

CHIRURGICKÁ REVASKULARIZACE MYOKARDU PRO 21. STOLETÍ – Méně štěpů více strategie?

Štěpán ČERNÝ

Klinika kardiovaskulární chirurgie

Fakultní nemocnice Motol a Homolka – pracoviště
Motol



2. LÉKAŘSKÁ FAKULTA
UNIVERZITA KARLOVA



ČESKÁ
KARDIOLOGICKÁ
SPOLEČNOST



ČESKÁ SPOLEČNOST
KARDIOVASKULÁRNÍ
CHIRURGIE

Chirurgická revaskularizace

Klasická chirurgická revaskularizace

Aortokoronární bypass model 1970

- 1x LIMA
- 2-3x VSM



Chirurgická revaskularizace



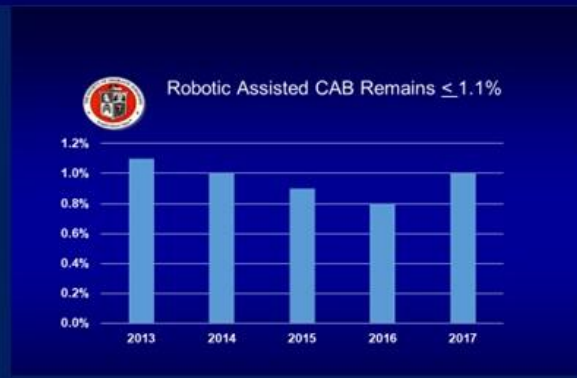
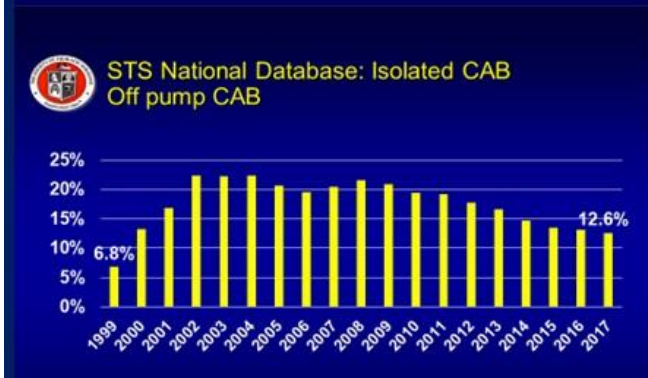
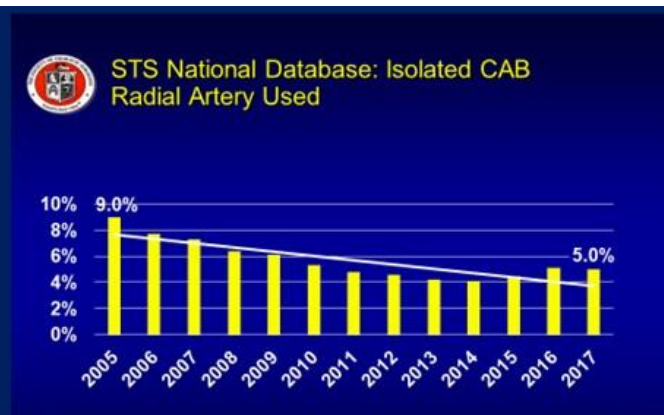
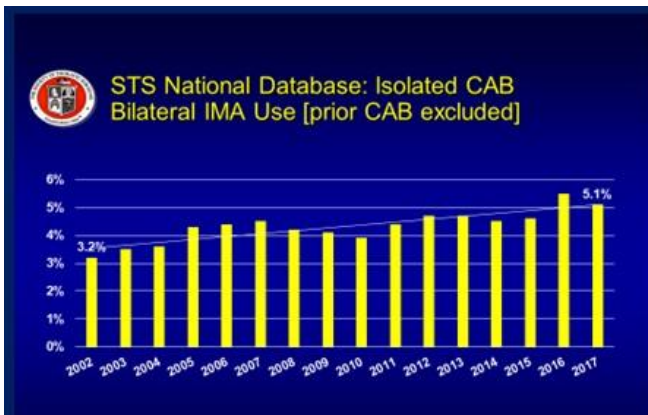
Klasická chirurgická revaskularizace

Aortokoronární bypass model 2025 ???

Chirurgická revaskularizace



Klasická chirurgická revaskularizace



Chirurgická revaskularizace

Klasická chirurgická revaskularizace

Aortokoronární bypass model 2025 ???



Chirurgická revaskularizace

Klasická chirurgická revaskularizace

Aortokoronární bypass model 2025 ???

- 1x LIMA
- 2-3x VSM



Chirurgická revaskularizace



Klasická chirurgická revaskularizace



1970



2025

Chirurgická revaskularizace



Klasická chirurgická revaskularizace – multiarteriální grafting

Multiarterial vs Single-Arterial Coronary Surgery: 10-Year Follow-up of 1 Million Patients



Joseph F. Sabik III, MD,¹ J. Hunter Mehaffey, MD,² Vinay Badhwar, MD,² Marc Ruel, MD,³ Patrick O. Myers, MD,⁴ Sigrid Sandner, MD,⁵ Faisal Bakaeen, MD,⁶ John Puskas, MD,⁷ David Taggart, MD,⁸ Thomas Schwann, MD,⁹ Joanna Chikwe, MD,¹⁰ Thomas E. MacGillivray, MD,¹¹ Abel Kho, MD,¹² and Robert H. Habib, PhD¹³

ABSTRACT

BACKGROUND Although many options exist for multivessel coronary revascularization, controversy persists over whether multiarterial grafting (MAG) confers a survival advantage over single-arterial grafting (SAG) with saphenous vein in coronary artery bypass grafting (CABG). This study sought to compare longitudinal survival between patients undergoing MAG and those undergoing SAG.

METHODS All patients undergoing isolated CABG with ≥ 2 bypass grafts in The Society of Thoracic Surgeons Adult Cardiac Surgery Database (2008-2019) were linked to the National Death Index. Risk adjustment was performed using inverse probability weighting and multivariable modeling. The primary end point was longitudinal survival. Subpopulation analyses were performed and volume thresholds were analyzed to determine optimal benefit.

RESULTS A total of 1,021,632 patients underwent isolated CABG at 1108 programs (100,419 MAG [9.83%]; 920,943 SAG [90.17%]). Median follow-up was 5.30 years (range, 0-12 years). After risk adjustment, all characteristics were well balanced. At 10 years, MAG was associated with improved unadjusted (hazard ratio, 0.59; 95% CI 0.58-0.61) and adjusted (hazard ratio, 0.86; 95% CI, 0.85-0.88) 10-year survival. Center volume of ≥ 10 MAG cases/year was associated with benefit. MAG was associated with an overall survival advantage over SAG in all subgroups, including stable coronary disease, acute coronary syndrome, and acute infarction. Survival was equivalent to that with SAG for patients age ≥ 80 years and those with severe heart failure, renal failure, peripheral vascular disease, or obesity. Only patients with a body mass index ≥ 40 kg/m² had superior survival with SAG.

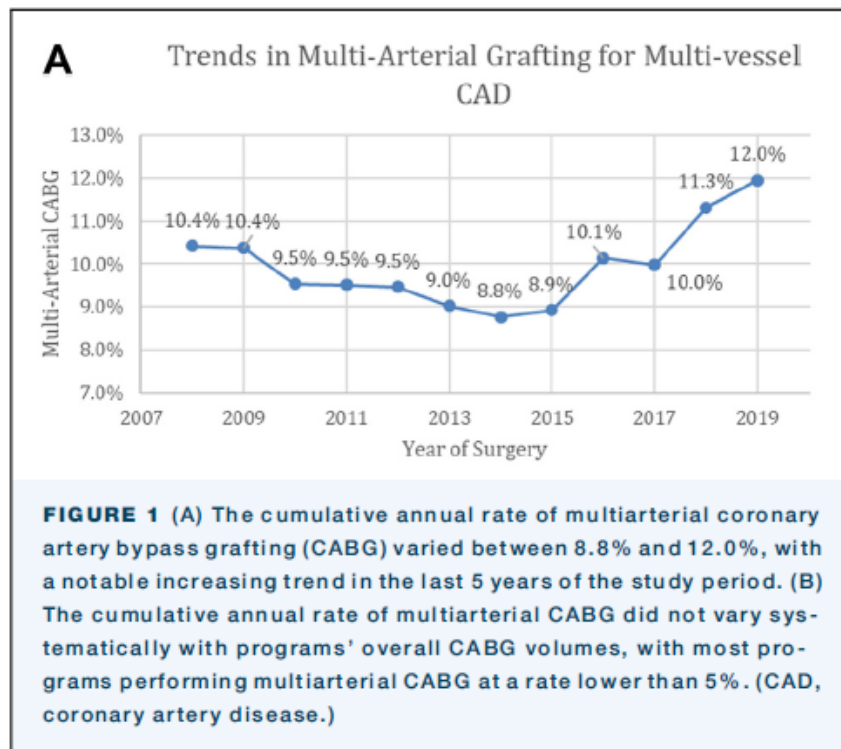
CONCLUSIONS Multiarterial CABG is associated with superior long-term survival and should be the surgical multivessel revascularization strategy of choice for patients with a body mass index of less than 40 kg/m².

Sabik J et al. Ann Thorac Surg 2024;117:780-8

Chirurgická revaskularizace



Klasická chirurgická revaskularizace – multiarteriální grafting



Sabik J et al. *Ann Thorac Surg* 2024;117:780-8

Chirurgická revaskularizace



Klasická chirurgická revaskularizace – multiarteriální grafting

TABLE Patient Characteristics in Single-Arterial (Control) vs Multiarterial (Treatment) Patient Groups Undergoing Coronary Artery Bypass Grafting: All Cases Before and After Matched Subcohorts

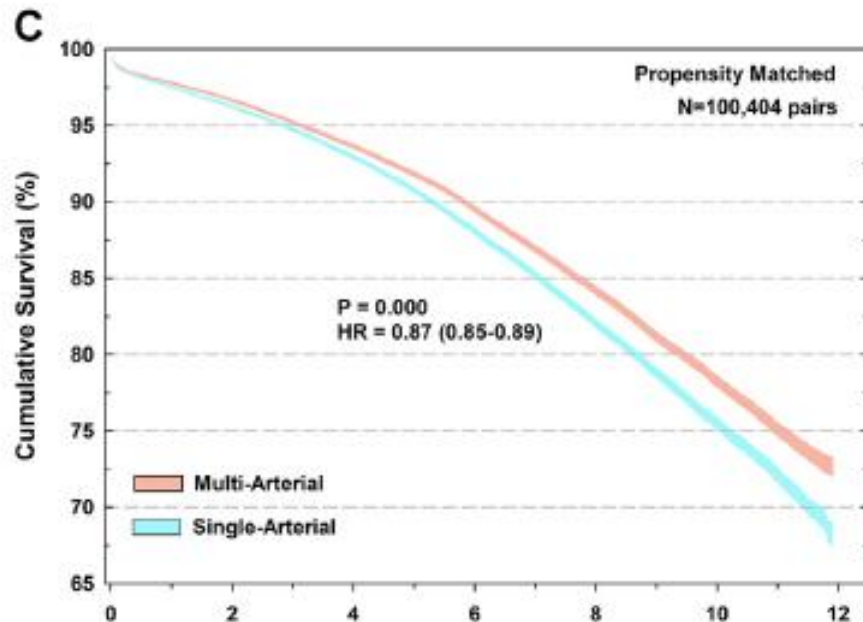
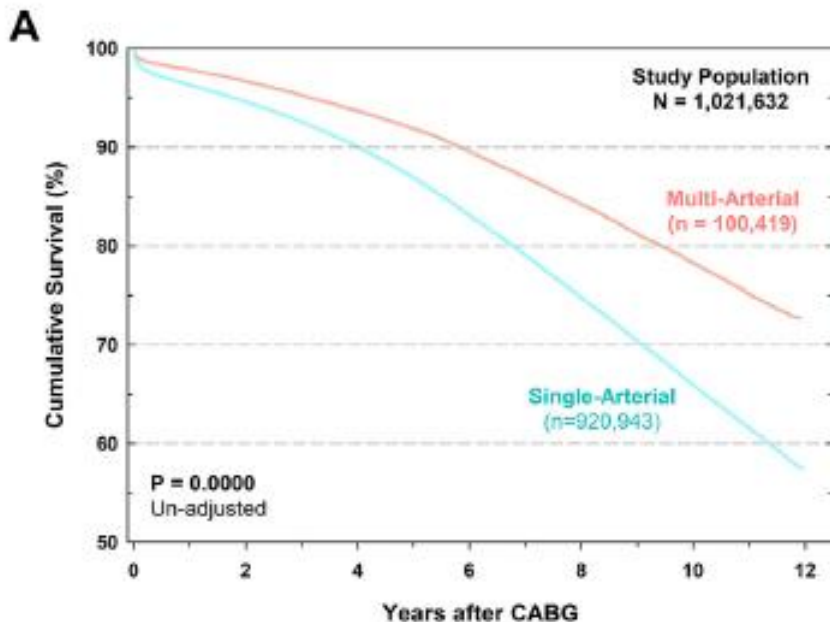
Patient Variables	All Cases			Propensity Matched		
	Single-Arterial (N = 920,943)	Multiarterial (N = 100,419)	Std Diff, %	Single-Arterial (N = 100,404)	Multiarterial (N = 100,404)	Std Diff, %
Preoperative data						
Male sex	74.50	84.50	-25.00	84.10	84.50	-1.00
Age, y	65.6 ± 10.1	60.3 ± 10.1	52.50	60.2 ± 10.3	60.3 ± 10.1	-1.0
Body surface area, m ²	2.01 ± 0.24	2.05 ± 0.23	-16.90	2.05 ± 0.23	2.05 ± 0.23	-0.50
Preoperative eGFR, mL/min/1.73 m ²	75 ± 21	81 ± 20	-31.60	81 ± 20	81 ± 20	-0.50
BMI category, kg/m ²						
<21	2.40	1.60	5.80	1.60	1.60	0.40
21-24.99	19.70	18.10	4.00	18.20	18.10	0.20
25-29.99	37.60	39.80	-4.60	39.60	39.80	-0.50
30-34.99	24.50	25.90	-3.20	26.00	25.90	0.30
35-39.99	10.40	9.80	2.00	9.80	9.80	-0.20
≥40	5.40	4.70	3.10	4.70	4.70	-0.10
Diabetes						
Oral	30.50	25.60	11.00	25.10	25.60	-1.10
Insulin	16.10	12.00	11.70	12.00	12.00	-0.20

Sabik J et al. Ann Thorac Surg 2024;117:780-8

Chirurgická revaskularizace



Klasická chirurgická revaskularizace – multiarteriální grafting



Sabik J et al. Ann Thorac Surg 2024;117:780-8

Chirurgická revaskularizace



Klasická chirurgická revaskularizace – kompletní revaskularizace

Surgical revascularization techniques that minimize surgical risk and maximize late survival after coronary artery bypass grafting in patients with diabetes mellitus

Sajjad Raza, MD,^a Joseph F. Sabik III, MD,^a Khalil Masabni, MD,^a Ponnuthurai Ainkaran, MS,^b Bruce W. Lytle, MD,^a and Eugene H. Blackstone, MD^{a,b}

Methods: From January 1972 to January 2011, 11,922 patients with diabetes underwent primary isolated CABG. The revascularization techniques investigated included bilateral internal thoracic artery (BITA) grafting (n = 938; 7.9%) versus single ITA (SITA) grafting, off-pump (n = 602; 5.0%) versus on-pump CABG, and incomplete (n = 2109; 18%) versus complete revascularization. The median follow-up was 7.8 years and total follow-up, 104,516 patient-years. Multivariable analyses were performed to assess the effects of surgical techniques on hospital outcomes and long-term mortality.

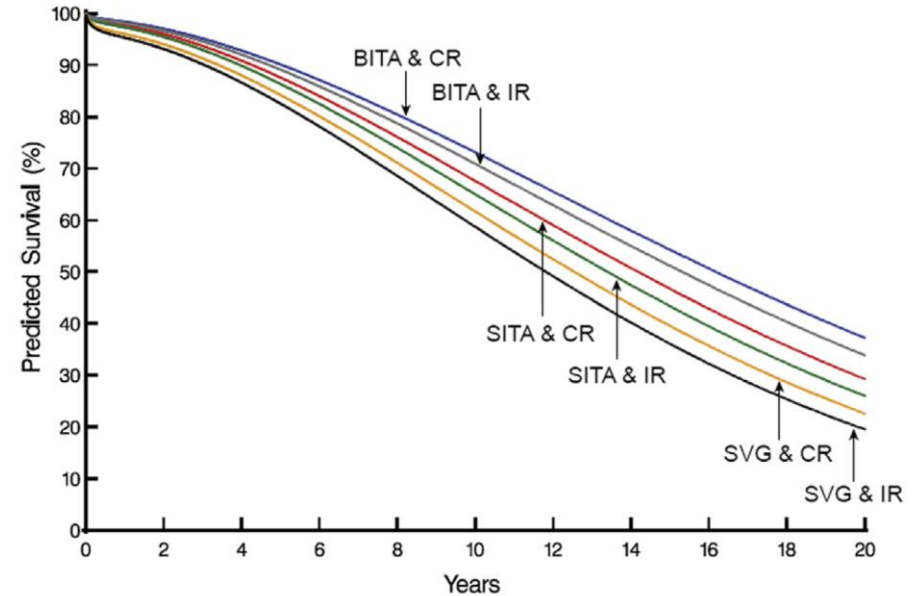


FIGURE 4. Risk-adjusted effect of bilateral (*BITA*) versus single (*SITA*) internal thoracic artery grafting and incomplete (*IR*) versus complete (*CR*) revascularization on predicted survival after coronary artery bypass grafting (*CABG*) in diabetic patients. Simulations were based on the

Raza S et al. *J Thorac Cardiovasc Surg* 2014;148:1257-66

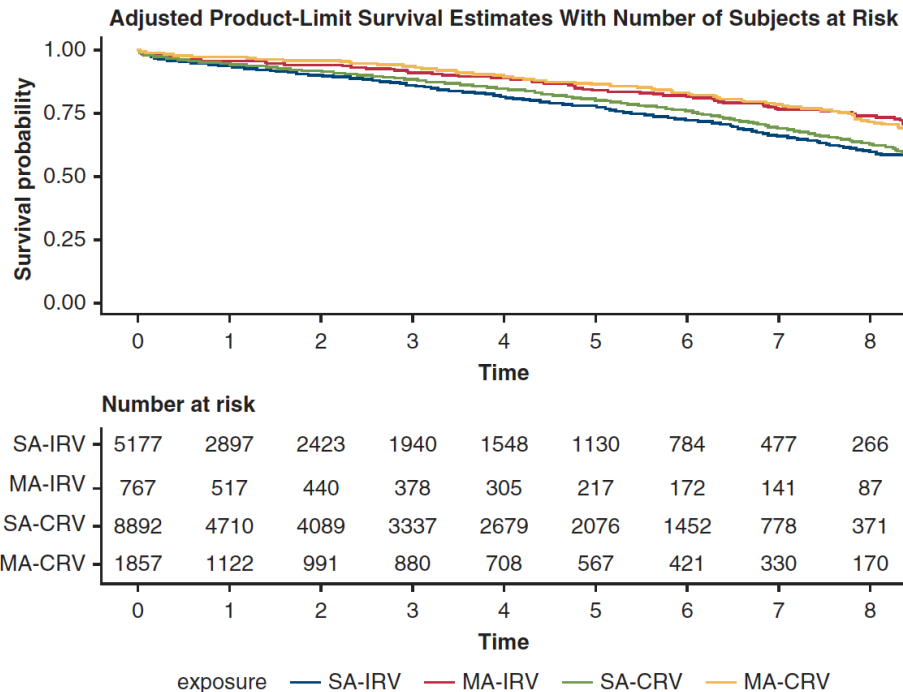
Chirurgická revaskularizace

Klasická chirurgická revaskularizace – kompletní revaskularizace

Priorities in coronary artery bypass grafting: Is midterm survival more dependent on completeness of revascularization or multiple arterial grafts?

Joshua Michael Rosenblum, MD, PhD,^a Jose Binongo, PhD,^b Jane Wei, MPH,^b Yuan Liu, PhD,^b Bradley G. Leshnowar, MD,^a Edward P. Chen, MD,^a Jeffrey S. Miller, MD,^a Steven K. Macheers, MD,^a Omar M. Lattouf, MD, PhD,^a Robert A. Guyton, MD,^a Vinod H. Thourani, MD,^a Michael E. Halkos, MD,^a and William Brent Keeling, MD^b

Methods: A retrospective review of 17,411 isolated, primary coronary artery bypass grafting operations from January 2002 to June 2016 at a US academic institution was performed. Patients were divided into groups based on complete or incomplete revascularization and number of arterial grafts. Inverse probability of treatment weighting based on the generalized propensity score was performed to minimize imbalance in preoperative characteristics. Between-group differences in outcomes were assessed using multivariable logistic and Cox regression analyses, incorporating the propensity score weights.



Rosenblum et al. *J Thorac Cardiovasc Surg* 2021;161:2070 - 8

Chirurgická revaskularizace

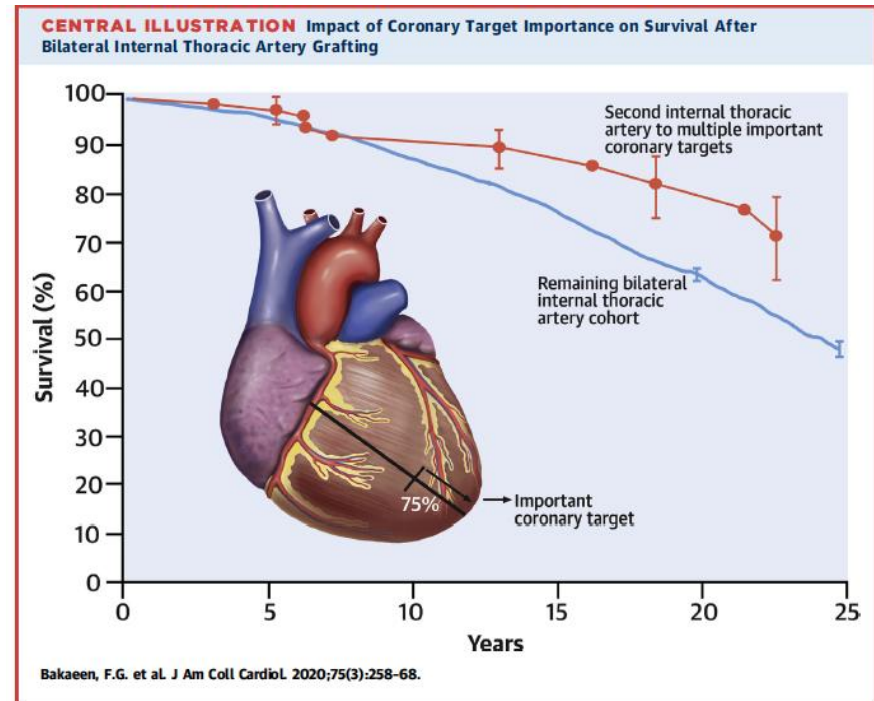
Klasická chirurgická revaskularizace – výběr cílového povodí

Coronary Artery Target Selection and Survival After Bilateral Internal Thoracic Artery Grafting

Faisal G. Bakaeen, MD,^{a,*} Kirthi Ravichandren, MD,^{a,*} Eugene H. Blackstone, MD,^{a,b} Penny L. Houghtaling, MS,^b Edward G. Soltesz, MD,^a Douglas R. Johnston, MD,^a Stephanie L. Mick, MD,^a José L. Navia, MD,^a Michael Zhen-Yu Tong, MD, MBA,^a Kenneth R. McCurry, MD,^a Rami Akhrass, MD,^a Mouin Abdallah, MD,^c Gösta B. Pettersson, MD, PhD,^a Nicholas M. Smedira, MD,^a Eric E. Roselli, MD,^a A. Marc Gillinov, MD,^a Lars G. Svensson, MD, PhD^a

METHODS From January 1972 to January 2011, of 6,127 patients who underwent BITA grafting, 2,551 received 1 ITA grafted to the LAD and had an evaluable coronary angiogram. A dominant LAD was defined as one that was wrapped around the left ventricular apex. Non-LAD targets were graded based on their terminal reach toward the apex: important: >75% (n = 1,698); and less important: ≤75% (n = 853). Mean follow-up was 14 ± 8.7 years. Multivariable analysis was performed to identify risk factors for time-related mortality.

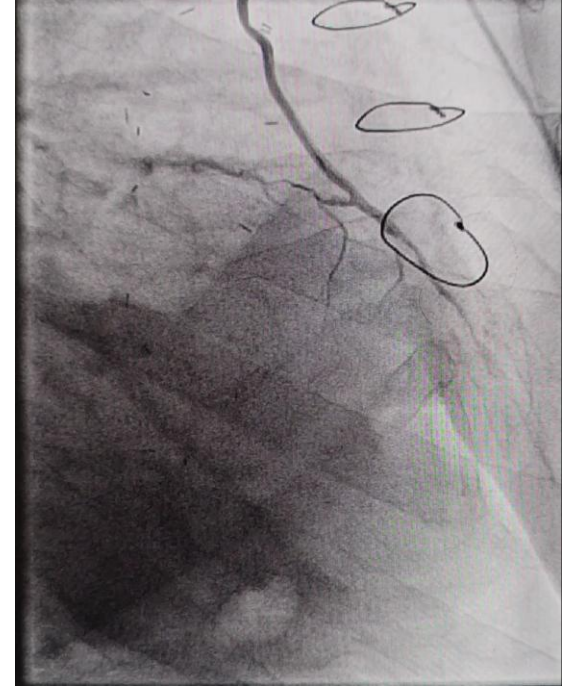
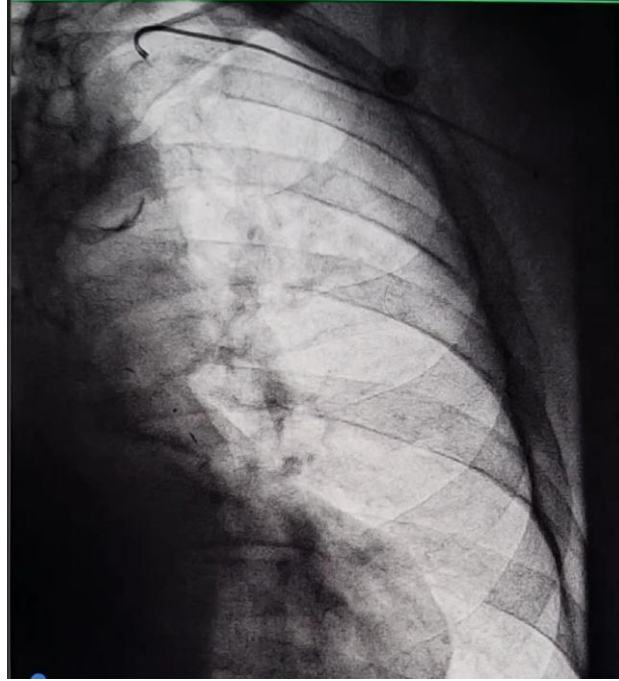
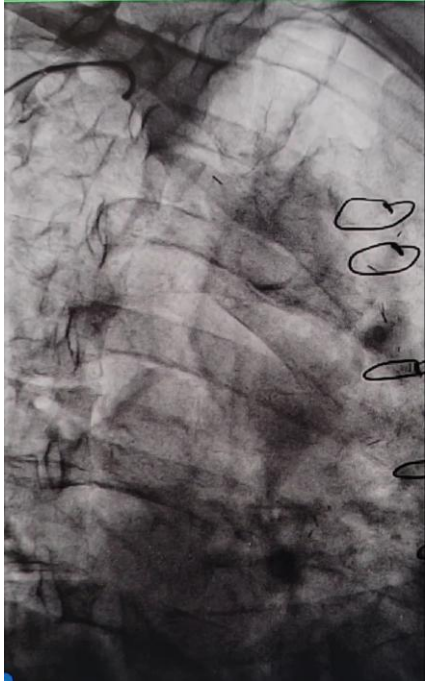
Bakaeen FG et al. J Am CollCardiol 2020;75(3):258-68



Bilateral internal thoracic artery grafting is associated with better survival when the second internal thoracic artery is bypassed to multiple important coronary artery targets with a >75% reach toward the apex of the heart. This is particularly important when the left anterior descending coronary artery is a nondominant vessel. Therefore, the revascularization strategy should focus on maximizing the myocardial mass supplied by internal thoracic artery grafts.

Chirurgická revaskularizace

Klasická chirurgická revaskularizace – kazuistika



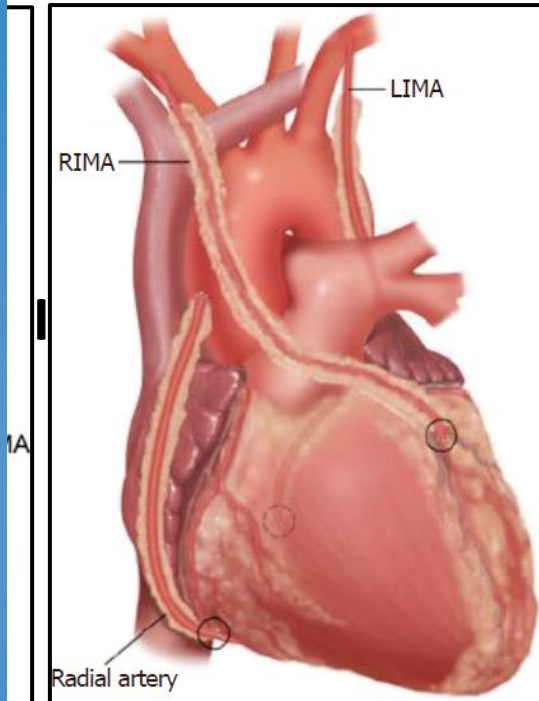
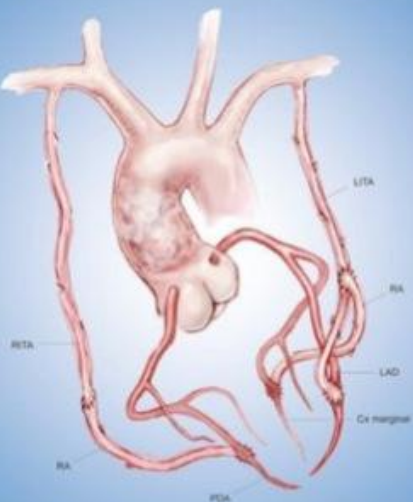
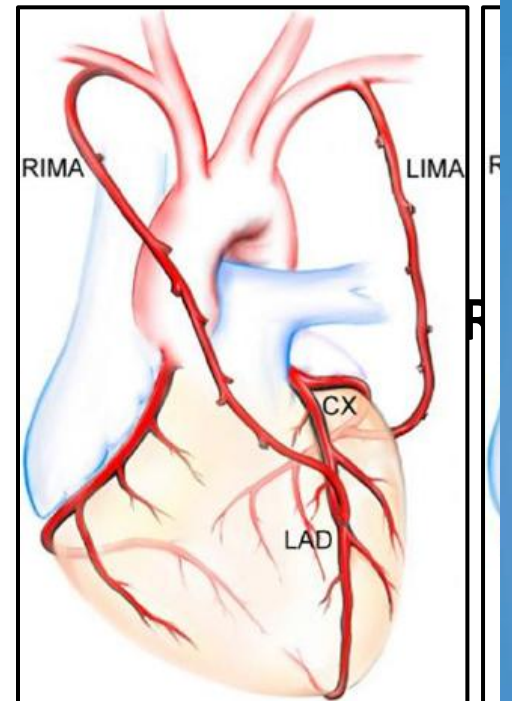
93 letý muž, v roce 1993 (v 60ti letech věku) podstoupil pro 3VD (90% proximální RIA, 100% ACD, 70% RMS) 4 násobný aortokoronární bypass LIMA-RIA, RIMA-ACD, SVG-RD+RMS

Chirurgická

Chirurgická kolateralizace

OXFORD

STATE OF THE ART SURGICAL CORONARY REVASCARIZATION



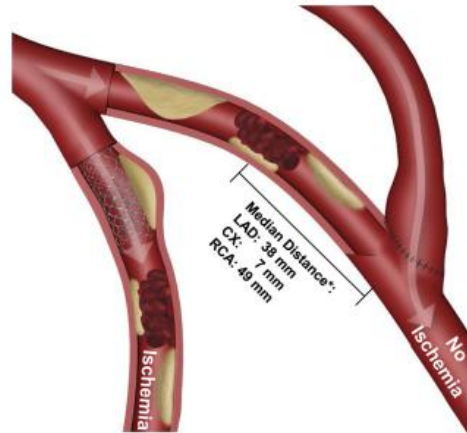
EDITED BY David P Taggart | John D Puskas

Chirurgická revaskularizace

Chirurgická kolateralizace

Surgical collateralization: The hidden mechanism for improving prognosis in chronic coronary syndromes

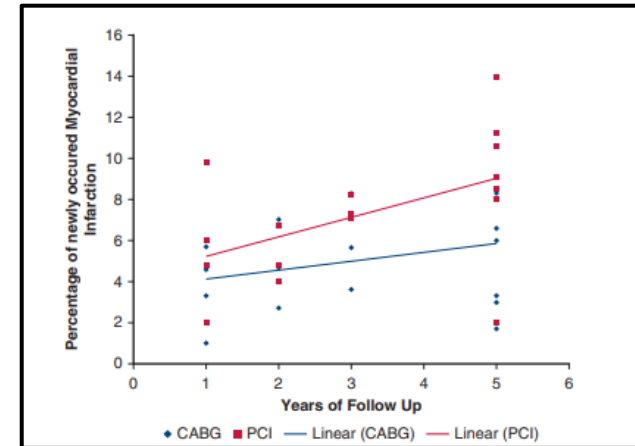
Torsten Doenst, MD, PhD,^a and Holger Sigusch, MD^b



CENTRAL MESSAGE

Prognostic effects of treatments for chronic CAD mainly depend on infarct prevention. Coronary bypass grafting prevents myocardial infarctions through surgical collateralization.

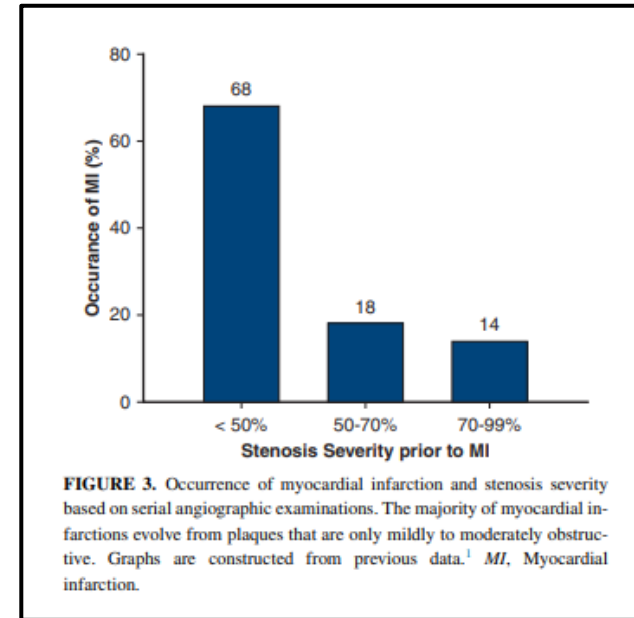
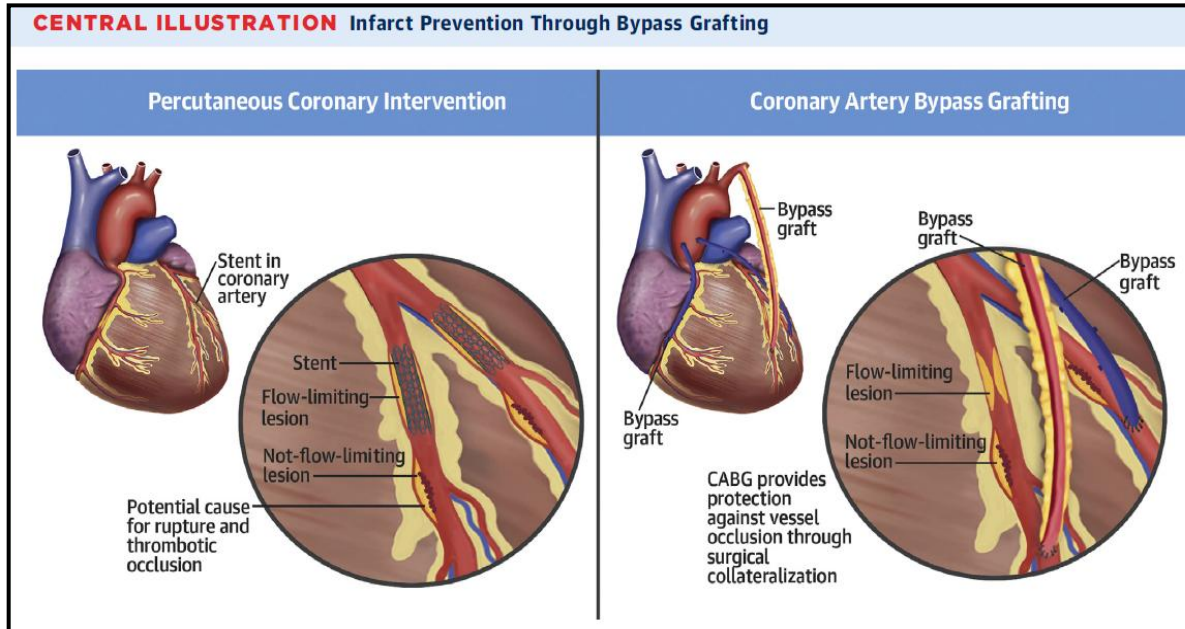
SURGICAL COLLATERALIZATION IS PARADIGM SHIFTING



Doenst T et al. *J Thorc Cardiovasc Suerg* 2022;163:703-708

Chirurgická revaskularizace

Chirurgická kolateralizace



Doenst T et al. *J Am Coll Cardiol* 2019;73(8):964-76

Doenst T et al. *J Thorc Cardiovasc Suerg* 2022;163:703-708

Chirurgická revaskularizace



CABG 1.0

CABG on pump
LIMA + SVG



CABG 2.0

CABG Multi-Arterial
or total arterial,



Chirurgická revaskularizace



CABG 1.0

CABG on pump
LIMA + SVG



CABG 2.0

CABG Multi-Arterial
or total arterial,



CABG 3.0

Robotic MIDCAB,
LIMA or BIMA



CABG 4.0

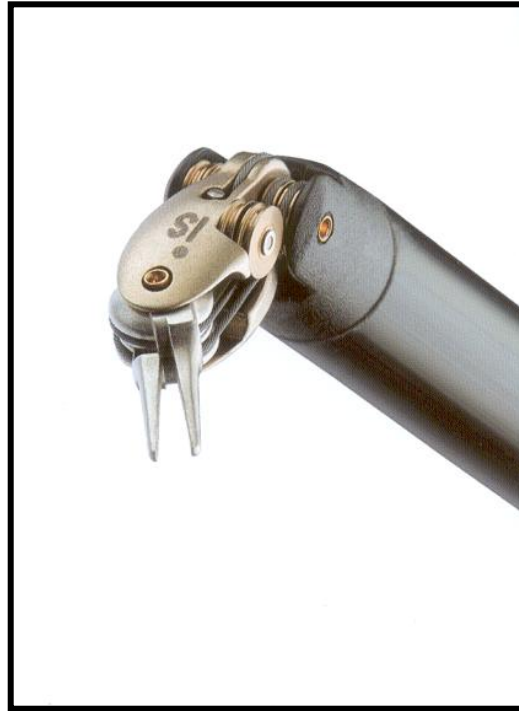
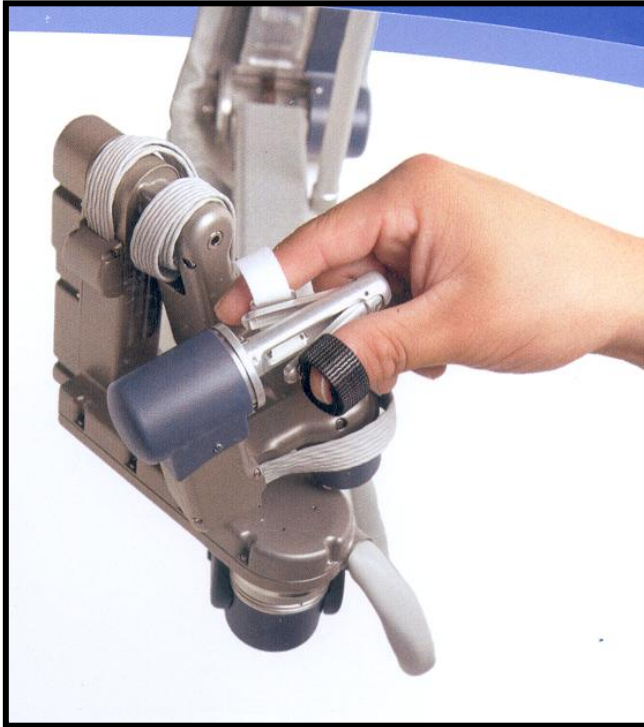
TECAB BIMA
Off pump



Chirurgická revaskularizace



Robotická kardiochirurgie

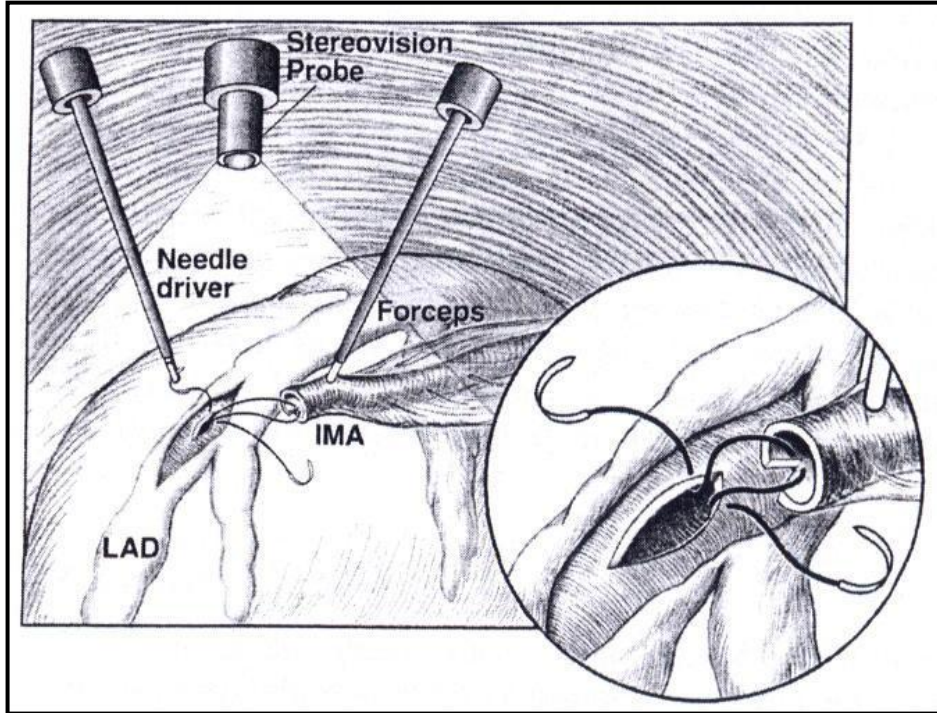


ROBOTIKA

=

TELEMANIPULACE

Limitace klasické lapro/torakoskopie



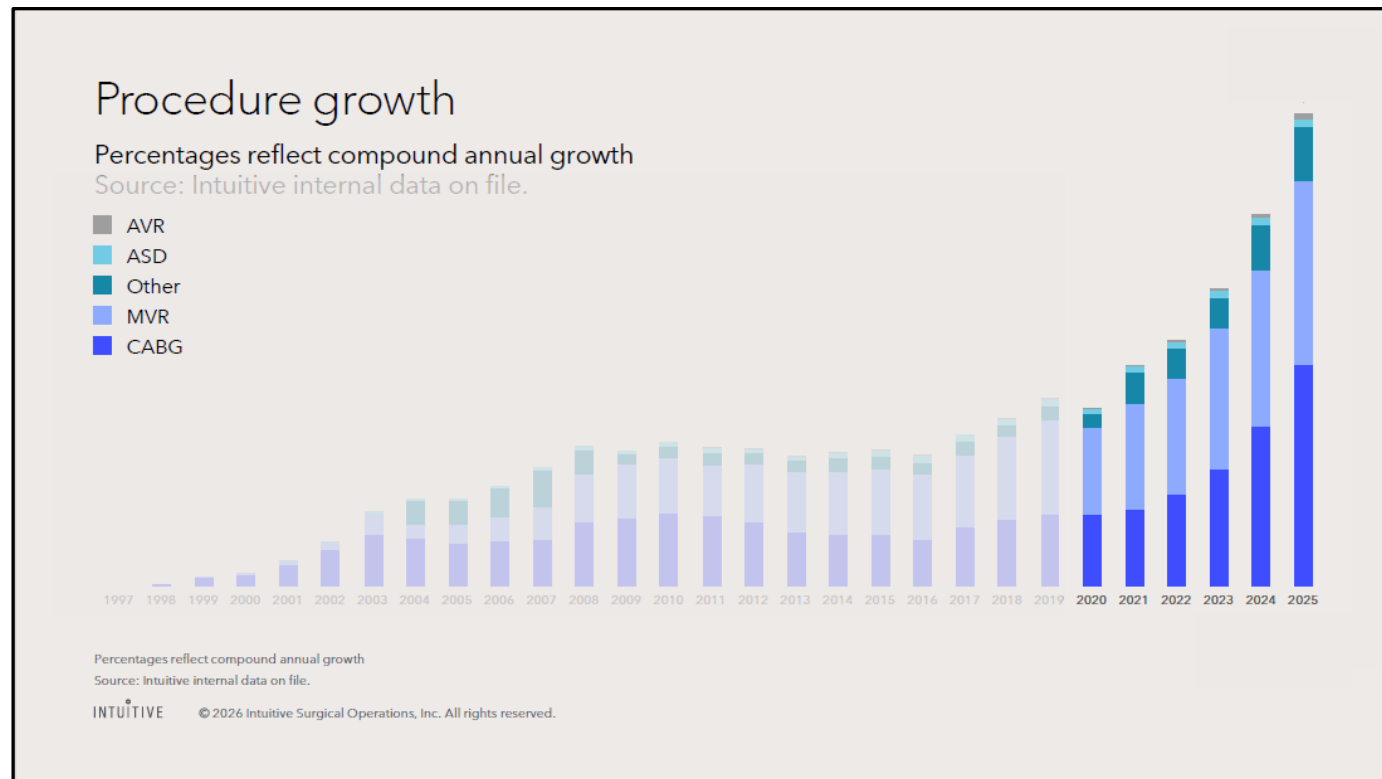
- Rekonstrukční“ charakter oboru
- Omezený (2D) přehled
- Dlouhé rigidní instrumenty (anastomosis, implantace atd..)
- 4 stupně volnosti na konci instrumentů
- „Fulcrum effect“ u anastomóz (především cévních)

Stevens JH et al. JTCVS 1996;62:435-41

Chirurgická revaskularizace



Robotická kardiochirurgie ve světě 1998 - 2025



Data: Intuitive Surgical

Chirurgická revaskularizace

Robotická revaskularizace – DVSVST/TECAB



ACB - Rozmístění portů

- Klíčový je odběr LIMA
- Tři až čtyři 8mm trokary
- 2, 4 a 6 mezižebří pro robotické nástroje a kameru
- Subkostální trokar pro stabilizátor
- RA - MIDCAB - 4 mezižebří pro minitorakotomii pro anastomózu 4-6 cm



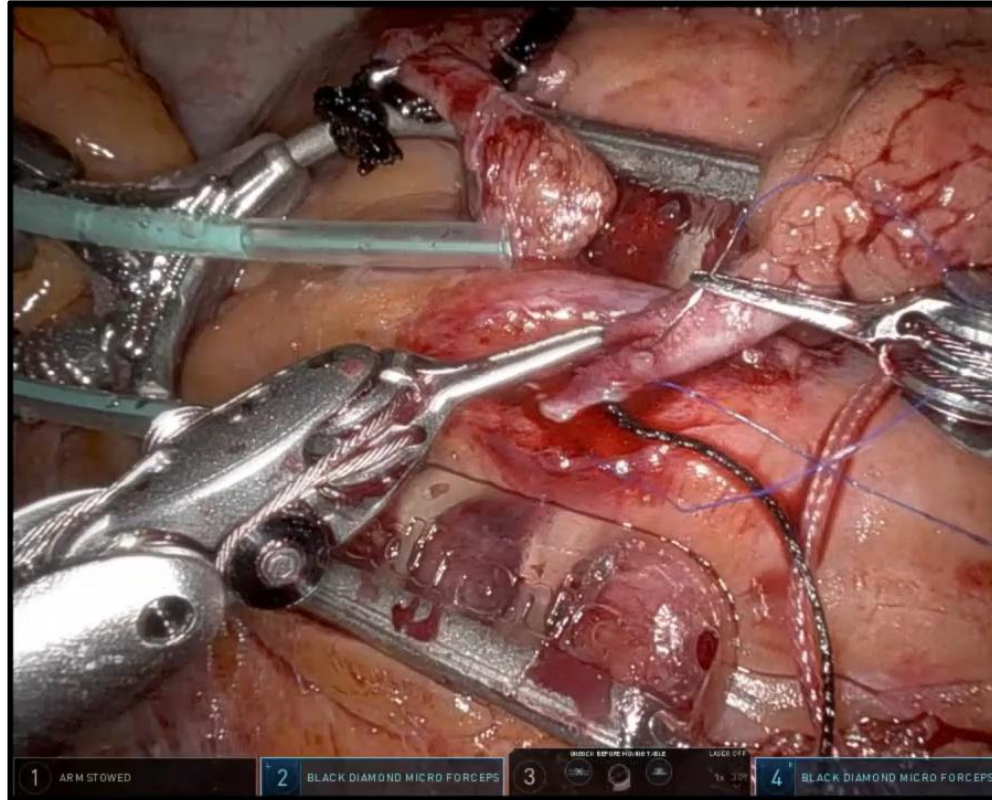
ACB - odběr LIMA

- Větve přerušeny klipy či bipolární koagulací
- Možný odběr obou IMA
 - 1. Odběr RIMA
 - 2. Odběr LIMA
- Otevření perikardu a revize koronárních tepen
- Přerušení (obou) IMA

Chirurgická revaskularizace



Robotická revaskularizace – TECAB

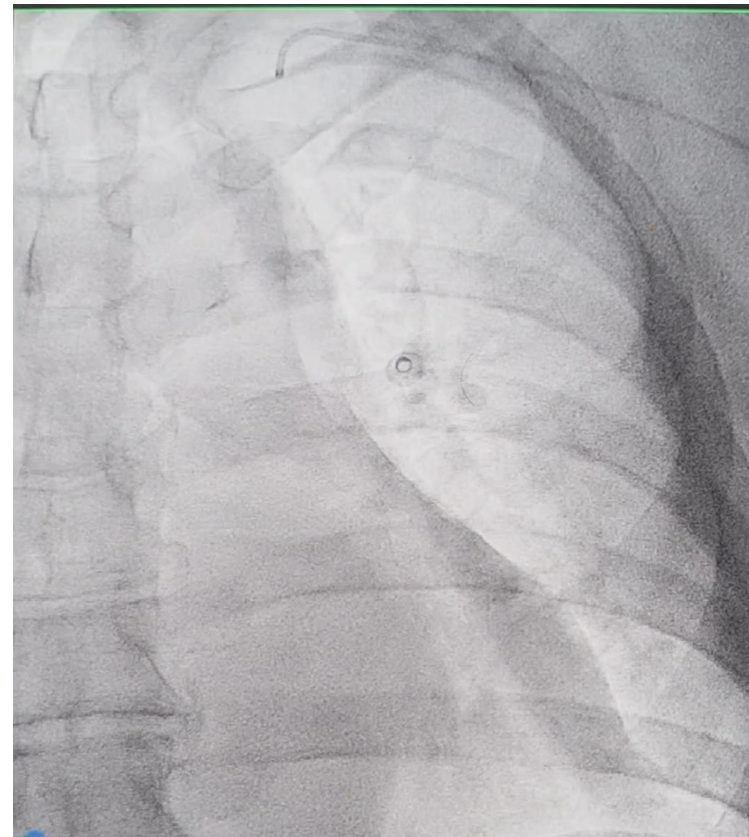
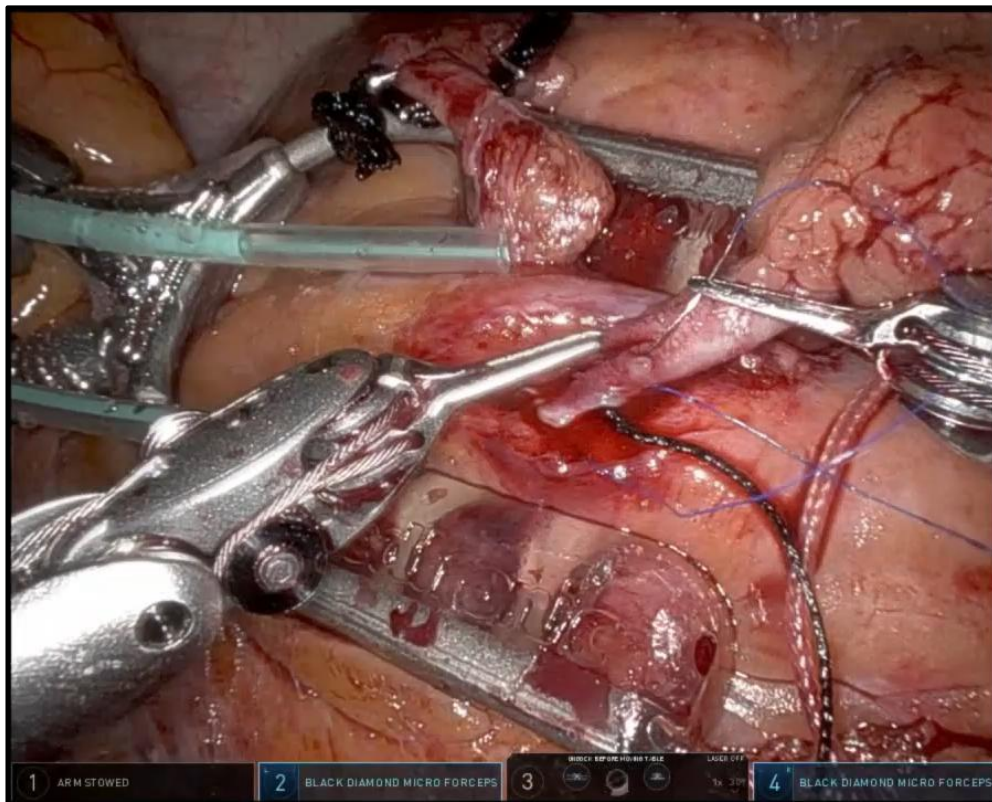


ACB - TECAB

- **ON PUMP**
- Kardioplegická zástava – Endoclamp
- **OFF PUMP**
- EndoWirst Stabilizátor (US)
- Octopus NUOVO (US+EU)

Chirurgická revaskularizace

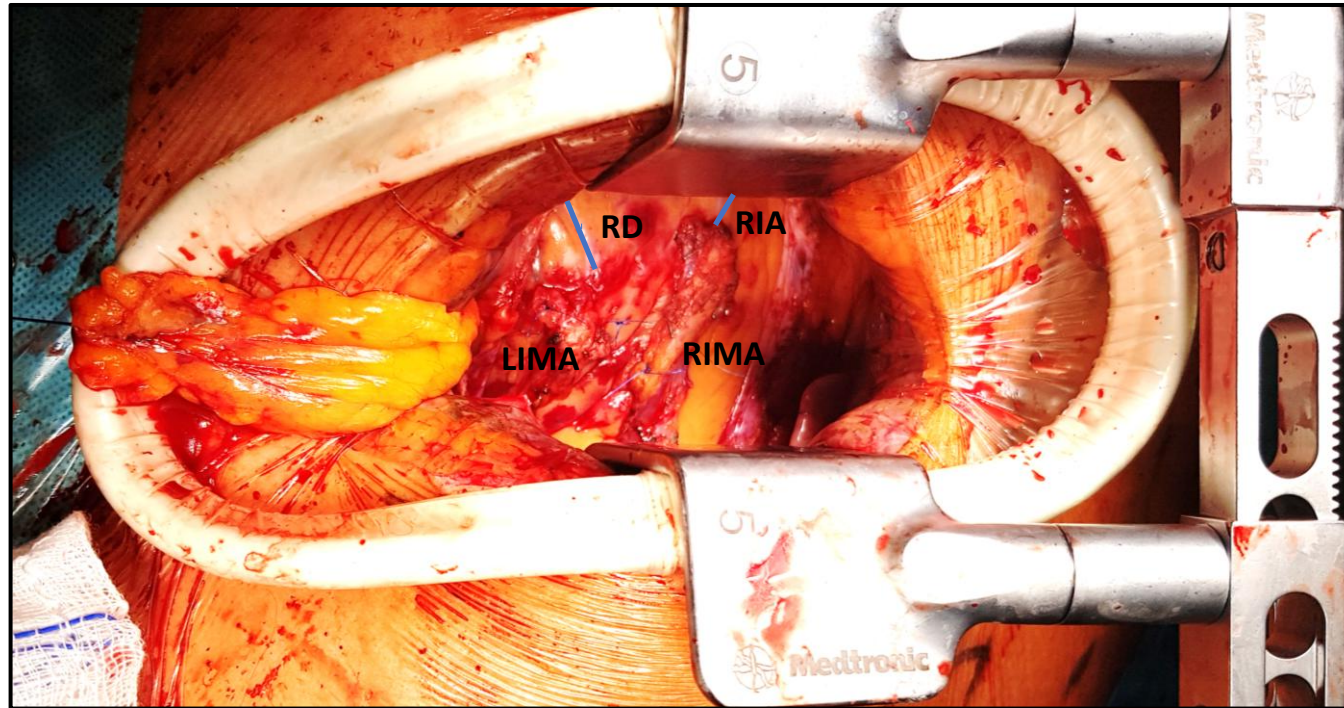
Robotická revaskularizace – TECAB



Chirurgická revaskularizace

Robotická revaskularizace – DVSVST

RA MIDCAB/DVSVST



- Odběr LIMA roboticky
- Anastomóza manuálně ze 4-6 cm torakotomie obvykle ve 4 mezižebří
- Možné i použití obou IMA
- Provedení více než 2 anastomóz – BIMA, ev sekvenční LIMA

Chirurgická revaskularizace

Robotická revaskularizace – DVSVST/TECAB



TECAB

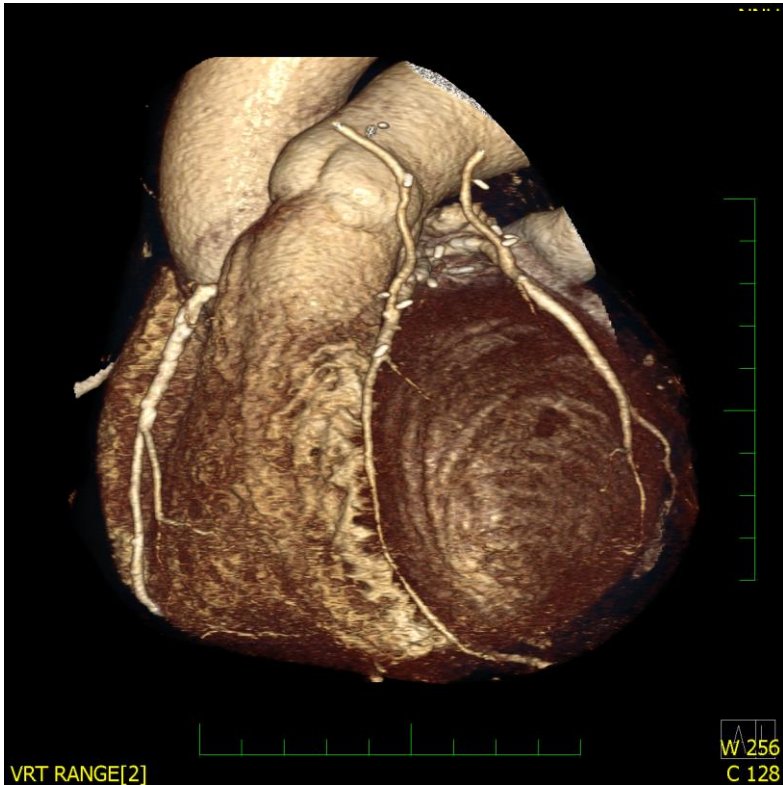


RA MIDCAB / DVSVST

Chirurgická revaskularizace



Robotická revaskularizace – DVSVST/TECAB



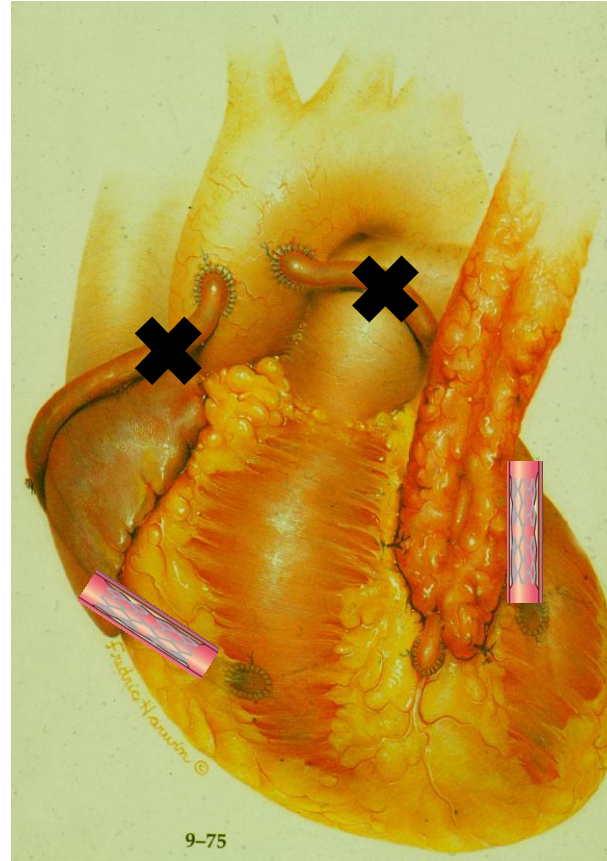
ACB s použitím BIMA

- RIA - RIMA
- RIM - LIMA
- CT SKG

Chirurgická revaskularizace

Hybridní revaskularizace – DVSVST/TECAB

„The best from both worlds“



Hybrid Coronary Revascularization in Selected Patients With Multivessel Disease

5-Year Clinical Outcomes of the Prospective Randomized Pilot Study

Mateusz Tajstra, MD,^a Tomasz Hrapkowicz, MD, PhD,^b Michał Hawranek, MD, PhD,^a Krzysztof Filipiak, MD, PhD,^b Marek Gierlotka, MD,^a Marian Zembala, MD,^b Mariusz Gąsior, MD,^a Michael Oscar Zembala, MD,^b on behalf of the POL-MIDES Study Investigators

ABSTRACT

OBJECTIVES This study aimed to investigate the 5-year clinical follow-up of the HYBRID (Hybrid Revascularization for Multivessel Coronary Artery Disease) trial.

BACKGROUND The HYBRID trial, the only randomized study involving thorough analysis of outcome after the 2 procedures, suggested that hybrid coronary revascularization (HCR) is feasible in selected patients with multivessel coronary disease referred for conventional coronary artery bypass grafting (CABG). There are currently no long-term outcome data from randomized trials in this setting.

METHODS A total of 200 patients with multivessel coronary disease referred for conventional surgical revascularization were randomly assigned to undergo HCR or CABG. The primary endpoint was the occurrence of all-cause mortality at 5 years.

RESULTS Nine patients (4 in HCR and 5 in CABG group) were lost to the 5-year follow-up. Finally, 191 patients (94 in HCR and 97 in CABG group) formed the basis of this study. The groups were well balanced in terms of pre-procedural characteristics. All-cause mortality at 5-year follow-up was similar in the 2 groups (6.4% for HCR vs. 9.2% for CABG; $p = 0.69$). The rates of myocardial infarction (4.3% vs. 7.2%; $p = 0.30$), repeat revascularization (37.2% vs. 45.4%; $p = 0.38$), stroke (2.1% vs. 4.1%; $p = 0.35$), and major adverse cardiac and cerebrovascular events (45.2% vs. 53.4%; $p = 0.39$) were also similar in the 2 groups.

CONCLUSIONS HCR has similar 5-year all-cause mortality when compared with conventional coronary bypass grafting (Safety and Efficacy Study of Hybrid Revascularization in Multivessel Coronary Artery Disease; NCT01035567) (J Am Coll Cardiol Intv 2018;11:847-52) © 2018 by the American College of Cardiology Foundation.

Gasior M et al: J Am Coll Cardiol Intv 2018;11:847-52

Chirurgická revaskularizace



Hybridní revaskularizace – POL-MIDES PRT

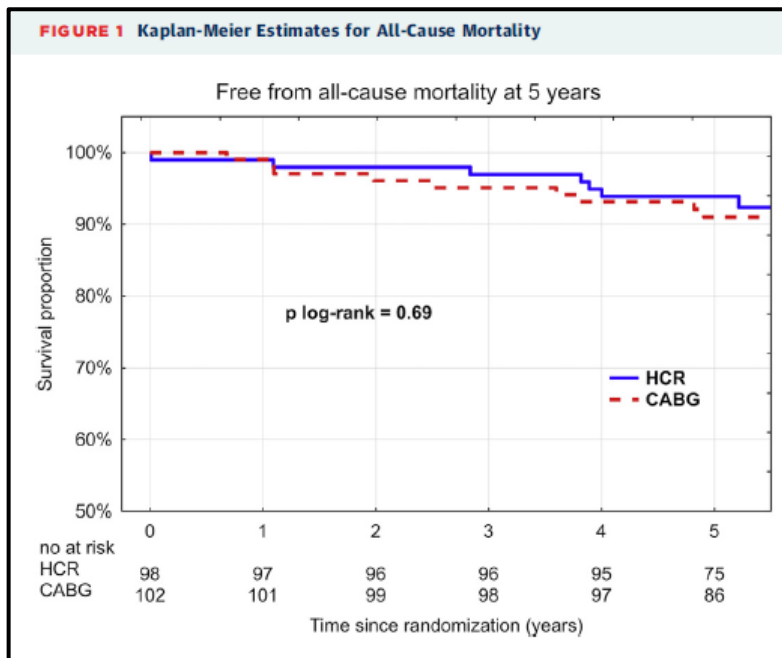


TABLE 2 5-Year Clinical Outcomes*†

	HCR (n = 94)	CABG (n = 97)	p Value
All-cause mortality‡	6.4	9.2	0.69
Myocardial infarction§	4.3	7.2	0.30
Coronary reintervention	37.2	45.4	0.38
Stroke	2.1	4.1	0.35
Any major adverse cardiac or cerebrovascular events¶	45.2	53.4	0.39

Gasior M et al: J Am Coll Cardiol Interv 2018;11:847-52

■ SHORT COMMUNICATION

Hybrid coronary revascularization in multivessel disease: Long-term clinical outcomes of a prospective randomized study

Mateusz Tajstra¹, Michael Oscar Zembala², Marek Gierlotka³, Krzysztof Filipiak⁴, Mariusz Gąsior¹,
Tomasz Hrapkowicz⁴, on behalf of POLMIDES study investigators

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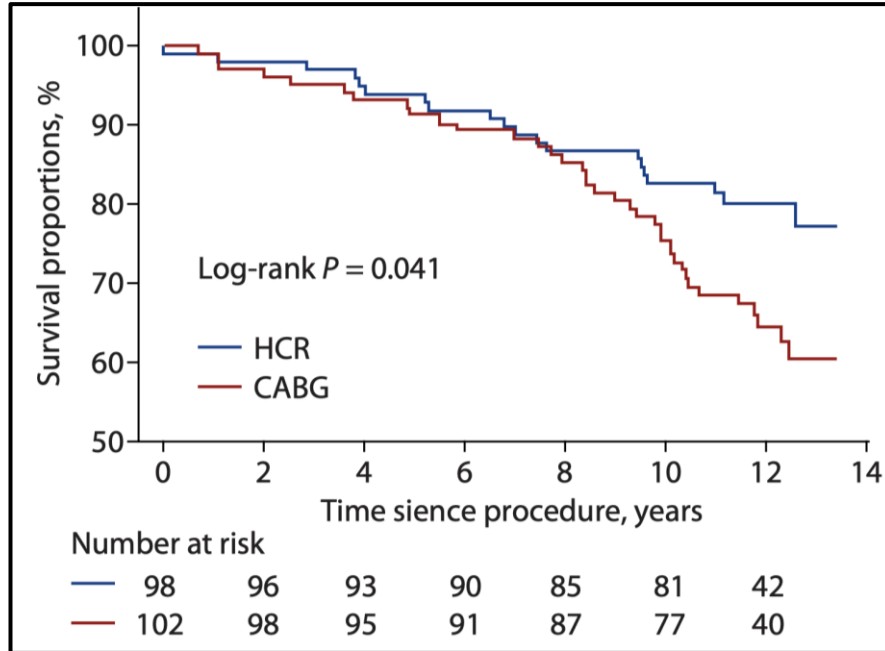
⁴Department of Cardiac, Vascular and Endovascular Surgery and Transplantology, Silesian Center for Heart Diseases, Medical University of Silesia, Zabrze, Poland

Tajstra M et al: *Kardiol Pol* 2024;82(12):1278-1220

Chirurgická revaskularizace



Hybridní revaskularizace – POL-MIDES PRT



Variable	HCR (n = 94)	CABG (n = 97)	P
All-cause mortality**, %	20.4	36.3	0.02
Myocardial infarction†, %	13.3	16.8	0.59
Coronary reintervention‡, %	47.1	51.0	0.27
Stroke, %	6.5	4.9	0.75
Any major adverse cardiac or cerebrovascular events‡, %	56.1	68.6	0.09

Tajstra M et al: Kardiologia 2024;82(12):1278-1220

Chirurgická revaskularizace



Hybridní revaskularizace

Hybrid coronary revascularization versus percutaneous coronary intervention: A systematic review and meta-analysis

Jef Van den Eynde^{a,b,*}, Michel Pompeu Sá^{c,d}, Senne De Groote^a, Andrea Amabile^e, Serge Sicouri^d, Basel Ramlawi^{c,d}, Gianluca Torregrossa^c, Wouter Oosterlinck^a

^a Department of Cardiovascular Diseases, University Hospitals Leuven & Department of Cardiovascular Sciences, KU Leuven, Leuven, Belgium

^b Helen B. Taussig Heart Center, The Johns Hopkins Hospital and School of Medicine, Baltimore, USA

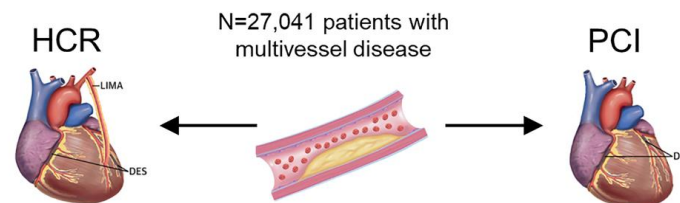
^c Department of Cardiothoracic Surgery, Lankenau Heart Institute, Main Line Health Wynnewood, PA, USA

^d Department of Cardiac Surgery Research, Lankenau Institute for Medical Research, Wynnewood, PA, USA

^e Division of Cardiac Surgery, Department of Surgery, Yale School of Medicine, New Haven, CT, USA

Methods: A systematic database search in PubMed/MEDLINE, Embase, Scopus, and CENTRAL/CCTR was conducted by June 2021. Random-effects meta-analysis was performed, comparing major adverse cardiac and cerebrovascular events (MACCE) at 30 days and at latest follow-up between patients undergoing HCR versus PCI. **Results:** A total of 27,041 patients (HCR: 939 patients, PCI: 26,102 patients) were included from seven studies published between 2013 and 2021. At latest follow-up, HCR was associated with lower rates of myocardial infarction (OR 0.40, 95% CI 0.20-0.80, $p = 0.010$) and target vessel revascularization (OR 0.49, 95% CI 0.37-0.64, $p < 0.001$), while the difference for MACCE did not reach statistical significance (OR 0.46, 95% CI 0.20-1.05, $p = 0.061$). No differences were observed in terms of 30-day outcomes, nor rates of mortality or stroke at latest follow-up.

Hybrid Coronary Revascularization versus Percutaneous Coronary Intervention: A Systematic Review and Meta-Analysis



30-day mortality, myocardial infarction, target vessel revascularization, or stroke	No difference
Myocardial infarction at follow-up	Favors HCR OR 0.40, 95% CI 0.20-0.80
Target vessel revascularization at follow-up	Favors HCR OR 0.49, 95% CI 0.37-0.64
Mortality and stroke at follow-up	No difference

Van den Eyde J *al*: *IJC Heart&Vasculature* 37 (2021) 100916

Hybridní revaskularizace

Hybrid coronary revascularization: position paper of the European Society of Cardiology Working Group on Cardiovascular Surgery and European Association of Percutaneous Cardiovascular Interventions

Matthias Thielmann ^{1a,*,†}, Nikolaos Bonaros ^{2b,*,†}, Emanuele Barbato ^{3c,d}, Fabio Barili ^{4e},
Thierry Folliguet ^{5f}, Guy Friedrich ^{6g}, Roman Gottardi ^{7h}, Jacek Legutko ⁸ⁱ,
Alessandro Parolari ^{9j}, Prakash Punjabi ^{10k,l}, Sigrid Sandner ^{11m}, Piotr Suwalski ¹²ⁿ, Sharaf-Eldin Shehata ^{13a},
Daniel Wendt ^{14o}, Martin Czerny ^{15p} and Claudio Muneretto ^{16q}

Procedural Sequence of HCR

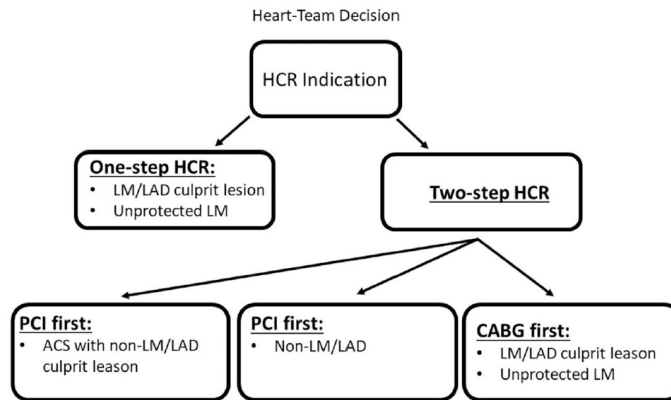


Table 3: Current indications for HCR

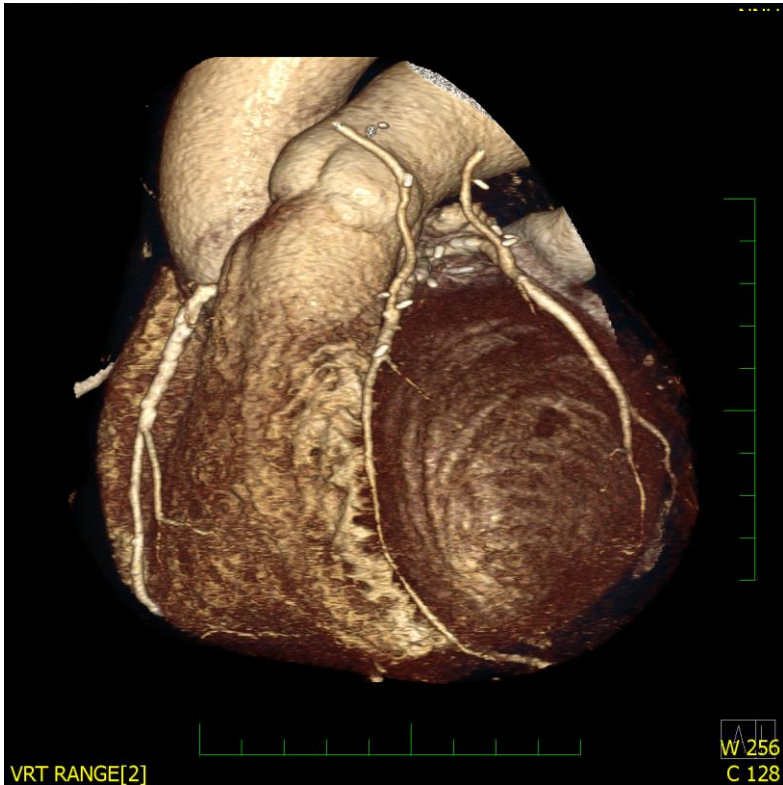
- Patients with double-vessel disease and a LAD lesion not amenable to PCI
- Patients with multivessel disease and an indication for CABG requiring complete revascularization in whom a full sternotomy is contraindicated
- Patients with multivessel disease and an indication for CABG requiring complete revascularization and lack of supplemental venous and/or arterial conduits
- Patients with multivessel disease and complex proximal LAD lesion and poor surgical targets in the circumflex (CX) or right coronary artery (RCA) territory amenable to PCI
- Patients with multivessel disease undergoing emergent culprit lesion PCI of a CX or RCA lesion and staged surgical revascularization of a residual LAD lesion
- Patients with multivessel disease and extensive atheromatous aortic disease at high risk of stroke in whom complete revascularization cannot be achieved without manipulation of the aorta

Thielmann et al: Eur J Cardiothor Surg 2024,66(2), ezae271

Chirurgická revaskularizace



Robotická revaskularizace – TECAB

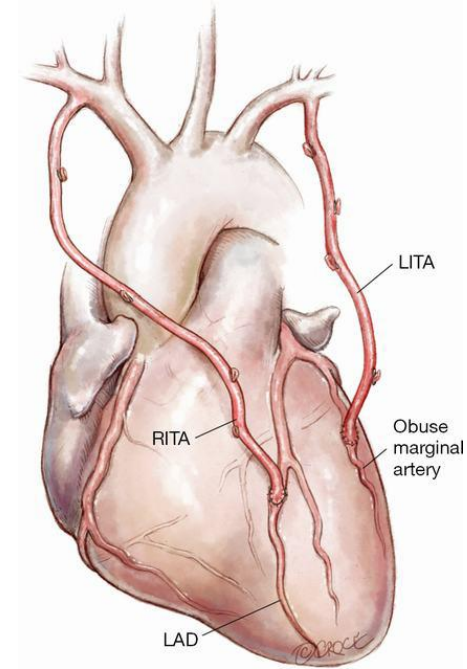


TECAB s použitím BIMA

- RIMA - RIA
- LIMA – RD, RIM, RMS, RPLS(D)
- „Right chest“ TECAB

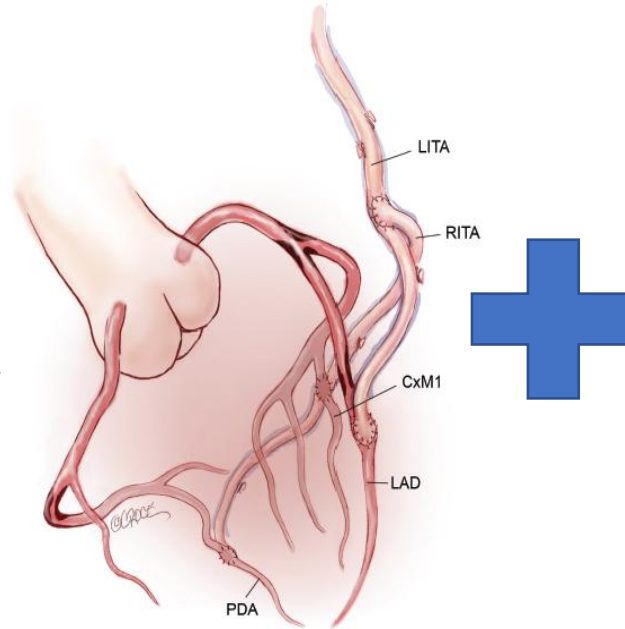
Chirurgická revaskularizace

Advanced Hybrid Procedure – TECAB BIMA + Stents

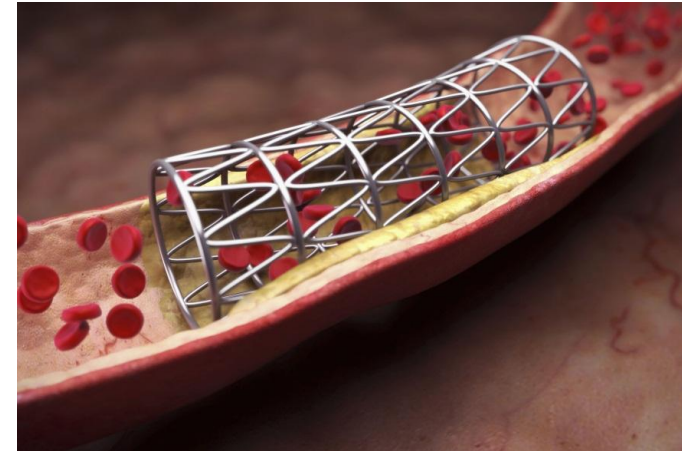


In Situ BIMA

OR



Y Graft BIMA



Chirurgická revaskularizace



Advanced Hybrid Procedure – TECAB BIMA + Stents

Robotic advanced hybrid coronary revascularization: Outcomes with two internal thoracic artery grafts and stents

Husam H. Balkhy, MD,^a Sarah Nisivaco, MD,^a Hiroto Kitahara, MD,^a Abdulrahman AbuTaleb, MD,^b Sandeep Nathan, MD,^b and Ibraheem Hamzat, BS^a

Methods: From August 2013 to February 2022, 664 patients underwent robotic totally endoscopic coronary artery bypass at our institution. Of the 293 patients who underwent totally endoscopic coronary artery bypass assigned to a hybrid revascularization strategy, 156 patients received bilateral internal thoracic artery grafts and are the subject of this review. Patients underwent percutaneous coronary intervention with drug-eluting stents before or after totally endoscopic coronary artery bypass. We reviewed early and midterm outcomes (up to 8 years) in this cohort of patients with intent-to-treat advanced hybrid coronary revascularization.

METHODS

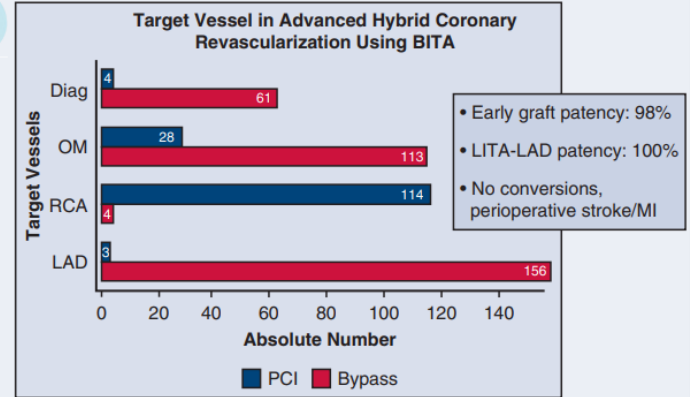
- 8/2013-2/2022, single institution
- 644 patients undergoing **TECAB** (totally endoscopic coronary artery bypass), **off-pump**, Da Vinci Si
- 294 **hybrid revascularization** patients → **156 received BITA grafts** (subject of this study)
- Early outcomes, angiographic data, & mid-term (max 8-year) follow-up

IMPLICATIONS

In selected patients with multivessel CAD, integrating robotic multi-vessel TECAB and PCI resulted in excellent early and midterm outcomes. The robotic endoscopic approach allows for the routine use of multiple arterial grafting in AHCR

What are the Outcomes when Multivessel Coronary Disease is Treated with Robotic TECAB using BITA Grafts and PCI?

RESULTS



Mean # of grafts:
2.14 ± 0.4

Mean # vessels stented:
1.23 ± 0.5

SYNTAX Score (pre):
30 ± 7.2

SYNTAX Score (post):
2.6 ± 3.0

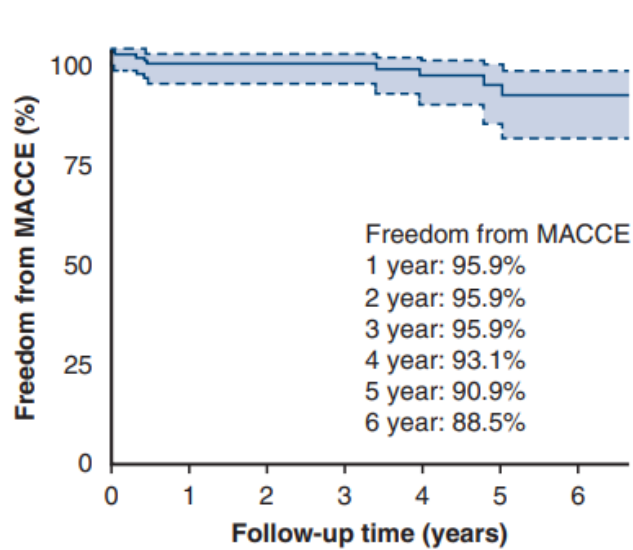
TECAB: Totally Endoscopic Coronary Artery Bypass; BITA Bilateral Internal Thoracic Arteries; PCI: Percutaneous Coronary Intervention; CAD: Coronary Artery Disease; AHCR: Advanced Hybrid Coronary Revascularization; LITA: Left Internal Thoracic Artery; LAD: Left Anterior Descending Artery; MI: Myocardial Infarction; OM: Obtuse Marginal; RCA: Right Coronary Artery

Balkhy HH et al: JTCVS Techniques 2022;16:76-88

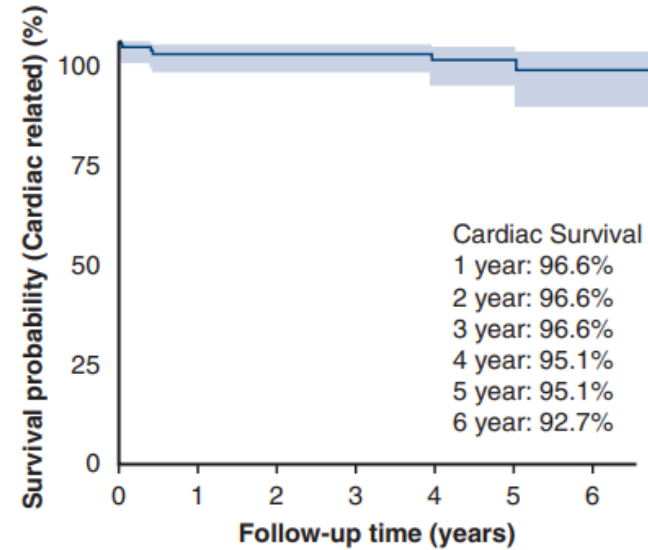
Chirurgická revaskularizace



Advanced Hybrid Procedure – TECAB BIMA + Stents



(Number at risk) 155 127 100 74 62 40 21



(Number at risk) 155 128 103 81 63 43 22

Balkhy HH et al: JTCVS Techniques 2022;16:76-88

Chirurgická revaskularizace

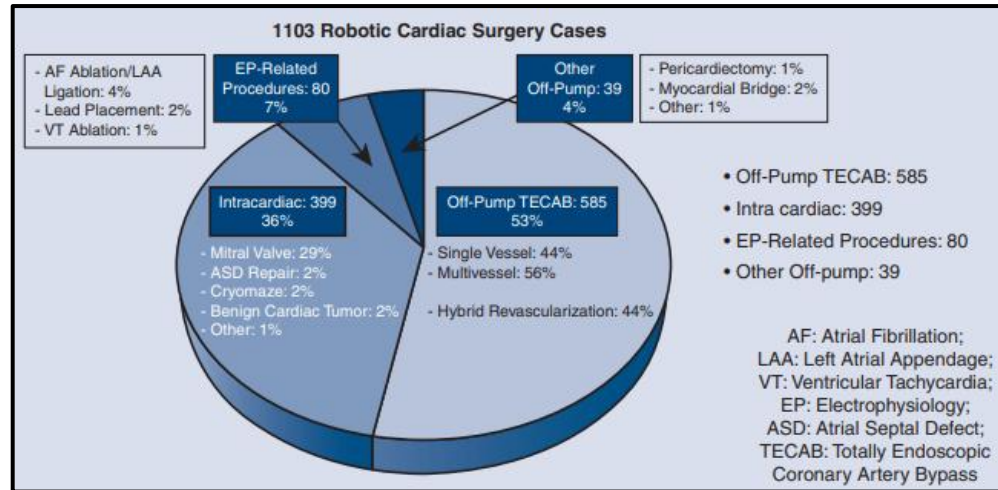


Advanced Hybrid Procedure – TECAB BIMA + Stents

Multi-spectrum robotic cardiac surgery: Early outcomes



Husam H. Balkhy, MD, Sarah Nisivaco, BS, Gianluca Torregrossa, MD, Hiroto Kitahara, MD, Brooke Patel, APN, Kaitlin Grady, PA-C, and Charocka Coleman, APN



- **1103 pacientů**
 - **TECAB 585 (53%)**
 - **Intrakardiální 399 (36%)**
 - DV MVP +/- TVP, MAZE
 - ASD, VSD atd
 - HOCM
 - AVR
 - **Elektrofyzologie 80 (7%)**
 - **Ostatní 39 (4%)**
- **Konverze 0,7%**
- **Revize 2,2%**
- **Mortalita 1,2%**
- **CMP 0,6%**


Balkhy H et al: JTCVS Techniques 2022;13:74-82

Chirurgická revaskularizace



Advanced Hybrid Procedure – TECAB BIMA + Stents

A Shifting Paradigm in Robotic Heart Surgery: From Single-Procedure Approach to Establishing a Robotic Heart Center of Excellence

Husam H. Balkhy¹, MD, Andrea Amabile¹, MD , and Gianluca Torregrossa¹, MD

Innovations

2020, Vol. 15(3) 187–194

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Chirurgická revaskularizace

Advanced Hybrid Procedure – TECAB BIMA + Stents



Sternotomy
CABG
Multiarterial
Off Pump

Sternotomy
CABG on
pump
LIMA + SVG

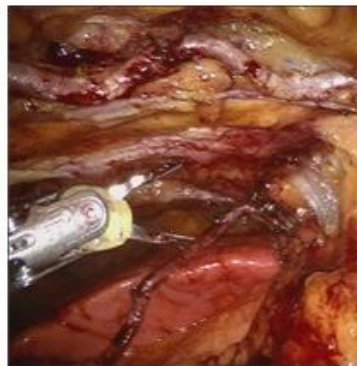


CABG Center of Excellence

Robotic
CABG
Multiarterial
BIMA

Robotic
CABG
Hybrid
LIMA-RIA +
stent

Robotic
CABG LIMA -
RIA



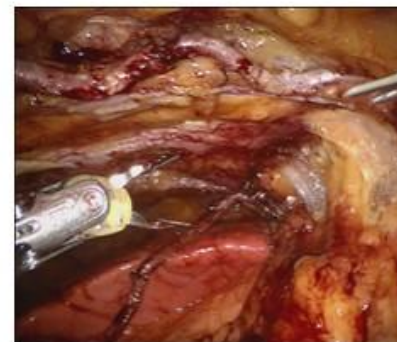
Chirurgická revaskularizace

Advanced Hybrid Procedure – TECAB BIMA + Stents



Avoid
peripheral
cannulation
in
Vasculopath
ic patients

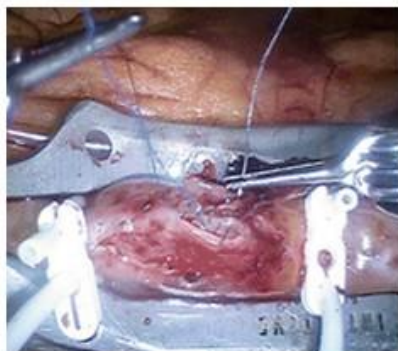
OFF PUMP
Aortic:
Nullify risk
of Stroke
and DWI



Robotic TECAB BIMA
Off Pump

Advanced
Hybris with
BIMA +
Stent

Democratize
use of BIMA
in all comers
(Hba1c,
BMI, COPD)



Increase
versatility
with precise
deployment
of IMAs



Chirurgická revaskularizace



TECAB centra celosvětově

TECAB SURGEONS
1/2026
n=17

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Teams India

Sathyaki Nambala
Apollo Hospital
Bengaluru

Kelsey Gray
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Gianluca Torregrossa
Lankenau
Heart Institute

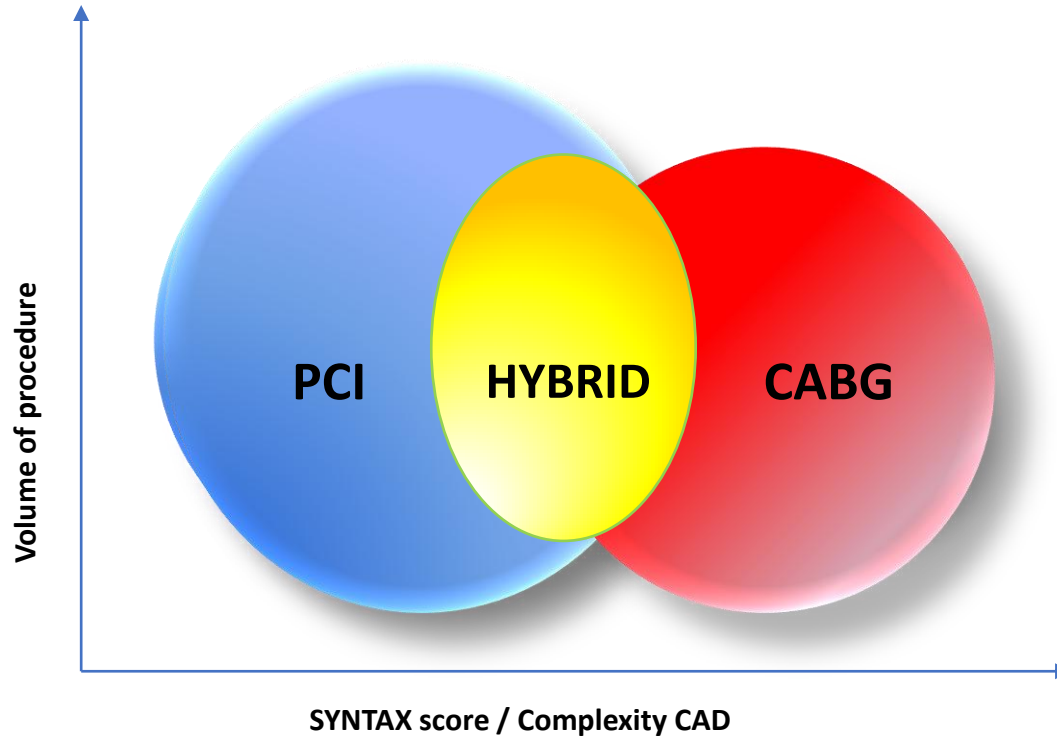
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UPMC HEART AND VASCULAR INSTITUTE

Chirurgická revaskularizace

Advanced Hybrid Procedure – TECAB BIMA + Stents



- **Koncept chirurgické arteriální kolateralizace znamená změnu paradigmatu v chirurgické léčbě ICHS a může znamenat i změnu pohledu na prevenci fatálních a nonfatálních IM**
- **Při multiarteriální revaskularizaci hraje roli počet arteriálních štěpů a výběr cílového teritoria, nikoliv kompletnost revaskularizace**
- **Robotické přístupy k revaskularizaci myokardu umožňují plné zachování této filozofie**
- **Chirurgická léčba ICHS ve 21. století půjde cestou pokročilých robotických hybridních revaskularizací (BIMA + stenty)**

Děkuji za pozornost !!!!