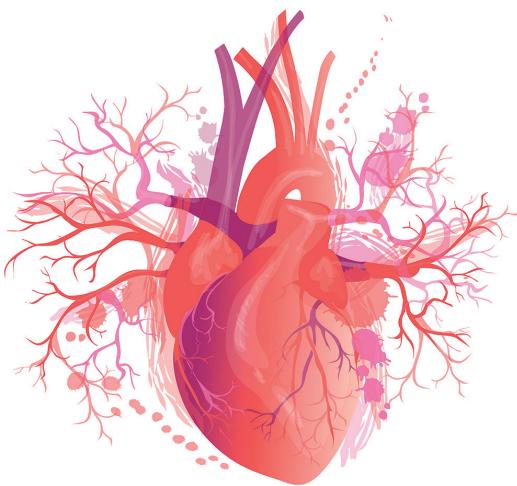


# BÖLÜM 26



## KORONER REOPERASYONLAR

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### GİRİŞ

İskemik kalp hastalığının tedavisinde koroner baypas cerrahisi (CABG), gelişmiş koroner girişim (PCI) tekniklerine rağmen hala günümüzde başarılı bir şekilde kullanılmaya devam edilmektedir. Özellikle heparinin keşfedilmesi ve kalp cerrahisinde kardiopulmoner bypass makinesinin yaygın kullanılmaya başlanması koroner cerrahisi için de dönüm noktası olmuştur. İlk kez 1967 yılında Favoloro tarafından safen ven CABG için kullanırken, aynı yıl Kolesov tarafından internal mamarian arter (İMA) grefti kullanılmıştır (1,2). Radyal arter ve gastroepiploik arter (GEA) gibi greftlerin takip eden yıllarda yaygın kullanılması özellikle çok damar kompleks lezyonlu hastalarda uzun dönem olumlu sonuçlar vermiştir. Buna karşın CABG operasyonu sonrası hastalığın doğal seyrinin ilerlemesi ve greft yetmezliği nedeni ile bazı hastalarda tekrar anjina semptomları ortaya çıkmaktadır. Akut koroner sendrom veya hayatı tehdit eden klinik tablo ortaya çıkması halinde bu hastalara optimal medikal tedavi ve PCI gerekmektedir. Buna karşın bir grup hastada redo CABG kaçınılmazdır. Redo CABG operasyonları bazı yönleri ve cerrahi tekniğin farklılıklarını dolayısı ile primer CABG'den

ayrılmaktadır. Operasyon sırasında diseksiyon, adezyonlar ve eski greftler nedeni ile zorluk yaşanırken, aynı zamanda greft hasarı, kardiyak yaralanma ve açık greftlerden kaynaklanan distal emboliye bağlı miyokard infarktüsü (MI) gibi komplikasyonlar da yüze çıkabilmektedir. Ayrıca redo CABG adaylarının genellikle daha yaşlı ve daha fazla komorbit faktörlere sahip olmaları nedeniyle, operatif mortalite ve morbidite daha yüksektir. Geçmişte redo CABG insidansı 5 yıllık %2,6, 10 yıllık %10,1 ve 20 yıllık takiplerde ise %24,4 olarak bildirilmiş idi (3). Ancak son yıllarda optimal medikal tedavi, daha sık arteriel greft kullanımı, daha agresif PCI uygulanmasına bağlı olarak %10'un altına inmiştir (4,5).

Bu bölümde redo CABG'ye neden olan faktörler, greft yetmezliği sonrası tedavi, cerrahi endikasyonlar, operasyon teknikleri ve stratejileri anlatılacaktır.

### PATOFİZYOLOJİ

#### Safen ven grefti yetmezliği

Safen ven greft (SVG) CABG operasyonunda arterial greftler ile beraber konduit olarak kullanılmaktadır. SVG patensi 10 yılda %50-60 arası ola-

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bolizasyon riski gibi avantajlar söz konusudur. Literatürde konu ile ilgili çalışmaların özeti Tablo-3 de verilmiştir. Dohi ve arkadaşlarının Japan Cardiovascular Surgery Database’ini kullanarak yaptıkları ve 617 hastanın incelendiği bir diğer çalışmada ise mortalite off-pump grubunda % 3,5 iken CPB altında CABG yapılan grupta % 7 olarak saptanmıştır. Ayrıca uzamış ventilasyon, uzamış yoğun bakım ünitesinde (YBÜ) kalış ve transfüzyon ihtiyacı daha az görülmüştür (81). Redo CABG hastalarında off-pump tekniğinin erken dönemde sağ kalımı artttığı ve uzun dönemde sonuçlarının benzer olduğu bilinmektedir. Ancak unutulmaması gerekirki, redo CABG operasyonunda asıl hedefin primer CABG de olduğu gibi komplet revaskülerizasyondur. Di Mouro ve arkadaşlarının yaptığı bir çalışmada redo CABG yapılan hastalarda inkomplet revaskülerizasyon insidansı off-pump grubunda %17,1 saptarken, bu oran on-pump grubunda %5,9 saptanmıştır(82). Ayrıca inkomplet revaskülerizasyonun 5 yıllık kardiyak mortalite için bağımsız bir risk faktörü olduğu unutulmamalıdır.

Bir diğer tartışma konusu da patent olan ancak anastomoz bölgesinde darlık bulunan İMA greftinin tekrar kullanımını önerinedir. Bu konuda yayınlanmış en geniş retrospektif çalışmada daha önce CABG operasyonu olmuş 60 hasta inceleñerek, bu hastalarda eski İMA grefti yeniden kullanılmıştır. Bu seride mortalite gözlenmemiþen, revaskülerizasyon ihtiyacı da olmamıştır. Ayrıca 1 yıllık sağ kalım % 93 ve 5 yıllık sağ kalım ise % 85 olarak bildirilmiştir (83).

Günümüzde arteriyal greftlerin primer CABG sırasında yaygın kullanılmasının uzun dönem sonuçları yüz güldürücü iken, redo CABG gereksinimini azaltacağı aşikardır. Buna karşın redo CABG gerekecek hastaların daha fazla komorbiditeye sahip, kompleks koroner anotomisi ve sol ventrikül disfonksiyonu olacaktır. Bu grup hastalarda komplikasyonlardan kaçınmak için çeşitli yenilikler gündeme gelmektedir. Minimal invazif, sternotomisiz ve CPB’siz yaklaşım redo

CABG operasyonlarının geleceğidir. Primer CABG’nin de minimal invazif olarak yapılmış olması, redo CABG gereksiniminde kolaylık sağlayacaktır. Ayrıca gelişmiş PCI teknikleri ile minimal invazif off-pump cerrahisinin kombine edilerek uygulanacak hibrit yöntemler, hastalar için en iyi seçenek olacağı öngörümektedir.

## SONUÇ

Redo CABG insidansı günümüzde çeşitli sebeplerden dolayı azalmakla beraber hala karşılaşlığımız, tecrübe gerektiren zorlu prosedürlerden biridir. Ayrıca mortalitesi primer CABG’den çok daha yüksektir. Erken dönem sonuçları daha iyi olan ve uzun dönemde redo CABG ile benzer sonuçlara sahip olan PCI revaskülerizasyon için ilk tercihdir. Ancak PCI için uygun olmayan hastalarda redo CABG ön planda düşünülmelidir. Bununla beraber redo CABG endikasyonu olan hastalarda off-pump tekniğin erken dönemde sonuçlarının daha iyi, komplikasyonun daha az olduğu ve uzun dönemde sonuçlarının benzer olduğu akılda tutulmalıdır. Donanımlı merkezlerde tecrübeli cerrahların geliştirdiği çeşitli stratejiler ile günümüzde redo CABG operasyonunun mortalitesinin azaldığı bilinmektedir.

## KAYNAKLAR

1. Favaloro RG, Effler DB, Cheanvechai C, Quint RA, Sones FM, Jr. Acute coronary insufficiency (impending myocardial infarction and myocardial infarction): surgical treatment by the saphenous vein graft technique. Am J Cardiol 1971;28:598-607.
2. Kolessov VI. Mammary artery-coronary artery anastomosis as method of treatment for angina pectoris. J Thorac Cardiovasc Surg 1967;54:535-44.
3. Cosgrove DM, Loop FD, Lytle BW, Gill CC, Golding LA, Gibson C, Stewart RW, Taylor PC, Goormastic M. Predictors of reoperation after myocardial revascularization. J Thorac Cardiovasc Surg 1986;92:811-21.
4. Keogh BE, Kinsman R. National adult cardiac surgical database report 2000-2001. Society of cardi-



- othoracic surgeons of Great Britain and Ireland. Henley-on-Thames: Dendrite Clinical Systems Ltd; 2002.
5. Ghanta RK, Kaneko TK, Gammie JS, Sheng S, Aranki SF. Evolving trends of reoperative coronary artery bypass grafting: an analysis of the Society of Thoracic Surgeons Adult Cardiac Surgery Database. *J Thorac Cardiovasc Surg* 2013;145:364-72.
  6. Motwani JG, Topol EJ. Aortocoronary saphenous vein graft disease: pathogenesis, predisposition, and prevention. *Circulation* 1998;97:916-31.
  7. Caliskan E, de Souza DR, Böning A, Liakopoulos OJ, Choi YH, Pepper J et al. Saphenous vein grafts in contemporary coronary artery bypass graft surgery. *Nat Rev Cardiol.* 2019 Aug 27.
  8. Zhao DX, Leacche M, Balaguer JM, Boudoulas KD, Damp JA, Greelish JP, Byrne JG; Writing Group of the Cardiac Surgery, Cardiac Anesthesiology, and Interventional Cardiology Groups at the Vanderbilt Heart and Vascular Institute, Ahmad RM, Ball SK, Cleator JH, Deegan RJ, Eagle SS, Fong PP, Fredi JL, Hoff SJ, Jennings HS III, McPherson JA, Piana RN, Pretorius M, Robbins MA, Slosky DA, Thompson A. Routine intraoperative completion angiography after coronary artery bypass grafting and 1-stop hybrid revascularization results from a fully integrated hybrid catheterization laboratory/operating room. *J Am Coll Cardiol* 2009;53:232-241.
  9. Kadyrov BA ,Steinbeck G, Amannepesov NK, Seitmuhammedov MD, Annayev MS (2019). Long-term Results of Venous Bypass Surgery of the LAD. *XIV Total Occlusion and Bifurcation Interventions, TOBI Main Congress(TOBI 2019)*, 7-8 November 2019, Milan, Italy.
  10. Zhang L, Peppel K, Brian L, Chien L, Freedman NJ. Vein graft neointimal hyperplasia is exacerbated by tumor necrosis factor receptor-1 signaling in graft-intrinsic cells. *Arterioscler Thromb Vasc Biol* 2004;24:2277-83.
  11. Lytle BW, Blackstone EH, Loop FD, Houghtaling PL, Arnold JH, Akhrass R et al. Two internal thoracic artery grafts are better than one. *J Thorac Cardiovasc Surg*. 1999 May;117(5):855-72.
  12. Cameron A, Davis KB, Green G, Schaff HV. Coronary bypass surgery with internal-thoracic-artery grafts—effects on survival over a 15-year period. *N Engl J Med* 1996;334:216.
  13. Tabata M, Grab JD, Khalpey Z, Edwards FH, O'Brien SM, Cohn LH, et al. Prevalence and variability of internal mammary artery graft use in contemporary multivessel coronary artery bypass graft surgery: analysis of the Society of Thoracic Surgeons National Cardiac Database. *Circulation* 2009;120:935-940.
  14. Tatoulis J, Buxton BF, Fuller JA. Patencies of 2127 arterial to coronary conduits over 15 years. *Ann Thorac Surg* 2004;77:93-101.
  15. Loop FD, Lytle BW, Cosgrove DM, Golding LA, Taylor PC, Stewart RW. Free (aorta-coronary) internal mammary artery graft. Late results. *J Thorac Cardiovasc Surg* 1986;92:827.
  16. Manabe S, Fukui T, Tabata M, Shimokawa T, Morita S, Takanashi S. Arterial graft deterioration one year after coronary artery bypass grafting. *J Thorac Cardiovasc Surg* 2010;140:1306-1311.
  17. Sabik JF 3rd, Lytle BW, Blackstone EH, Khan M, Houghtaling PL, Cosgrove DM. Does competitive flow reduce internal thoracic artery graft patency? *Ann Thorac Surg* 2003;76:1490-1497.
  18. Tatoulis J, Buxton BF, Fuller JA, Meswani M, Theodore S, Powar N, et al. Long-term patency of 1108 radial arterial-coronary angiograms over 10 years. *Ann Thorac Surg* 2009;88:23-30.
  19. Weinschelbaum EE, Macchia A, Caramutti VM, Machain HA, Raffaelli HA, Favoloro MR, et al. Myocardial revascularization with radial and mammary arteries: initial and mid-term results. *Ann Thorac Surg* 2000;70:1378.
  20. Royse AG, Royse CF, Tatoulis J, Grigg LE, Shah P, Hunt D, et al. Postoperative radial artery angiography for coronary artery bypass surgery. *Eur J Cardiothorac Surg* 2000;17:294.
  21. Moran SV, Baeza R, Guarda E, Zalaquett R, Irarrázaval MJ, Marchant E, et al. Predictors of radial artery patency for coronary bypass operations. *Ann Thorac Surg* 2001;72:1552.
  22. Tatoulis J, Buxton BF, Fuller JA. The right internal thoracic artery: the forgotten conduit-- 5,766 patients and 991 angiograms. *Ann Thorac Surg* 2011;92:9-15.
  23. Sergeant PT, Blackstone EH, Meyns BP. Does arterial revascularization decrease the risk of infarction after coronary artery bypass grafting? *Ann Thorac Surg* 1998;66:1.
  24. Sergeant P, Blackstone E, Meyns B, Stockman B, Jashari R. First cardiological or cardiosurgical re-intervention for ischemic heart disease after primary coronary artery bypass grafting. *Eur J Cardiothorac Surg* 1998;14:480.



25. Alderman EL, Kip KE, Whitlow PL, et al. Native coronary disease progression exceeds failed revascularization as cause of angina after five years in the Bypass Angioplasty Revascularization Investigation (BARI). *J Am Coll Cardiol* 2004;44:766-74.
26. Fremes SE, Levinton C, Naylor CD, Chen E, Christakis GT, Goldman BS. Optimal antithrombotic therapy following aortocoronary bypass: a meta-analysis. *Eur J Cardiothorac Surg* 1993;7:169-80.
27. Shah SJ, Waters DD, Barter P, et al. Intensive lipid-lowering with atorvastatin for secondary prevention in patients after coronary artery bypass surgery. *J Am Coll Cardiol* 2008;51:1938-43.
28. Lytle BW, Loop FD, Taylor PC, et al: The effect of coronary reoperation on the survival of patients with stenoses in saphenous vein to coronary bypass grafts. *J Thorac Cardiovasc Surg* 1993; 105:605.
29. Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery. Guidelines on myocardial revascularization. *Eur J Cardiothorac Surg* 2010;38:S1-52.
30. Mauri L, Cox D, Hermiller J, et al. The PROXIMAL trial: Proximal protection during saphenous vein graft intervention using the Proxis Embolic Protection System: A randomized, prospective, multicenter clinical trial. *J Am Coll Cardiol* 2007;50:1442-9.
31. Subramanian S, Sabik JF, III, Houghtaling PL, et al. Decision-making for patients with patent left internal thoracic artery grafts to left anterior descending. *Ann Thorac Surg.* 2009;87:1392– 8.
32. Brener SJ, Lytle BW, Casserly IP, et al. Predictors of revascularization method and long-term outcome of percutaneous coronary intervention or repeat coronary bypass surgery in patients with multivessel coronary disease and previous coronary bypass surgery. *Eur Heart J* 2006;27:413-8.
33. Lytle BW, Loop FD, Taylor PC, et al: Vein graft disease: the clinical impact of stenoses in saphenous vein bypass grafts to coronary arteries. *J Thorac Cardiovasc Surg* 1992; 103:831.
34. Fosbøl EL, Zhao Y, Shahian DM, et al. Repeat coronary revascularization after coronary artery bypass surgery in older adults: the Society of Thoracic Surgeons' national experience, 1991-2007. *Circulation* 2013;127:1656-63.
35. Sabik JF III, Blackstone EH, Houghtaling PL, et al. Is reoperation still a risk factor in coronary artery bypass surgery? *Ann Thorac Surg* 2005;80:1719-27.
36. Yap CH, Sposato L, Akowuah E, et al. Contemporary results show repeat coronary artery bypass grafting remains a risk factor for operative mortality. *Ann Thorac Surg* 2009;87:1386-91.
37. Parasca CA, Head SJ, Milojevic MSYNTAX Investigators, et al. Incidence, characteristics, predictors, and outcomes of repeat revascularization after percutaneous coronary intervention and coronary artery bypass grafting: The SYN-TAX trial at 5 years. *JACC Cardiovasc Interv* 2016;9:2493-507.
38. Bakaeen FG, Akras Z, Sevsson LG. Redo coronary artery bypass grafting. *Indian J Thorac Cardiovasc Surg* 2018;34:272-8.
39. Yaku H, Doi K. Redo coronary artery bypass grafting. *Gen Thorac Cardiovasc Surg* 2014;62:453-60.
40. Ghanta RK, Kaneko T, Gammie JS, et al. Evolving trends of reoperative coronary artery bypass grafting: an analysis of the Society of Thoracic Surgeons Adult Cardiac Surgery Database. *J Thorac Cardiovasc Surg* 2013;145:364-72.
41. Spiliopoulos K, Maganti M, Brister S, et al. Changing pattern of re-operative coronary artery bypass grafting: A 20-year study. *Ann Thorac Surg* 2011;92:40-6.
42. Morrison DA, Sethi G, Sacks J, et al. Percutaneous coronary intervention versus coronary artery bypass graft surgery for patients with medically refractory myocardial ischemia and risk factors for adverse outcomes with bypass: a multicenter, randomized trial. Investigators of the Department of Veterans Affairs Cooperative Study #385, the Angina With Extremely Serious Operative Mortality Evaluation (AWESOME). *J Am Coll Cardiol* 2001;38:143-9.
43. Harskamp RE, Beijk MA, Damman P, et al. Clinical outcome after surgical or percutaneous revascularization in coronary bypass graft failure. *J Cardiovasc Med (Hagerstown)* 2013;14:438-45.
44. Brener SJ, Lytle BW, Casserly IP, Ellis SG, Topol EJ, Lauer MS. Predictors of revascularization method and long-term outcome of percutaneous coronary intervention or repeat coronary bypass surgery in patients with multivessel coronary disease and previous coronary bypass surgery. *Eur Heart J* 2006;27:413-8.
45. Neumann FJ, Sousa-Uva M, Ahlsson A, Alfonso F, Banning AP, Benedetto U et. al 2018 ESC/EACTS Guidelines on myocardial revascularization. *European Heart Journal* (2019) 40, 87–165.



46. Hillis D, Smith PK, Anderson JL, Bittl JA, Bridges CR, Byrne JG et al 2011 ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery. *Circulation*. 2011;124:e652– e735.
47. Jennifer SL, Jacqueline ET, Sripal B et al 2021 ACCF/AHA Guideline for Coronary Artery Revascularisation. *Circulation*. 2021;144:00– 00.
48. Gonzalez-Stawinski GV, Lytle BW. Coronary artery reoperations. In: Cohn LH, editor. *Cardiac surgery in the adult*. 4th ed. New York: The McGraw-Hill Companies; 2012.
49. Elami A, Laks H, Merin G. Technique for reoperative median sternotomy in the presence of a patent left internal mammary artery graft. *J Card Surg* 1994;9:123-7.
50. Grunwald RP. A technique for direct-vision sternal reentry. *Ann Thorac Surg* 1985;40:521-2.
51. Higami T, Kozawa S, Asada T, Shida T, Ogawa K. Skeletonization and harvest of the internal thoracic artery with an ultrasonic scalpel. *Ann Thorac Surg*. 2000;70:307-8
52. Gold JP, Torres KE, Maldarelli W, et al. Improving outcomes in coronary surgery: the impact of echo-directed aortic cannulation and perioperative hemodynamic management in 500 patients. *Ann Thorac Surg* 2004;78:1579-85
53. Lemaire, A., Batsides, G., Saadat, S., Ghaly, A., Nishimura, T., Volk, L., et al . ( 2016 ). Effect of repeat sternotomy on cardiac surgery outcomes . *Annals of Surgery and Perioperative Care*, 1 (1), 1001.
54. Mills NL, Everson CT, Hockmuth DR. Technical considerations for myocardial protection during the course of coronary artery bypass reoperation: the impact of functioning saphenous vein and internal mammary artery grafts. *J Card Surg* 1991;6:34-40.
55. Loop FD, Lytle BW, Gill CC, et al. Trends in selection and results of coronary artery reoperations. *Ann Thorac Surg* 1983;36:380-8.
56. Min HK, Lee YT, Kim WS, et al. Complete revascularization using a patent left internal thoracic artery and variable arterial grafts in multivessel coronary reoperation. *Heart Surg Forum* 2009;12:E244-9.
57. Taggart DP, D'Amico R, Altman DG. Effect of arterial revascularization on survival: a systematic review of studies comparing bilateral and single internal mammary arteries. *Lancet* 2001;358:870-5.
58. Svensson LG, Mumtaz MA, Blackstone EH, et al. Does use of a right internal thoracic artery increase deep wound infection and risk after previous use of a left internal thoracic artery? *J Thorac Cardiovasc Surg* 2006;131:609-13.
59. Grondin CM, Pomar JL, Hebert Y et al. Reoperation in patient with patent atherosclerotic coronary vein grafts. A different approach to a different disease. *J Thorac Cardiovasc Surg*. 1986;42:122.
60. Grondin CM. The removal of still functioning albeit old grafts: Not in our genes? *Ann Thorac Surg*, 1986;42:122.
61. Navia D, Cosgrove DM 3rd, Lytle BW, et al. Is the internal thoracic artery the conduit of choice to replace a stenotic vein graft? *Ann Thorac Surg* 1994;57:40-3; discussion 43-4
62. Wendler O, Tscholl D, Huang Q, et al. Free flow capacity of skeletonized versus pedicled internal thoracic artery grafts in coronary artery bypass grafts. *Eur J Cardiothorac Surg* 1999;15:247-50.
63. Maltais S, Widmer RJ, Bell MR, et al. Reoperation for coronary artery bypass grafting surgery: outcomes and considerations for expanding interventional procedures. *Ann Thorac Surg* 2017;103:1886-92.
64. Ueki C, Miyata H, Motomura N, et al. Off-pump versus on-pump coronary artery bypass grafting in patients with left ventricular dysfunction. *J Thorac Cardiovasc Surg* 2016;151:1092-8
65. Sepehripour AH, Saso S, Harling L, et al. Does off-pump coronary revascularization reduce mortality in re-operative coronary artery surgery? A meta-analysis of observational studies. *Perfusion* 2013;28:340-9.
66. Mishra YK, Collison SA, Malhotra R, et al. Ten-year experience with single-vessel and multivessel reoperative off-pump coronary artery bypass grafting. *J Thorac Cardiovasc Surg* 2008;135:527-32.
67. Tugtekin SM, Alexiou K, Kappert U, et al. Coronary reoperation with and without cardiopulmonary bypass. *Clin Res Cardiol* 2006;95:93-8.
68. Kara I, Cakalagaoglu C, Ay Y, et al. Reoperative coronary artery bypass surgery: the role of on-pump and off-pump techniques on factors affecting hospital mortality and morbidity. *Ann Thorac Cardiovasc Surg* 2013;19:435-40.
69. Sedrakyan A, Wu AW, Parashar A, et al. Off-pump surgery is associated with reduced occurrence of stroke and other morbidity as compared with traditional coronary artery bypass grafting: a meta-analysis of systematically reviewed trials. *Stroke* 2006;37:2759-69.



70. Doi K, Yaku H. Importance of cerebral artery risk evaluation before off-pump coronary artery bypass grafting to avoid perioperative stroke. *Eur J Cardiothorac Surg* 2010;38:568-72.
71. Machiraju VR. How to avoid problems in redo coronary artery bypass surgery. *J Card Surg* 2004;19:284-90.
72. Jones JM, O'kane H, Gladstone DJ, et al. Repeat heart valve surgery: risk factors for operative mortality. *J Thorac Cardiovasc Surg* 2001;122:913-8.
73. Lytle BW, Loop FD, Cosgrove DM et al. Fifteen hundred coronary reoperations. *J Thorac Cardiovasc Surg*, 1987;93:847.
74. Loop FD, Lytle BW, Cosgrove DM, Stewart RW, Goormastic M, Williams GW, Golding LA, Gill CC, Taylor PC, Sheldon WC. Influence of the internal-mammary-artery graft on 10-year survival and other cardiac events. *N Engl J Med*. 1986;314:1-6
75. Carey JS, Cukingnan RA, Singer LK. Quality of life after myocardial revascularization. Effect of increasing age. *J Thorac Cardiovasc Surg* 1992;103(1):108-15.
76. Yap CH, Sposato L, Akowuah E, Theodore S, Dinh DT, Shardey GC, et al. Contemporary results—how repeat coronary artery bypass grafting remains a risk factor for operative mortality. *Ann Thorac Surg* 2009;87(5):1386-91.
77. Maltais S, Widmer RJ, Bell MR, Daly RC, Dearani JA, Greason KL, et al. Reoperation for coronary artery bypass grafting surgery: outcomes and considerations for expanding interventional procedures. *Ann Thorac Surg* 2017;103(June (6)):1886-92.
78. Gallo M, Trivedi JR, Montreal G, Ganzel BL, Slaughter S. Risk Factors and Outcomes in Redo Coronary Artery Bypass Grafting Heart, Lung and Circulation (2019) xx, 1-6.
79. Bruno VD, Zakkar M, Rapetto F, Rathore A, Marsico R, Chivasso P et al. Early health outcome and 10-year survival in patients undergoing redo coronary surgery with or without cardiopulmonary bypass: a propensity score-matched analysis. *European Journal of Cardio-Thoracic Surgery* 52 (2017) 945-951.
80. Taggart DP, Aratari C, Wong P, et al. Applicability of intermittent global ischemia for repeat coronary artery operations. *J Thorac Cardiovasc Surg* 1996;112:501-7. Erratum in: *J Thorac Cardiovasc Surg* 1996 Dec;112(6):1484 Atari C [corrected to Aratari C].
81. Dohi M, Miyatab H, Doia K, Okawa K, Moto-murab N, Takamotob S et al. The off-pump technique in redo coronary artery bypass grafting reduces mortality and major morbidities: propensity score analysis of data from the Japan Cardiovascular Surgery Database. *European Journal of Cardio-Thoracic Surgery* 47 (2015) 299-308.
82. Di Mauro M, Iaco AL, Contini M, et al. Reoperative coronary artery bypass grafting: analysis of early and late outcomes. *Ann Thorac Surg* 2005;79:81-7.
83. El Oumeiri B, Glineur D, Price J, Boodhwani M, Etienne PY, Poncelet A et al. Recycling of internal thoracic arteries in reoperative coronary surgery: in-hospital and midterm results. *Ann Thorac Surg* 2011;91:1165-8.