BÖLÜM 39

PROSTETİK VASKÜLER GREFT ENFEKSİYONLARI

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GİRİŞ

Prostetik vasküler greft enfeksiyonu (PVGE) hastaların % 1-5'i arasında görülen nadir bir komplikasyondur.(1) Enfeksiyondan koruyucu çeşitli yöntemlere rağmen hala mortalite riskinin %10-50 oranında ve amputasyon riskinin %4-14 olduğu bildirilmektedir.(2) Çoğunlukla cerrahi sırasında direk kontaminasyonla PVGE gelişmesine rağmen, hematojen yolla yayılımla da enfeksiyon oluşabilir.(3) Daha önce PVGE gelişen bir hastamızla ilgili tecrübemizi bildirdikten sonra PVGE hakkında genel bigiler verilecektir.

VAKA

59 yaşında erkek hastaya yaklaşık 6 ay önce expanded polytetrafluoroethylene (ePTFE) greft ile dizüstü femoro-popliteal bypass ameliyatı yapılmıştı. Hastaya daha sonra iki kez grefte trombektomi ameliyatı yapılmış. Bize başvurduğunda dizüstü bölgedeki insizyondan akıntı mevcuttu, yara iyileşmemişti, greft tıkalı idi. Enfekte görünen bölgeden kültür örnekleri alındı, parenteral 1. kuşak sefalosporin başlandı. Bir gün sonra hasta operasyona alındı. Dizüstü, distal anastomoz bölgesinde greft nativ arterden tamamen ayrılmıştı, ePTFE greft proksimal anastomoz bölgesinden de ayırarak çıkarıldı. Hastada kritik iskemi bulguları olmadığı için intravenöz antibiyotiğe devam edildi. Yaklaşık 20 metrede kladikasyo şikayeti olan hastaya endovasküler girişim planlandı. Antegrad ve retrograd girişim denenmesine rağmen süperfisial femoral arter(SFA) proksimalindeki oklüzyon geçilemedi ve hastaya hibrit olarak distal SFA balon anjioplasti ile proksimal SFA büyük safen ven greft (SVG) interpozisyonu ile revaskülarize edildi. Böylece enfekte bölgeye greft yeniden kullanılmamış oldu. Bir yıl sonra distal SFA da darlık nedeni ile yine balon anjioplasti yapıldı ve sonrasında medikal tedavi ile takip edildi. Medikal tedavi ile Rutherford evre 1 olarak takip edilmektedir.

TARTIŞMA:

Prostetik vasküler greftler, vasküler rekonstrüksiyon amacı ile 1950 yılının başlarında kullanılmaya başlandı.(4) Bu greftler tıkayıcı arteriyel hastalıklarda, arteriyel anevrizmalarda ve hemodiyaliz amaçlı damar erişimi oluşturmak amacı ile çeşitli ilerlemeler kaydederek kullanılmaya devam etmektedir. Son zamanlarda bu greftler stent teknolojisi ile birleştirilerek endovasküler stent greft olarak da geniş kullanım alanı bulmuştur. Vasküler greft teknolojisindeki ilerlemelerle birlikte enfeksiyon açısından daha yüksek riskli, ciddi komorbid hastalığı olan hastalarda da kullanılmaya başlanmıştır. Yüksek riskli hastalarda kullanılma-

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takip edilmelidir. Enfeksiyon bulguları kaybolduktan sonra yıllık takipler laboratuvar testleri ve BTA ile yapılabilir. Cerrahi için uygun olmayan ömür boyu antimikrobiyal tedavi ile takip edilen hastalar daha sık aralıklarla takip edilmelidir.

KAYNAKLAR

1. M. Revest *et al.*, "Medical treatment of prosthetic vascular graft infections: Review of the literature and proposals of a Working Group," *Int. J. Antimicrob. Agents*, vol. 46, no. 3, pp. 254–265, Sep. 2015.
2. S. F. FitzGerald, C. Kelly, and H. Humphreys, "Diagnosis and treatment of prosthetic aortic graft infections: Confusion and inconsistency in the absence of evidence or consensus," *J. Antimicrob. Chemother.*, vol. 56, no. 6, pp. 996–999, 2005.
3. Moore WS, Rosson CT, Hall AD, et al. Transient bacteremia: a cause of infection in prosthetic vascular grafts. Am J Surg. 1969;117:342–343.
4. Wilson WR, Bower TC, Creager MA, et al. Vascular graft infections, mycotic aneurysms, and endovascular infections: a scientific statement from the American Heart Association. Circulation 2016;134:e412–60.
5. Calligaro KD, Veith FJ, Schwartz ML, et al. Differences in early versus late extracavitary arterial graft infections. J Vasc Surg. 1995;22:680–685
6. Legout L, D'Elia PV, Sarraz-Bournet B, et al. Diagnosis and management of prosthetic vascular graft infections. *Med Mal Infect*. 2012;42(3):102-109. doi:10.1016/j.medmal.2012.01.003
7. Chakfé N, Diener H, Lejay A, et al. Editor's Choice - European Society for Vascular Surgery (ESVS) 2020 Clinical Practice Guidelines on the Management of Vascular Graft and Endograft Infections. *Eur J Vasc Endovasc Surg*. 2020;59(3):339-384. doi:10.1016/j.ejvs.2019.10.016
8. Batt M, Feugier P, Camou F, et al. A meta-analysis of outcomes after in situ reconstructions for aortic graft infection. Angiology 2018;69:370e9.
9. Thomas S, Ghosh J, Porter J, et al. Periodontal disease and late-onset aorticprosthetic vascular graft infection. Case Rep Vasc Med 2015;2015:768935.
10. Cotti E, Arrica M, Di Lenarda A, et al. The perioperative dental screening andmanagement of patients undergoing cardiothoracic, vascular surgery and othercardiovascular invasive procedures: a systematic review. Eur J Prev Cardiol2017;24:409–25.
11. Bandyk DF. Vascular surgical site infection: risk factors and preventive measures. Seminars in vascular surgery. Elsevier; 2008. p. 119–23.
12. Inui T, Bandyk DF. Vascular surgical site infection: risk factors and preventive measures. Seminars in vascular surgery. Elsevier; 2015. p. 201–7.
13. Vogel TR, Symons R, Flum DR. The incidence and factors associated with graft infection after aortic aneurysm repair. J Vasc Surg 2008;47:264–9
14. Hicks RC, Greenhalgh RM. The pathogenesis of vascular graft infection. Eur JVasc Endovasc Surg 1997;14(Suppl A):5–9.
15. Richet H, Chidiac C, Prat A, et al. Analysis of risk factors for surgical wound infections following vascular surgery. Am J Med 1991;91:S170–2.
16. Geerlings SE, Hoepelman AI. Immune dysfunction in patients with diabetes mellitus (DM). Pathog Dis 1999;26:259–65
17. Antonios VS, Noel AA, Steckelberg JM, et al. Prosthetic vascular graft infection: a risk factor analysis using a case-control study. J Infect 2006;53:49–55.
18. Engin C, Posacioglu H, Ayik F, et al. Management of vascular infection in the groin. Tex Heart Inst J 2005;32:529–34.
19. Chiesa R, Astore D, Frigerio S, et al. Vascular prosthetic graft infection: epidemiology, bacteriology, pathogenesis and treatment. Acta Chir Belg 2002;102: 238–47
20. Rosenman JE, Pearce WH, Kempczinski RF. Bacterial adherence to vasculargrafts after in vitro bacteremia. J Surg Res 1985;38:648–55
21. Schmitt DD, Bandyk DF, Pequet AJ, et al. Bacterial adherence to vascular prostheses: a determinant of graft infectivity. J Vasc Surg 1986;3:732–40.
22. Szilagyi DE, Smith RF, Elliott JP, et al. Infection in arterial reconstruction with synthetic grafts. Ann Surg 1972;176:321
23. Bunt T. Synthetic vascular graft infections. I. Graft infections. Surgery 1983;93: 733–46
24. Samson RH, Veith FJ, Janko GS, et al. A modified classification and approach to the management of infections involving peripheral arterial prosthetic grafts. J Vasc Surg 1988;8:147–53.
25. Kieffer E, Bahnini A, Koskas F, et al. In situ allograft replacement of infected infrarenal aortic prosthetic grafts: results in forty-three patients. *J Vasc Surg*. 1993;17(2):349-356.
26. Swain TW 3rd, Calligaro KD, Dougherty MD. Management of infected aortic prosthetic grafts. *Vasc Endovascular Surg*. 2004;38:75–82
27. Bandyk DF. Vascular graft infections: epidemiology, microbiology,pathogenesis, and prevention. In: Bernhard VM, Towne JB, eds. *Complication in Vascular Surgery*. St. Louis, MO: Quality Medical Publishing; 1991:223–234.
28. O'Connor S, Andrew P, Batt M, et al. A systematic review and meta-analysis of treatments for aortic graft infection. *J Vasc Surg*. 2006;44:38–45. doi: 10.1016/j.jvs.2006.02.053
29. Oderich GS, Panneton JM. Aortic graft infection: what have we learned during the last decades? Acta Chir Belg. 2002;102:7–13.
30. Bruggink JLM, Glaudemans AWJM, Saleem BR, et al. Accuracy of FDG-PETeCT in the diagnostic work-up of vascular prosthetic graft infection. Eur J Vasc Endovasc Surg 2010;40:348e54.
31. Orton DF, LeVeen RF, Saigh JA, et al. Aortic prosthetic graft infections: radiologic manifestations and implications for management. Radiographics 2000;20:977e93.
32. Bruggink JLM, Slart RHJA, Pol JA,et al. Current role of imaging in diagnosing aortic graft infections. Semin Vasc Surg 2011;24:182e90.
33. Spartera C, Morettini G, Petrassi C, et al. Role of magnetic resonance imaging in the evaluation of aortic graft

healing, perigraft fluid collection, and graft infection. Eur J Vasc Surg 1990;4:69e73.
34. Siracuse JJ, Nandivada P, Giles KA,et al. Prosthetic graft infections involving thefemoral artery. J Vasc Surg 2013;57:700e5.
35. Shahidi S, Eskil A, Lundof E, et al. Detection of abdominal aortic graft infection: comparison of magnetic reso- nance imaging and indium-labeled white blood cell scanning. Ann Vasc Surg 2007;21:586e92
36. Rabkin Z, Israel O, Keidar Z. Do hyperglycemia and diabetes affect the incidence of false-negative 18F-FDG PET/CT studies in patients evaluated for infection or inflammation and cancer? A comparative analysis. J Nucl Med 2010;51:1015e20.
37. Kagna O, Kurash M, Ghanem-Zoubi N,et al. Does antibiotic treatment affect the diagnostic accuracy of 18F-FDG PET/CT studies in patients with suspected infectious processes? J Nucl Med 2017;58:1827e30.
38. Keidar Z, Nitecki S. FDG-PET in prosthetic graft infections. Se- min Nucl Med. 2013;43:396–402. doi: 10.1053/j.semnu- clmed.2013.04.004.
39. Sah BR, Husmann L, Mayer D, et al; VASGRA Cohort. Diagnostic performance of 18F-FDG-PET/CT in vascular graft infections. Eur J Vasc Endovasc Surg. 2015;49:455–464. doi: 10.1016/j.ejvs.2014.12.024.
40. Reinders Folmer EI, Von Meijenfeldt GCI, Van der Laan MJ, et al. Diagnostic Imaging in Vascular Graft Infection: A Systematic Review and Meta-Analysis. *Eur J Vasc Endovasc Surg*. 2018;56(5):719-729. doi:10.1016/j.ejvs.2018.07.010
41. Erba PA, Leo G, Sollini M, et al. Radiolabelled leucocyte scintigraphy versus conventional radiological imaging for the management of late, low-grade vascular prosthesis infections. *Eur J Nucl Med Mol Imaging*. 2014;41(2):357-368. doi:10.1007/s00259-013-2582-9
42. Signore A, Jamar F, Israel O, et al. Clinical indications, image acquisition and data interpretation for white blood cells and anti-granulocyte monoclonal antibody scintigraphy: an EANM procedural guideline. *Eur J Nucl Med Mol Imaging*. 2018;45(10):1816-1831. doi:10.1007/s00259-018-4052-x
43. Annovazzi A, Bagni B, Burroni L,et al. Nuclear medicine imaging of inflammatory/infective disorders of the abdomen. *Nucl Med Commun*. 2005;26(7):657-664. doi:10.1097/01.mnm.0000169202.68011.47
44. Gassel HJ, Klein I, Steger U, et al. Surgical management of prosthetic vascular graftinfection: comparative retrospective analysis of 30 consecutivecases. Vasa 2002;3:48e55.
45. Haefner TA, Lewis C, Baluh G,et al. Initial Inoculation Concentration Does Not Affect Final Bacterial Colonization of In vitro Vascular Conduits. Surg Infect 2018;19:352e7.
46. Ehsan O, Gibbons CP. A 10-year experience of using femoro-popliteal vein for re-vascularisation in graft and arterial infections. Eur J Vasc Endovasc Surg 2009;38:172e9.
47. Johnson JJ, Alex Jacocks M, Gauthier SC, et al. Establishing a swine model to compare vascular prostheses in a contaminated field. J Surg Res 2013;181: 355e8
48. Langenberg JCM, Kluytmans JAJW, Mulder PGH, et al. Peri-operative nasal eradication therapy prevents Staphylococcus aureus surgical site infections in aor- toiliac surgery. Surg Infect 2018;19:510e5.
49. Stewart AH, Eyers PS, Earnshaw JJ. Prevention of infection in peripheral arterial reconstruction: a systematic review and meta- analysis. J Vasc Surg 2007;46:148e55
50. van der Slegt J, van der Laan L, Veen EJ, et al. Implementation of a bundle of care to reduce surgical site infections in patients undergoing vascular surgery. PLoS ONE 2013;8:e71566.
51. Stone P, Campbell J, AbuRahma A, et al. Vascular Surgical Antibiotics Prophylaxis Study (VSAPS). Vasc Endovasc Surg 2010;44:521e8
52. Stone P, AbuRahma A, Campbull J, et al. Prospective randomized double-blinded trial comparing 2 anti-MRSA agents with supplemental coverage of cefazolin before lower extremity revascularization. Ann Surg. 2015;262:492e501
53. Wanhainen A, Verzini F, Van Herzeele I,et al. European Society for Vascular Surgery (ESVS) 2019 clinical practice guidelines on the management of abdominal aorto-iliac aneurysms. Eur J Vasc Endovasc Surg 2018;57:8e93.
54. Zdanowski Z, Danielsson G, Jonung T, et al. Intraoperative contamination of synthetic vascular grafts. Effect of glove change before graft implantation. A prospective randomised study. Eur J Vasc Endovasc Surg 2000;19:283e7.
55. Parizh D, Ascher E, Raza Rizvi SA,et al. Quality improvement initiative: preventative surgi- cal site infection protocol in vascular surgery. Vascular 2018;26:47e 53.
56. Kahlberg A, Melissano G, Mascia D, et al. How to best treat infectious complications of open and endovascular thoracic aortic repairs. Semin Vasc Surg 2017;30:95e102.
57. Darouiche RO. Treatment of infections associated with surgical implants. N Engl J Med 2004;350:1422e9.
58. Spiliotopoulos K, Preventza O, Green SY,et al. Open descending thoracic or thoracoabdominal aortic approaches for complications of endo- vascular aortic procedures: 19-year experience. J Thorac Car- diovasc Surg 2018;155:10e8.
59. 59. Tacconelli E, Cataldo MA, Dancer SJ, et al. ESCMID guidelines for the management of the infection control measures to reduce transmission of multidrug- resistant Gram-negative bacteria in hospitalized patients. Clin Microbiol Infect 2014;20:1e55
60. Revest M, Camou F, Senneville E, et al. Medical treatment of prosthetic vascular graft infections: review of the literature and proposals of a working group. Int J Antimicrob Agents 2015;46:254e65.
61. Dorigo W, Pulli R, Azas L, et al. Early and long-term results of conventional surgical treatment of secondary aorto-enteric fistula. Eur J Vasc Endovasc Surg 2003;26:512e8
62. Jamieson RW, Burns PJ, Dawson AR, et al. Aortic graft preservation by debridement and omental wrapping. Ann Vasc Surg 2012;26:423
63. Lejay A, Koncar I, Diener H, et al Postoperative infection of prosthetic grafts or stents involving the supra aortic trunks: a comprehensive review. Eur J Vasc Endovasc Surg 2018;56:885e900.

64. Knight BC, Tait WF. Dacron patch infection following carotid endarterectomy: a systematic review of the literature. Eur J Vasc Endovasc Surg 2009;37:140e8.
65. Asciutto G, Geier B, Marpe B, et al. Dacron patch infection after carotid angioplasty. A report of 6 cases. Eur J Vasc Endovasc Surg 2007;33:55e7.
66. Myles O, Thomas WJ, Daniels JT, et al. Infected endovascular stents managed with medical therapy alone. Catheter Cardiovasc Interv 2000;51:471e6.
67. Teebken OE, Pichlmaier MA, Brand S, et al. Cryopreserved arterial allografts for in situ reconstruction ofinfected arterial vessels. Eur J Vasc Endovasc Surg 2004;27:597e602.
68. Zetrenne E, McIntosh BC, McRae MH, et al.Prostheticvasculargraftinfection:amulti-center review of surgical management. Yale J Biol Med 2007;80:113e21.
69. Younis G, Reul GJ, Krajcer Z. Combined endovascular and sur- gical treatment of infected carotid-carotid bypass graft. J Endovasc Ther 2006;13:687e92.
70. Bond KM, Brinjukii W, Murad MH, et al. Endo- vascular treatment of carotid blowout syndrome. J Vasc Surg 2017;65:883e8.
71. Thorbjornsen K, Djavani Gidlund K, Björck M, et al. Long-term outcome after endoVAC hybrid repair of infected vascular reconstructions. Eur J Vasc Endovasc Surg 2016;51:724e32
72. Kaviani A, Ouriel K, Kashyap VS. Infected carotid pseudoaneurysm and carotid-cutaneous fistula as a late complication of carotid artery stenting. J Vasc Surg 2006;43:379e82.
73. Alawy M, Tawfick W, ElKassaby M, et al. Late Dacron Patch Inflammatory Reaction after Carotid Endarterectomy. *Eur J Vasc Endovasc Surg*. 2017;54(4):423-429. doi:10.1016/j.ejvs.2017.06.015
74. Czerny M, Eggebrecht H, Sodeck G, et al. New insights regarding the incidence, presentation andtreatment options of aorto-oesophageal fistulation after thoracic endovascular aortic repair: the European Registry of Endovascular Aortic Repair Complications. Eur J Cardiothorac Surg2014;45:452e7.
75. Czerny M, Reser D, Eggebrecht H, et al. Aorto-bronchial and aorto-pulmonary fistulation afterthoracic endovascular aortic repair: an analysis from the European Registry of Endovascular Aortic Repair Complications. EurJ Cardiothorac Surg 2015;48:252e7.
76. Chiesa R, Melissano G, Marone EM,et al. Aorto-oesophageal and aortobronchial fistulaefollowing thoracic endovascular aortic repair: a national survey.Eur J Vasc Endovasc Surg 2010;39:273e9.
77. Smeds MR, Duncan AA, Harlander-Locke MP, et al. Treatment and outcomes of aorticendograft infection. J Vasc Surg 2016;63:332e40.
78. Kahlberg A, Grandi A, Loschi D, et al. Infection of descending thoracic aortic graftand endograft: a systematic review. J Vasc Surg 2019;69:1941e51.
79. Albers M, Romiti M, Pereira CA, et al. Metaanalysis of allograft bypass grafting to infrapopliteal arteries. EurJ Vasc Endovasc Surg 2004;28:462e72.
80. Nagpal A, Sohail MR. Prosthetic vascular graft infections: acontemporary approach to diagnosis and management. CurrInfect Dis Rep 2011;13:317e23
81. Batt M, Jean-Baptiste E, O'Connor S, et al.Contemporary management of infrarenal aortic graft infection: early and late results in 82 patients. Vascular 2012;20:129e37.
82. Sgroi MD, Kirkpatrick VE, Resnick KA, et al. Less than total excision of infected prosthetic PTFE graft does not increase the risk of reinfection. Vasc Endovasc Surg2015;49:12e5.
83. Sharif MA, Lee B, Lau LL, et al.Prosthetic stent graft infection after endovascular abdominalaortic aneurysm repair. J Vasc Surg 2007;46:442e8
84. Calligaro KD, Veith FJ, Yuan JG, et al.Intra-abdominal aortic graft infection: complete or partial graftpreservation in patients at very high risk. J Vasc Surg 2003;38:1199e205.
85. Miyamoto K, Inaba M, Kojima T, et al. Intra-Aortic Balloon Occlusion (IABO) may be useful for the management of secondary aortoduodenal fistula (SADF): a casereport. Int J Surg Case Rep 2016;25:234e7.
86. Dorweiler B, Neufang A, Chaban R, et al. Use and durability of femoral vein for autologousreconstruction with infection of the aortoiliofemoral axis. J VascSurg 2014;59:675e83.
87. Heinola I, Kantonen I, Jaroma M, et al. Editor's Choice e treatment of aortic prosthesis infectionsby graft removal and in situ replacement with autologousfemoral veins and fascial strengthening. Eur J Vasc Endovasc Surg2016;51:232e9.
88. Oderich GS, Bower TC, Cherry Jr KJ, et al. Evolution from axillofemoral to in situ prostheticreconstruction for the treatment of aortic graft infections at asingle center. J Vasc Surg 2006;43:1166e74.
89. Ali AT, Modrall JG, Hocking J, et al. Long-term results of the treatment of aortic graft infectionby in situ replacement with femoral popliteal vein grafts. J VascSurg 2009;50:30e9.
90. Bíró G, Szabó G, Fehérvári M, et al.Late outcome following open surgical management of secondaryaortoenteric fistula. Langenbecks Arch Surg 2011;396:1221e9.
91. Lejay A, Delay C, Girsowicz E, et al. Cryopreserved cadaveric arterial allograft forarterial reconstruction in patients with prosthetic infection. Eur JVasc Endovasc Surg 2017;54:636e44.
92. Harlander-Locke MP, Harmon LK, Lawrence PF, Oderich GS,et al. The use of cryopreservedaortoiliac allograft for aortic reconstruction in the United States.J Vasc Surg 2014;59:669e74.
93. Heo SH, Kim YW, Woo SY, et al. recentresults of in situ abdominal aortic reconstruction with cryopreserved arterial allograft. Eur J Vasc Endovasc Surg 2017;53:158e67.
94. ToumaJ,CochennecF,ParisotJ, et al. In situ reconstruction in native andprosthetic aortic infections using cryopreserved arterial allografts. Eur J Vasc Endovasc Surg 2014;48:292e9.
95. Bisdas T, Bredt M, Pichlmaier M, et al. Eight-year experience with cryopreserved arterial homografts for the in situ reconstruction of abdominal aortic infections. J Vasc Surg 2010;52:323e30
96. Garot M, Delannoy PY, Meybeck A, et al. Intra-abdominal aortic graft infection: prognostic factors associated with in-hospital mortality. BMC InfectDis 2014;14:215.

97. Kieffer E, Gomes D, Chiche L, et al.Allograft replacement for infrarenal aortic graft infection: early andlate results in 179 patients. J Vasc Surg 2004;39:1009e17.
98. Ben Ahmed S, Louvancourt A, Daniel G, et al. Cryopreserved arterial allografts for in situreconstruction of abdominal aortic native or secondary graftinfection. J Vasc Surg 2018;67:468e77.
99. Young RM, Cherry Jr KJ, Davis PM, et al. The results of in situ prosthetic replacementfor infected aortic grafts. Am J Surg 1999;178:136e40.
100. Hayes PD, Nasim A, London NJ, et al. In situ replacement of infected aortic grafts withrifampicin-bonded prostheses: the Leicester experience. J VascSurg 1999;30:92e8.
101. Bandyk DF, Navotney ML, Back MR,et al.Expanded application of in situ replacement for prosthetic graftinfection. J Vasc Surg 2001;34:411e9.
102. Torsello G, Sandmann W. Use of antibiotic-bonded graftsin vascular graft infection. Eur J Vasc Endovasc Surg 1997;14:84e7.
103. Ueberrueck T, Zippel R, Tautenhahn J, et al. Vascular graft infections: in vitro and in vivo investigations of a new vascular graft with long-term protection.J Biomed Mater Res B Appl Biomater 2005;74:601e7.
104. Ricco JB, Assadian A, Schneider F, et al. In vitro evaluation of the antimicrobial efficacy of a new silver-triclosan vs asilvercollagen-coatedpolyestervasculargraftagainstmethicillin-resistant Staphylococcus aureus. J Vasc Surg 2012;55:823e9.
105. Mirzaie M, Schmitto JD, Tirilomis T, et al. Surgical management of vascular graft infectionin severely ill patients by partial resection of the infected prosthesis. Eur J Vasc Endovasc Surg 2007;33:610e3.
106. Inoue T, Imura M, Kaneda T, et al. Long-term survival aftercoverage with prevertebral fascia for abdominal aortic stumpclosure. Vasc Endovascular Surg 2017;51:43e6.
107. Mayer D, Hasse B, Koelliker J,et al. Long-term results of vascular graft and artery preservingtreatment with negative pressure wound therapy in Szilagyigrade III infections justify a paradigm shift. Ann Surg 2011;254:754e9
108. Seeger JM, Pretus HA, Welborn MB, et al. Long-term outcome after treatment of aortic graftinfection with staged extra-anatomic bypass grafting and aorticgraft removal. J Vasc Surg 2000;32:451e9.
109. Brown KE, Heyer K, Rodriguez H, et al. Arterial reconstruction with cryopreserved humanallografts in the setting of infection: a single-center experiencewith midterm follow-up. J Vasc Surg 2009;49:660e6.
110. Charlton-Ouw KM, Kubrusly F, Sandhu HK, et al. In vitro efficacy of antibiotic beads in treatingabdominal vascular graft infections. J Vasc Surg 2015;62:1048e53.
111. Yeager RA, Taylor Jr LM, Moneta GL, et al. Improved results with conventional management of infrarenal aortic infection. J Vasc Surg 1999;30:76e83.
112. O'Banion LA, Wu B, Eichler CM, et al. Cryopreserved saphenous vein as a last-ditchconduit for limb salvage. J Vasc Surg 2017;66:844e9.
113. Reilly LM, Stoney RJ, Goldstone J, et al. Improvedmanagement of aortic graft infection: the influence of operationsequence and staging. J Vasc Surg 1987;5:421e31.
114. Sarac TP, Augustinos P, Lyden S, et al. Use of fascia-peritoneum patch as a pledget for an infected aortic stump.J Vasc Surg 2003;38:1404e6.
115. Yamanaka K, Omura A, Nomura Y, et al. Surgical strategy for aorta-related infection.Eur J Cardiothorac Surg 2014;46:974e80.
116. Jausseran JM, Stella N, Courbier R, et al. Total prosthetic graft excision and extra-anatomicbypass. Eur J Vasc Endovasc Surg 1997;14:59e65.
117. Simmons CD, Ali AT, Foteh K, et al. Unilateral inline replacement of infected aortofemoral graftlimb with femoral vein. J Vasc Surg 2017;65:1121e9.
118. Phang D, Smeds MR, Abate M, et al revascularizationwithobturatororhemi-neoaortoiliacsystemforpartial aortic graft infections. Ann Vasc Surg 2019;54:166e75.
119. Crawford JD, Landry GJ, Moneta GL, et al. Outcomes ofunilateral graft limb excision for infected aortobifemoral graftlimb. J Vasc Surg 2016;63:407e13.
120. Fatima J, Duncan AA, de Grandis E, et al. treatment strategies and outcomes inpatients with infected aortic endografts. J Vasc Surg 2013;58:371e9.
121. Davila VJ, Stone W, Duncan AA, et al. A multicenter experience with the surgical treatment ofinfected abdominal aortic endografts. J Vasc Surg 2015;62:877e83.
122. Chaufour X, Gaudric J, Goueffic Y,et al. A multicenter experience with infectedabdominal aortic endograft explantation. J Vasc Surg 2017;65:372e80.
123. Schoell T, Manceau G, Chiche L, et al. Surgery for secondary aorto-enteric fistula or erosion(SAEFE) complicating aortic graft replacement: a retrospectiveanalysis of 32 patients with particular focus on digestive management. World J Surg 2015;39:283e91.
124. Lazaris A, Sayers RD, Thompson M, et al. Patchcorrugation on duplex ultrasonography may be an early warning ofprosthetic patch infection. Eur J Vasc Endovasc Surg 2005;29:91e2.
125. Kakkos SK, Antoniadis PN, Klonaris CN, et al. Open or endovascularrepair of aortoenteric fistulas? A multicentre comparative study.Eur J Vasc Endovasc Surg 2011;41:625e34.
126. Burks Jr JA, Faries PL, Gravereaux EC, et al.Endovascular repair of bleeding aortoenteric fistulas: a 5-yearexperience. J Vasc Surg 2001;34:1055e9.
127. Biancari F, Romsi P, Perälä J, et al. Staged endovascular stent-grafting and surgical treatment of a secondary aortoduodenal fistula. Eur J VascEndovasc Surg 2006;31:42e3.
128. Franchin M, Tozzi M, Piffaretti G, et al.Emergency endovascular 'bridge' treatment for iliac-enteric fistula. Cardiovasc Intervent Radiol 2011;34:1106e8.
129. Chick JFB, Castle JC, Cooper KJ, et al. Aortoenteric fistulae temporization andtreatment: lessons learned from a multidisciplinary approach to3 patients. Radiol Case Rep 2017;12:331e4.
130. Batt M, Jean-Baptiste E, O'Connor S, et al. Early and late results of contemporary management of 37 secondary aortoenteric fistulae. Eur J Vasc EndovascSurg 2011;41:748e57.
131. Bergqvist Björck M. Secondary arterioenteric fistulation e asystematic literature analysis. Eur J Vasc Endovasc Surg 2009;37:31e42
132. Rodrigues dos Santos C, Casaca R, Mendes de, et al. Enteric repair in aortoduodenal fistulas: aforgotten but

often lethal player. Ann Vasc Surg 2014;28:756e62.

133. Delva JC, Déglise S, Bérard X, et al. In-situ revascularisation for secondary aorto-enteric fistulae:the success of silver-coated Dacron is closely linked to a suitable bowel repair. Eur J Vasc Endovasc Surg 2012;44:417e24.
134. Johnston PC, Guercio AF, Johnson SP, et al. Endovascular recanalization of the superior mesenteric artery in the context of mesenteric bypass graft infection.J Vasc Surg 2013;57:1398e400.
135. Mufty H, Fourneau I. Gastric erosion by abscess 15 yearsafter mesenteric bypass surgery. Eur J Vasc Endovasc Surg2017;54:93.
136. van den Bergh RC, Moll FL, de Vries JP, et al. Arterioureteralfistulas: unusual suspects-systematic review of 139 cases. Urology2009;74:251e5.
137. Das A, Lewandoski P, Laganosky D, et al. Ureteroarterial fistula: a review of the literature. Vascular 2016;24:203e7.
138. Malgor RD, Oderich GS, Andrews JC, et al. Evolution from open surgical to endovasculartreatment of ureteral-iliac artery fistula. J Vasc Surg 2012;55:1072e80.
139. Madoff DC, Gupta S, Toombs BD, et al. Arterioureteral fistulas: a clinical, diagnostic, and therapeutic dilemma. AJR Am J Roentgenol 2004;182:1241e50.
140. Pillai AK, Anderson ME, Reddick MA, et al.Ureteroarterial fistula: diagnosis and management. AJR Am JRoentgenol 2015;204:592e8.
141. Shenouda M, Molena E, Maftei N, et al. Remnant prosthetic graftin revision or limb-salvage surgery: routine complete excision?Ann Vasc Surg 2014;28:1566.
142. Eiberg JP, Røder O, Stahl-Madsen M, et al. Fluoropolymer-coated dacron versus PTFEgrafts for femorofemoral crossover bypass: randomised trial. EurJ Vasc Endovasc Surg 2006;32:431e8.
143. Exton RJ, Galland RB. Major groin complications following theuse of synthetic grafts. Eur J Vasc Endovasc Surg 2007;34:188e90.
144. Brothers TE, Robison JG, Elliott BM. Predictors of prostheticgraft infection after infrainguinal bypass. J Am Coll Surg2009;208:557e61.
145. Bosman WM, Borger van der Burg BL, Schuttevaer HM, et al. Infections of intravascular bare metalstents: a case report and review of the literature. Eur J VascEndovasc Surg 2014;47:87e9.
146. Thermann F, Wollert U. Continuous irrigation as a therapeuticoption for graft infections of the groin. World J Surg 2014;38:2589e96.
147. Saleem BR, Meerwaldt R, Tielliu IF, et al. Conservative treatment of vascularprosthetic graft infection is associated with high mortality. Am Jsurg2010;200:47e52.
148. Verma H, Ktenidis K, George RK, et al. Vacuum-assistedclosure therapy for vascular graft infection (Szilagyi grade III) inthe groin-a 10-year multi-center experience. Int Wound J2015;12:317e21.
149. Armstrong PA, Back MR, Bandyk DF, et al.Selective application of sartorius muscle flaps and aggressivestaged surgical debridement can influence long-term outcomes ofcomplex prosthetic graft infections. J Vasc Surg 2007;46:71e8.
150. Cheng HT, Hsu YC, Wu CI. Efficacy and safety of negative pressurewound therapy for Szilagyi grade III peripheral vascular graftinfection. Interact Cardiovasc Thorac Surg 2014;19:1048e52.
151. Andersson S, Monsen C, Acosta S. Outcome and complicationsusing negative pressure wound therapy in the groin for perivascular surgical site infections after vascular surgery. Ann Vasc Surg 2018;48:104e10.
152. Monsen C, Wann-Hansson C, Wictorsson C, et al. Vacuum-assisted wound closure versus alginate for the treatment of deepperivascular wound infections in the groin after vascular surgery. J Vasc Surg 2014;59:145e51.
153. Chatteriee A, Macarios D, Griffin L, et al. Cost-utility analysis: sartorius flap versusnegative pressure therapy for infected vascular groin graftmanagment. Plast Reconstr Surg Glob Open 2015;3:11e9.
154. Gabriel M, Pukacki F, Ł Dzieciuchowicz, et al.Cryopreserved arterial allografts in the treatment of prostheticgraft infections. Eur J Vasc Endovasc Surg 2004;27:590e6.
155. Verhelst R, Lacroix V, Vraux H, et al. Use of cryopreserved arterial homografts formanagement of infected prosthetic grafts: a multicentric study.Ann Vasc Surg 2000;14:602e7.
156. McCready RA, Bryant MA, Fehrenbacher JW, et al. Long-term results with cryopreserved arterial allografts (CPAs) in the treatment of graft orprimary arterial infections. J Surg Res 2011;168:149e53.
157. Earnshaw JJ. The current role of rifampicin-impregnated grafts:pragmatism versus science. Eur J Vasc Endovasc Surg 2000;20:409e12.
158. Berard X, Stecken L, Pinaquy JB, et al. Comparison of the antimicrobial properties ofsilver impregnated vascular grafts with and without triclosan.Eur J Vasc Endovasc Surg 2016;51:285e92.
159. De Luccia N, Sassaki P, Durazzo A, et al. Limb salvage using bypass to the perigeniculatearteries. Eur J Vasc Endovasc Surg 2011;42:374e8.
160. Töpel I, Audebert F, Betz T, et al. Microbial spectrumand primary resistance to rifampicin in infectious complicationsin vascular surgery: limits to the use of rifampicin-bondedprosthetic grafts. Angiology 2010;61:423e6.
161. HoballahJJ,ChalmersRTA,SharpWJ,et al. Lateral approach to the poplitealand crural vessels for limb salvage. Cardiovasc Surg 1996;4:165e8.
162. McMillan WD, Leville CD, Hile CN. Bovine pericardial patchrepair in infected fields. J Vasc Surg 2012;55:1712e5.
163. Brewer MB, Ochoa CJ, Woo K, et al. Sartorius muscle flaps for vascular groin wound complications. Am Surg 2015;81:1163e9.
164. Fischer JP, Mirzabeigi MN, Sieber BA, et al. Outcome analysis of 244 consecutive flaps formanaging complex groin wounds. J Plast Reconstr Aesthet Surg2013;66:1396e404.
165. Schutzer R, Hingorani A, Ascher E, et al. Early transposition of the sartorius muscle for exposed patent infrainguinal bypass grafts. Vasc EndovascularSurg2005;39:159e62
166. Stone PA, Mousa AY, Hass SM, et al. Antibiotic-loaded polymethylmetacrylate beads for the treatment of extracavity vascular surgical site infections.J Vasc Surg 2012;55:1706e11.
167. Poi MJ, Pisimisis G, Barshes NR, et al. Evaluating effectiveness of antibioticpolymethylmethacryla- te beads in

achieving wound sterilization andgraft preservation in patients with early and late vasculargraftinfections. Surgery 2013;153:673e82.
168. Chalmers RT, Wolfe JH, Cheshire NJ,et al. Improved management of infrainguinalbypass graft infection with methicillin-resistant Staphylococcusaureus. Br J Surg 1999;86:1433e6.
169. Sugawara Y, Sueda T, Orihashi K, et al. Retro-sartorius bypass in the treatment of graft infec-tion after peripheral vascular surgery. J Vasc Surg 2003;37:892e4.