

procedures, such as routine aortic arch replacement and total aortic root replacement or valve sparing aortic root reconstruction, should be performed [22–25]. In our experience, as long as the primary intimal tear was resected, there was no patent false lumen left postoperatively in either the aortic root or aortic arch in any of the patients using adventitial inversion technique. Therefore, ascending aorta/hemiarch replacement with supracoronary tube graft would suffice for most of the patients with acute type A aortic dissection in the absence of Marfan or annuloaortic ectasia.

4.4. Limitations of this study

The main limitation of the present study was that it was retrospective in nature without control group. Furthermore, the follow-up period is relatively short to prove the superiority of this technique in preventing late pseudoaneurysm formation or redissection compared to conventional anastomotic techniques using felt strips or biological glues. A large-scale prospective randomized clinical controlled study would be necessary to address these issues.

5. Conclusion

The adventitial inversion technique provides an excellent immediate hemostasis and facilitates thrombotic closure of the proximal and the distal false lumen in the treatment for acute aortic dissection. This technique is a promising alternative procedure to Teflon felt or biologic glues for restoring the integrity of the aortic wall in the surgical treatment of acute type A aortic dissection.

References

- [1] Immer FF, Hagen U, Berdat PA, Eckstein FS, Carrel TP. Risk factors for secondary dilatation of the aorta after acute type A aortic dissection. *Eur J Cardiothorac Surg* 2005;27:654–71.
- [2] Moore NR, Parry AJ, Trotman-Dickenson B, Pillai R, Westaby S. Fate of the native aorta after repair of acute type A dissection: a magnetic resonance imaging study. *Heart* 1996;75:62–6.
- [3] Fattori R, Bacchi-Reggiani L, Bertaccini P, Napoli G, Fusco F, Longo M, Pierangeli A, Gavelli G. Evolution of aortic dissection after surgical repair. *Am J Cardiol* 2000;86:868–72.
- [4] 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;87:1378–82.
- [5] Driever R, Botsics S, Schmitz E, Donovan J, Vetter HO. Long-term effectiveness of operative procedures for Stanford type A aortic dissections. *Cardiovasc Surg* 2003;11:265–72.
- [6] Floten HS, Ravichandran PS, Furnary AP, Gately HL, Starr A. Adventitial inversion technique in repair of aortic dissection. *Ann Thorac Surg* 1995;59:771–2.
- [7] Garcia-Rinaldi R, Carballido JC, Mojica J, Soltero ER, Curcic S, Barcelo J, Porro R. Surgical treatment of aortic dissections: initial experience

- with the adventitial inversion technique. *Ann Thorac Surg* 1998;65:1255–9.
- [8] Sabik JF, Lytle BW, Blackstone EH, McCarthy PM, Loop FD, Cosgrove DM. Long-term effectiveness of operations for ascending aortic dissections. *J Thorac Cardiovasc Surg* 2000;119:946–62.
- [9] Kazui T, Washiyama N, Muhammad BAH, Terada H, Yamashita K, Takinami M, Tamiya Y. Extended total arch replacement for acute type A aortic dissection: experience with seventy patients. *J Thorac Cardiovasc Surg* 2000;119:558–65.
- [10] Svensson LG, Crawford ES, Hess KR, Coselli JS, Safi HJ. Dissection of the aorta and dissecting aortic aneurysms. Improving early and long-term surgical results. *Circulation* 1990;82:IV24–38.
- [11] Bachet J, Goudot B, Dreyfus G, Banfi C, Ayle NA, Aota M, Brodaty D, Dubois C, Delentdecker P, Guilmet D. The proper use of glue: a 20-year experience with the GRF glue in acute aortic dissection. *J Card Surg* 1997;12:243–53.
- [12] Raanani E, Georghiou GP, Kogan A, Wandwi B, Shapira Y, Vidne BA. 'BioGlue' for the repair of aortic insufficiency in acute aortic dissection. *J Heart Valve Dis* 2004;13:734–7.
- [13] Hoschtitzky JA, Crawford L, Brack M, Au J. Acute coronary syndrome following repair of aortic dissection. *Eur J Cardiothorac Surg* 2004;26:860–2.
- [14] Mastroberroto P, Chello M, Onorati F, Renzulli A. Embolisation, inflammatory reaction and persistent patent false lumen: is biological glue really effective in repair of type A aortic dissection? *Eur J Cardiothorac Surg* 2005;27:529–32.
- [15] Fukunaga S, Karck M, Harringer W, Cremer J, Rhein C, Heverich A. The use of gelatin–resorcin–formalin glue in acute aortic dissection type A. *Eur J Cardiothorac Surg* 1999;15:564–70.
- [16] Bingley JA, Gardner MAH, Stafford G, Mau TK, Pohlner PG, Tam RKW, Jalali H, Tesar PJ, O'Brien MF. Late complications of tissue glues in aortic surgery. *Ann Thorac Surg* 2000;69:1764–8.
- [17] Kazui T, Washiyama N, Bashar AHM, Terada H, Suzuki K, Yamashita K, Takinami M. Role of biologic glue repair of proximal aortic dissection in the development of early and midterm redissection of the aortic root. *Ann Thorac Surg* 2001;72:509–14.
- [18] Suehiro K, Hata T, Yoshitaka H, Tsumura Y, Matsumoto M, Hamanaka S, Mohri M, Ohtani S, Nagao A, Kojima T. Late aortic root redissection following surgical treatment for acute type A aortic dissection using gelatin–resorcin–formalin glue. *Jpn J Thorac Cardiovasc Surg* 2002;50:195–200.
- [19] Von Oppell UO, Karani Z, Brooks A, Brink J. Dissected aortic sinus repaired with gelatin–resorcin–formaldehyde (GRF) glue are not stable on follow up. *J Heart Valve Dis* 2002;11:249–57.
- [20] Ergin MA, Phillips RA, Galla JD, Lansman SL, Mendelson DS, Quintana CS, Griep R. Significance of distal false lumen after type A dissection repair. *Ann Thorac Surg* 1994;57:820–5.
- [21] Nguyen B, Muller M, Kipfer B, Berdat P, Walpoth B, Althaus U, Carrel T. Different techniques of distal aortic repair in acute type A dissection: impact on late aortic morphology and reoperation. *Eur J Cardiothorac Surg* 1999;15:496–501.
- [22] Ando M, Nakajima N, Adachi S, Nakaya M, Kawashima Y. Simultaneous graft replacement of the ascending aorta and total aortic arch for type A aortic dissection. *Ann Thorac Surg* 1994;57:669–76.
- [23] Ergin MA, McCullough J, Galla JD, Lansman SL, Griep RB. Radical replacement of the aortic root in acute type A dissection: indications and outcome. *Eur J Cardiothorac Surg* 1996;10:840–4.
- [24] Niederhauser U, Rudiger H, Vogt P, Kunzli A, Zund G, Turina M. Composite graft replacement of the aortic root in acute dissection. *Eur J Cardiothorac Surg* 1998;13:144–50.
- [25] Kallenbach K, Pethig K, Leyh RG, Baric A, Harringer W. Acute dissection of the ascending aorta: first results of emergency valve sparing aortic root reconstruction. *Eur J Cardiothorac Surg* 2002;22:218–22.

Editorial comment

Reinforcing the anastomotic cuff in aortic dissection

The dissected aorta is prone to anastomotic complications such as bleeding and dehiscence. The aortic wall is friable due to medial cystic necrosis, fragmentation of the elastic

lamellae, focal fibrosis, and the dissecting hematoma between the middle and the outer third of the media. Yet the adventitial layer remains intact [1]. Current methods to reinforce the

aorta make use of Teflon or Dacron strips and biologic glue. Resulting possible disadvantages are difficulties to accurately localize anastomotic bleeding and a bulky anastomosis predisposing to luminal narrowing and pressure decrease. Therefore, reference surgeons recommended neither to use prosthetic reinforcement nor the inclusion technique [2].

Tanaka et al. present the formerly described adventitial inversion technique for the repair of acute type A aortic dissection with respect to closure of the false lumen [3,4]. The dissected flap is trimmed back 1 cm distal to the resection line. The redundant layer of adventitia including the adherent outer third of media is folded into the lumen and tacked down. Thereby the resulting anastomotic cuff consists of two adventitial and external elastic lamina layers "sandwiching" two thirds of the friable media. A tough but soft cuff for anastomosis is created, with a low profile enabling accurate suturing and precise localization of bleeding points. Besides, the cuff has a desirable sealing effect by activation of the extrinsic coagulation pathway via exposed adventitial collagen and tissue factor [5]. The latter is a cell membrane bound glycoprotein, and upon exposure to blood, binds to factor VII. The tissue factor–factor VIIa complex activates factor X and thence generates thrombin.

This technique carries the potential risk of thrombus formation at the adventitial anastomotic rim with subsequent embolization. In small caliber anastomoses with intima–adventitia apposition, thrombus deposition has been observed only at the adventitial rim not causing luminal narrowing [6]. It is unlikely that in a high-flow system such as the aorta, protruding thrombus is developing at the anastomotic site. However, surface irregularities are certainly filled up by thrombus that becomes subsequently replaced by neointima during anastomotic remodeling [7]. The embolic potential is probably very low.

The proposed technique ensures that the false lumen is excluded from antegrade flow at the anastomotic level. Although important, Tanaka et al. show that other means are

equally crucial in contributing to the closure of the intimal tear at the entry site. They underscore the importance of exploration of the aortic arch including replacement whenever necessary and avoidance of distal clamping to prevent damage to the aorta beyond the anastomosis.

References

- [1] Cotran RS, Kumar V, Collins T, Robbins SL. Robbins pathologic basis of disease, 6th ed., Elsevier Science Health Science; 1998.
- [2] Svensson LG, Crawford ES, Hess KR, Coselli JS, Safi HJ. Dissection of the aorta and dissecting aortic aneurysms. Improving early and long-term surgical results. *Circulation* 1990;82(Suppl. IV):IV24–38.
- [3] Floten HS, Ravichandran PS, Furnary AP, Gately HL, Starr A. Adventitial inversion technique in repair of aortic dissection. *Ann Thorac Surg* 1995;59:771–2.
- [4] Garcia-Rinaldi R, Carballido J, Mojica J, Soltero ER, Curcic S, Barcelo J, Porro PR. Surgical treatment of aortic dissections: initial experience with the adventitial inversion technique. *Ann Thorac Surg* 1998;65:1255–9.
- [5] Dumanian GA, Heil BY, Khouri RK, Hing C, Labadie K, Wun T-C, Johnson PC. Tissue factor and its inhibition at the human microvascular anastomosis. *J Surg Res* 1996;60:263–9.
- [6] Heijmen RH, Gründeman PF, Borst C. Intima–adventitia apposition in end-to-side arterial anastomosis: an experimental study in the pig. *Ann Thorac Surg* 1998;65:705–11.
- [7] Marty B, Maeder B, Gallino A, Mucciolo A, von Segesser LK. Does large oversizing of self-expandable endoprosthesis compensate for aortic growth? *J Vasc Surg* 2003;38:1368–75.

Bettina Marty*

*Department of Cardiovascular Surgery,
University Hospital CHUV,
Rue de Bugnon 46, 1011 Lausanne,
Switzerland*

* Tel.: +41 21 314 2596; fax: +41 21 314 2278.

E-address: martyb@hopcantfr.ch

doi:10.1016/j.ejcts.2005.10.009