypertension are diverse; one study found more pronounced dilatation in hypertensive patients,¹³ whereas other reports found no correlation.^{3,10} With few exceptions, patients with dilated grafts did not have anastomotic aneurysms and vice versa. Even when looking at the 10% segment of the series with the greatest dilatation, it has not been possible to demonstrate a predilection for graft complications.³

Current Study

As a result of the uncertainty, we set up a randomized clinical trial in the mid-1990s to compare perioperative handling and complications, and long-term results and dilatation of knitted Dacron grafts against stretch ePTFE grafts. The first 100 consecutive patients admitted for aortic reconstruction for AAA or occlusive disease were followed for at least 5 years with annual CT and ultrasound. The next 200 patients were followed with ultrasound imaging only. Data from this study has not yet been analyzed, but results will be presented.

References

1. Alimi Y, Juhan C, Morati N, et al. Dilatation of woven and knitted aortic prosthetic grafts: CT scan evaluation. *Ann Vasc Surg* 1994;8:238-42.
2. Berman SS, Hunter GC, Smyth SH, et al. Application of computed tomography for surveillance of aortic grafts. *Surgery* 1995;118(1):8-15.
3. Blumenberg RM, Gelfand ML, Barton EA, et al. Clinical significance of aortic graft dilation. *J Vasc Surg* 1991;14:175-80.

4. den Hoed PT, Veen HF. The late complications of aorto-ilio-femoral Dacron prostheses: dilatation and anastomotic aneurysm formation. *Eur J Vasc Surg* 1992;6:282-7.
5. Erdoes LS, Berman SS, Bernhard VM, et al. Clinical and CT evaluation of a new stretch polytetrafluoroethylene aortic graft. *Ann Vasc Surg* 1995; 9:441-7.
6. Goeau-Brissonniere OA, Qanadli SD, et al. Can knitting structure affect dilation of polyester bifurcated prostheses? A randomized study with the use of helical computed tomography scanning. *J Vasc Surg* 2000;31(1 Pt 1):157-63.
7. Goossens D, Weyers L, Engels P, et al. 'In vivo' size of knitted Dacron prostheses (Gelseal) used in the thoracic aorta: a computed tomography study. *Cardiovasc Surg* 1996;4:205-6.
8. Igari T, Iwaya F, Hoshino S. Postoperative alteration in the size of Dacron vascular prostheses implanted in the infrarenal abdominal aorta. *Surg Today* 1995;25:605-7.
9. Kaiser MM, Wenk H, Link J, et al. [PTFE prostheses in infrarenal aneurysms of the abdominal aorta]. *Langenbecks Arch Chir* 1994;379:280-4.
10. Mattens E, Engels P, Hamerlijncck R, et al. Gelseal versus Gelweave Dacron prosthetic grafts in the descending thoracic aorta: a two-year computed tomography scan follow-up study. *Cardiovasc Surg* 1999;7:432-5.
11. Mikati A, Marache P, Watel A, et al. End-to-side aortoprosthetic anastomoses: long-term computed tomography assessment. *Ann Vasc Surg* 1990;4:584-91.
12. Mohan CR, Hoballah JJ, Martinasevic M, et al. The aortic polytetrafluoroethylene graft: further experience. *Eur J Vasc Endovasc Surg* 1996;11:158-63.
13. Nunn DB, Carter MM, Donohue MT, Hudgins PC. Postoperative dilation of knitted Dacron aortic bifurcation graft. *J Vasc Surg* 1990;12:291-7.
14. Nunn DB, Carter MM, Donohue MT, Pourdeyhimi B. Dilative characteristics of Microvel and Vasculour-II aortic bifurcation grafts. *J Biomed Mater Res* 1996;30(1):41-6.
15. Nunn DB, Freeman MH, Hudgins PC. Postoperative alterations in size of Dacron aortic grafts: an ultrasonic evaluation. *Ann Surg* 1979;189:741-5.
16. Quarmby JW, Burnand KG, Lockhart SJ, et al. Prospective randomized trial of woven versus collagen-impregnated knitted prosthetic Dacron grafts in aortoiliac surgery. *Br J Surg* 1998;85:775-7.
17. Riepe G, Klinggräff GV, Imig H. [Graft dilatation following aortic resection]. *Angio* 1989;11:153-7.
18. Robinson DA, Lennox A, Englund R, Hanel KC. Graft dilatation following abdominal aortic aneurysm resection and grafting. *Aust N Z J Surg* 1999;69:849-51.
19. Simoni G, Cittadini G Jr, Perrone R, et al. [Postoperative evaluation of vascular bifurcation prostheses by means of helical CT]. *Minerva Cardioangiol* 1996;44:223-7.
20. Swartbol P, Albrechtsson U, Parsson H, Norgren L. Dilatation of aorto-bifemoral knitted Dacron grafts after a mean implantation of 5 years. *Int Angiol* 1996;15:236-9.
21. Utoh J, Goto H, Hirata T, et al. Dilatation of sealed Dacron vascular prostheses: a comparison of Gelseal and Hemashield. *J Cardiovasc Surg (Torino)* 1998;39:179-80.
22. Utoh J, Goto H, Obayashi H, et al. Dilation of gelatin-sealed knitted dacron prosthesis. *J Cardiovasc Surg (Torino)* 1996;37:343-4.
23. Wenk H, Shekarriz H, Bruch HP. [Choice of vascular prosthesis material in treatment of infrarenal abdominal aortic aneurysms—initial results of a prospective randomized study]. *Zentralbl Chir* 1997;122:743-6.

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