



CABG Helps People Live Longer

S. Chris Malaisrie, MD

Professor of Surgery

Program Director, Thoracic Surgery Residency and Fellowship

Division of Cardiac Surgery

Northwestern University Feinberg School of Medicine

Attending Cardiac Surgeon

Co-Director of Thoracic Aortic Surgery

Associate Director of Center for Heart Valve Disease

Bluhm Cardiovascular Institute

Northwestern Medicine, Northwestern Memorial Hospital

Co-Chair of AATS Cardiac Clinical Practice Standards Committee

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Overview

- Evidence supporting survival benefit of CABG for multivessel disease compared to medical therapy
- Evidence supporting survival benefit of CABG for left main CAD compared to medical therapy
- Evidence supporting survival benefit of CABG for left main CAD or multivessel disease compared to PCI



Is there a survival benefit to CABG compared to medical therapy for multivessel disease?





US and EU guidelines differ...

US 7.1 Revascularization to Improve Survival in SIHD Compared With Medical Therapy

2b	B-R	5. In patients with SIHD, normal ejection fraction, significant stenosis in 3 major coronary arteries (with or without proximal LAD), and anatomy suitable for CABG, CABG may be reasonable to improve survival (10,13-15).
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EU 5. Revascularization for stable coronary artery disease

Proximal LAD stenosis >50%. ^{c 62,68,70,72}	I	A
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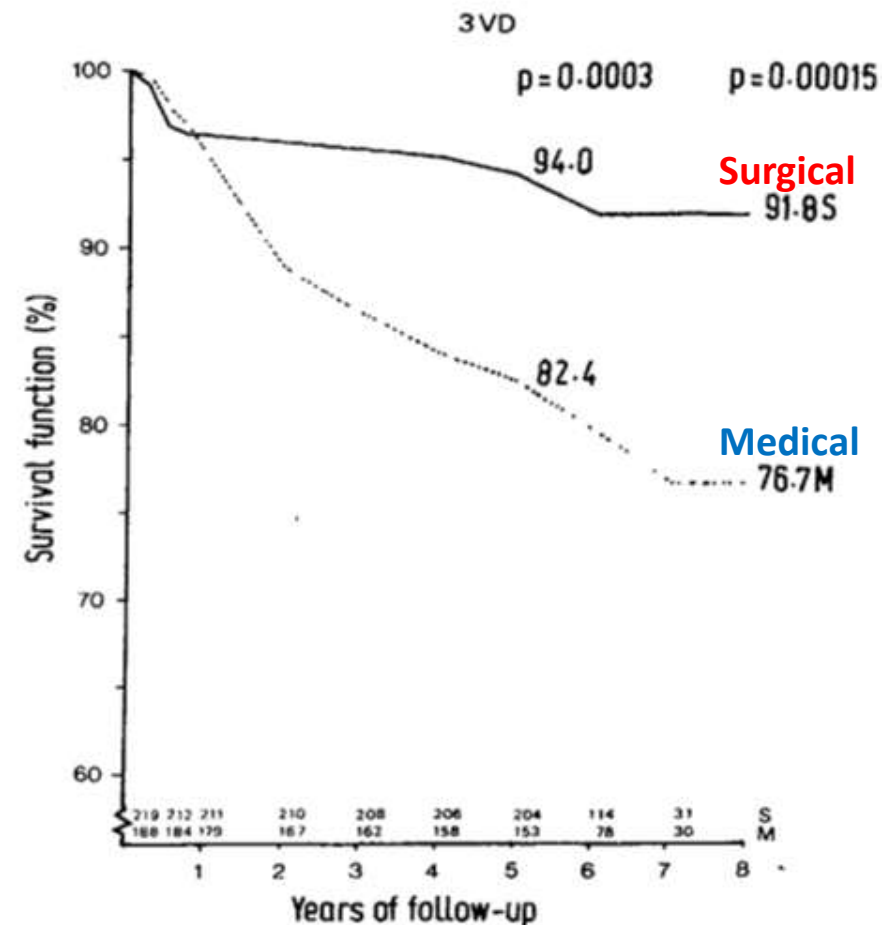


Classical evidence

“Long-term results of prospective randomised study of coronary artery bypass surgery in stable angina pectoris”

ECSS Group **Lancet 1982 Nov 27;2(8309):1173-80**

- **ECSS study** consisting of 768 men under 65 years old with mild to moderate angina, 50% or greater stenosis in at least 2 major coronary arteries, and good LV function were randomly assigned to CABG surgery and no treatment groups, concluded that there was a significantly higher survival rate in patients with multivessel disease in the surgery group after 5 years.

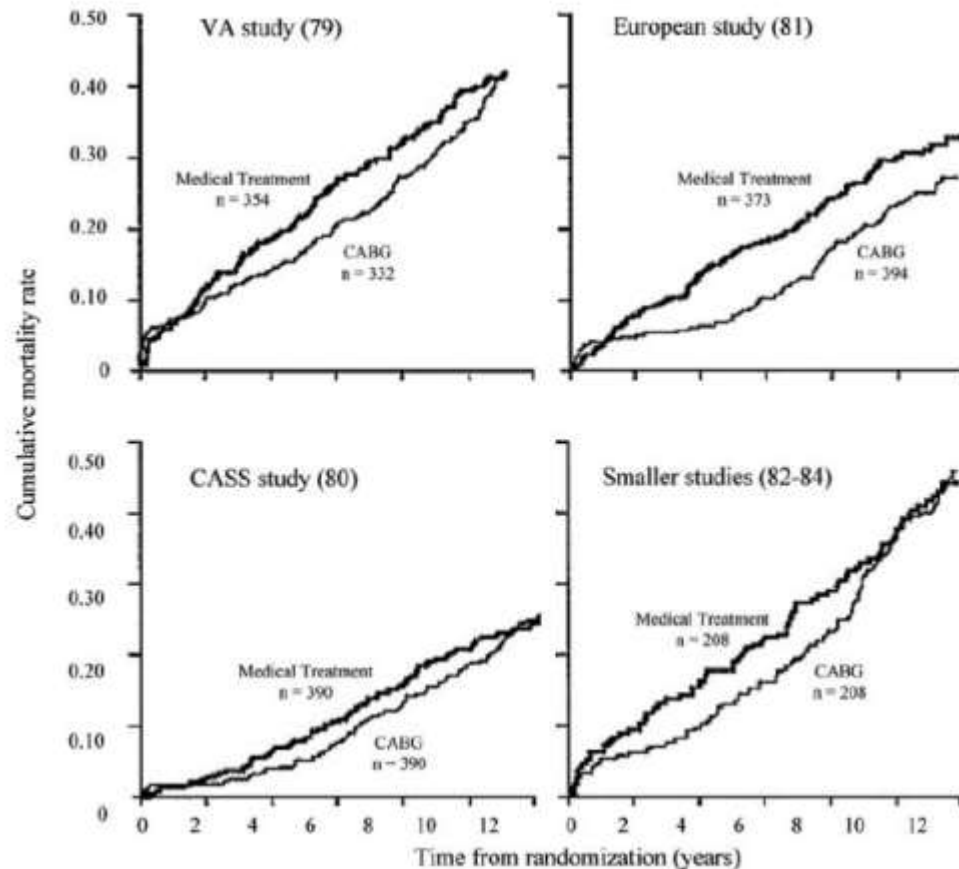




Classical evidence

“Effect of coronary artery bypass graft surgery on survival...”

Yusuf et al. **Lancet 1994;344:563-570**



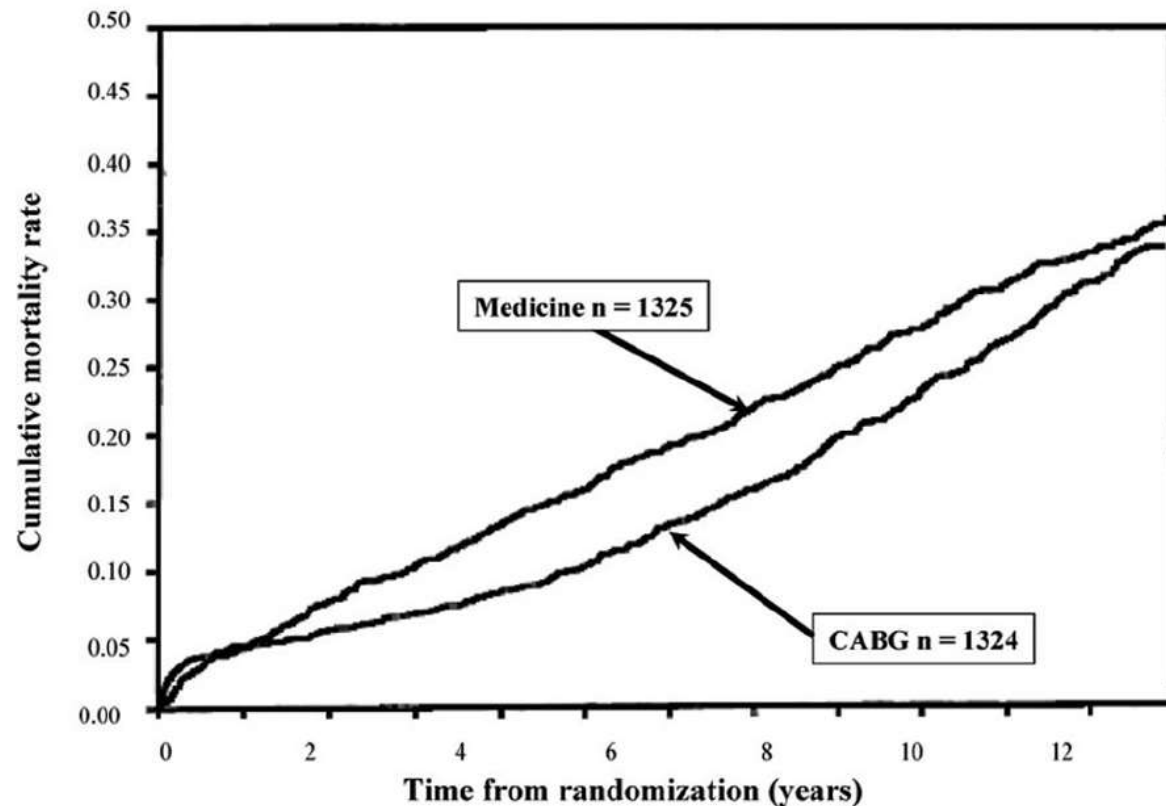
- **Yusuf** meta-analysis collecting 2,649 patients with stable coronary artery disease that were randomly assigned to CABG surgery or medical treatment, showed improved survival in the CABG group over 10 years, especially with patients with complex disease (left main and 3 vessel CAD).



Classical evidence

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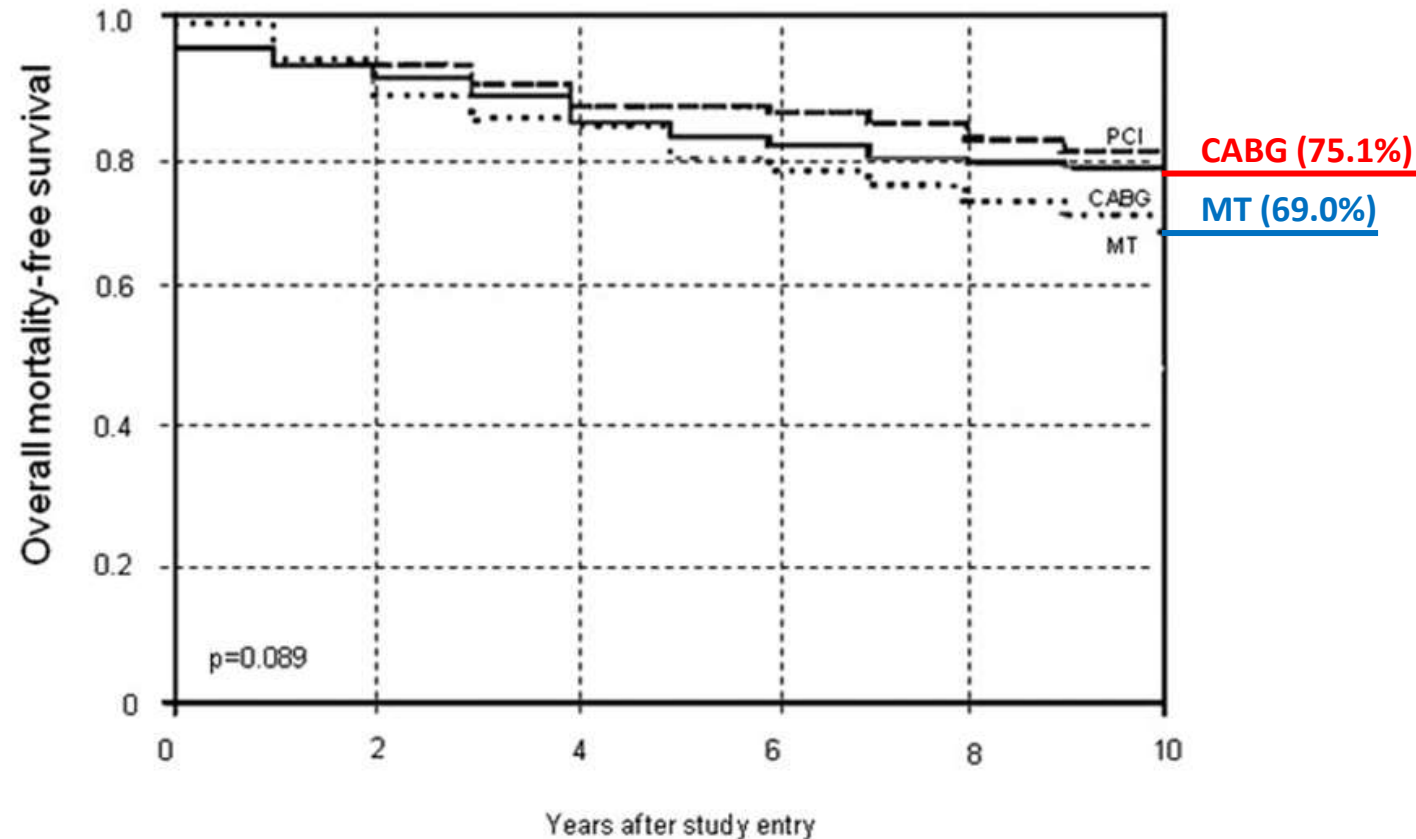


Modern evidence

“Ten-Year Follow-Up Survival of the Medicine, Angioplasty, or Surgery Study (MASS II)”

Hueb et al. [Circulation 2010;122:949-957](#)

- **MASS II** study where 611 patients were randomly assigned to CABG, PCI, and medical treatment groups; study concluded that, over 10 years, CABG had lower incidence of MI, repeat revascularization, and cardiac death compared to medical therapy.





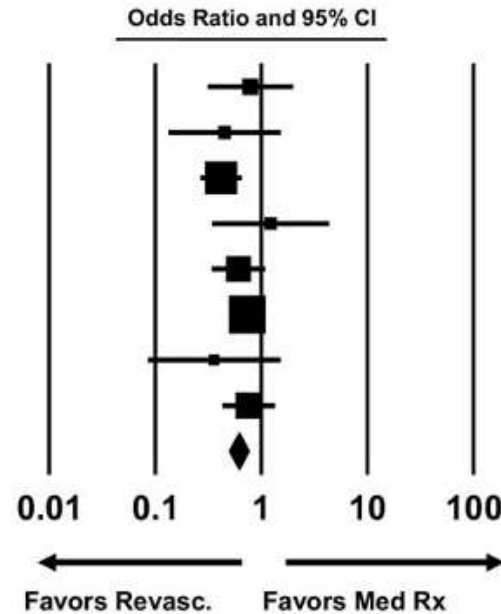
Modern evidence

“The Impact of Revascularization on Mortality in Patients with Nonacute Coronary Artery Disease”

Jeremias et al. *Am J Med* 2009;122:152-161

CABG vs Medical therapy

Study Name	OR	Lower Limit	Upper Limit
Mathur et al	0.79	0.32	1.96
Kloster et al	0.45	0.14	1.50
ECSS	0.42	0.27	0.64
Norris et al	1.22	0.35	4.26
CASS	0.61	0.35	1.07
VA Cooperative Study	0.74	0.51	1.07
MASS I (CABG)	0.36	0.09	1.49
MASS II (CABG)	0.76	0.44	1.32
Combined	0.62	0.50	0.77



- **Jeremias** meta-analysis of 28 studies consisting of 13,121 patients were randomized to revascularization and medical therapy groups, concluded that revascularization (CABG or PCI) resulted in a reduction in mortality compared to medical therapy alone.

AHA/ACC reasoning for downgrade

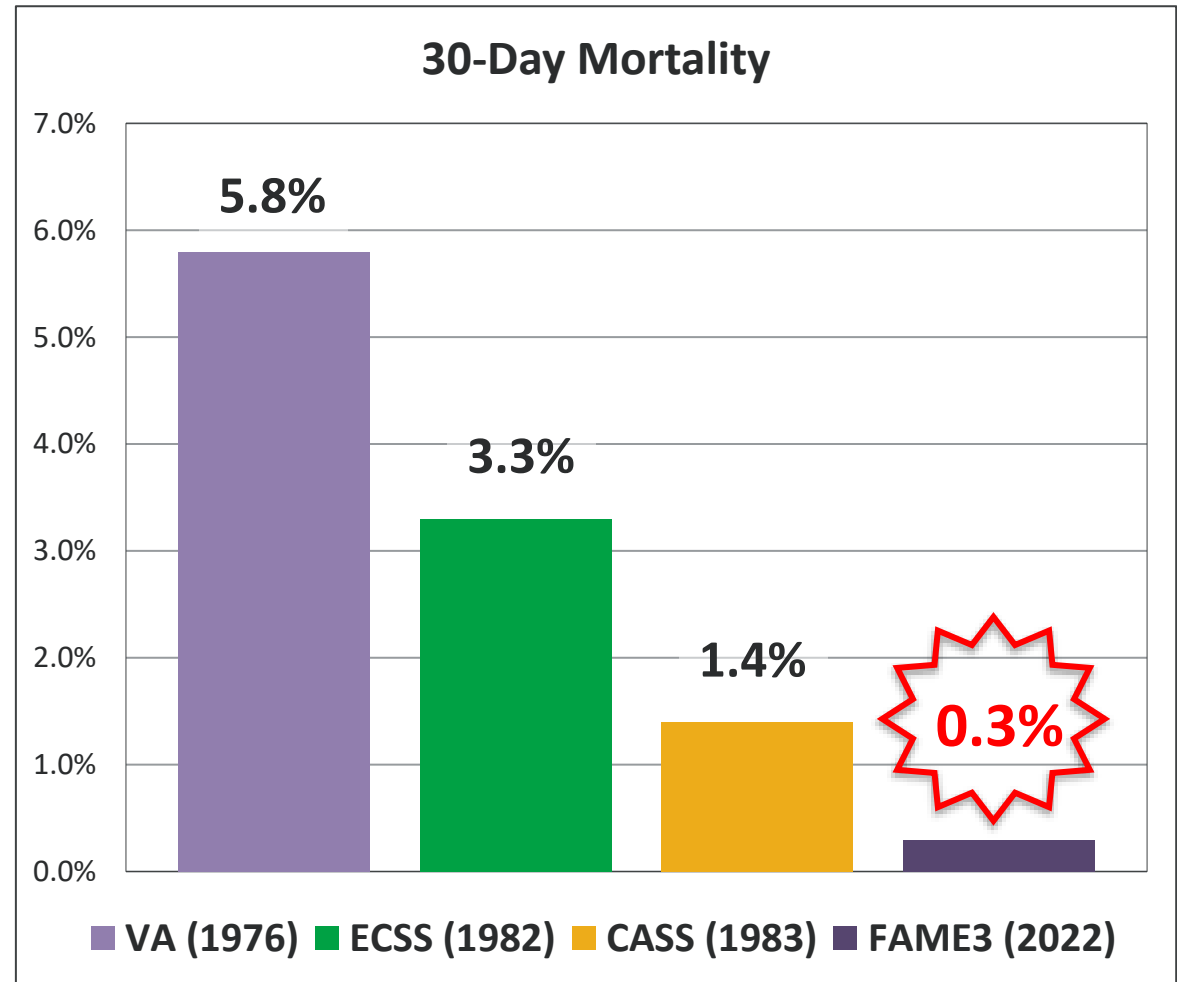


- “The older recommendation was based on evidence from registry studies, a meta-analysis, and a single RCT, all of which were completed >20 to 40 years ago...” **Not true**
- “...before the widespread use of antiplatelet and statin therapies and before the broad recognition of benefit from beta-blockers and ACE inhibitors/ARBs.” **Agree**
- “...before the development of newer surgical techniques” **Undervalued**

Advances in CABG are undervalued



- When comparing the historical studies to the FAME3 study, the advancements in CABG surgery are clear.
- A reduction from 5.8, 3.3%, and 1.4% to 0.3% 30-day mortality.



FAME3: CABG vs PCI 30-day mortality



Table S4. Other secondary outcomes

	PCI (n=757)	CABG (n=743)	Hazard Ratio (95% CI)
Primary endpoint at 30 Days			
MACCE	25 (3.3)	23 (3.1)	1.1 (0.6, 1.9)
Secondary endpoints at 30 Days			
Death	2 (0.3)	2 (0.3)	1.0 (0.1, 7.1)
Cardiac death	1 (0.1)	1 (0.1)	
Myocardial infarction (MI)	19 (2.5)	15 (2.0)	1.3 (0.7, 2.6)
Stroke	3 (0.4)	4 (0.5)	0.7 (0.2, 3.3)
Repeat revascularization	4 (0.5)	11 (1.5)	0.4 (0.1, 1.1)
Cardiac death or MI	20 (2.6)	16 (2.2)	1.3 (0.7, 2.5)
Cardiac death, MI, stroke, or repeat revascularization	25 (3.3)	22 (3.0)	1.2 (0.6, 2.1)
Other secondary endpoints at 1 year			
Death or MI	51 (6.7)	32 (4.3)	1.6 (1.0, 2.5)
Cardiac death or MI	45 (5.9)	29 (3.9)	1.6 (1.0, 2.5)
Cardiac death, MI, stroke, or repeat revascularization	75 (9.9)	49 (6.6)	1.5 (1.0, 2.2)
Rehospitalization	139 (18.4)	158 (21.3)	N/A



AMERICAN ASSOCIATION
FOR THORACIC SURGERY
A Century of Modeling Excellence



“The American Association for Thoracic Surgery (AATS) and The Society of Thoracic Surgeons (STS) have decided not to endorse the 2021 ACC/AHA/SCAI Coronary Artery Revascularization Guidelines as they do not reflect our interpretation of the best treatment for patients with ischemic heart disease.”

-Sabik, Bakaeen et al. JTCVS 2022



Survival benefit of CABG vs medical therapy for MVD



American Heart Association.



AMERICAN COLLEGE of CARDIOLOGY

COR 2b, LOE B-R

AATS/STS did not endorse



EACTS
European Association For Cardio-Thoracic Surgery

COR 1, LOE A



ESC
European Society of Cardiology

Is there a survival benefit to CABG compared to medical therapy for left main CAD?





Guidelines differ

US 7.1 Revascularization to Improve Survival in SIHD Compared With Medical Therapy

1	B-R	3. In patients with SIHD and significant left main stenosis, CABG is recommended to improve survival (9-12).
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EU 5. Revascularization for stable coronary artery disease

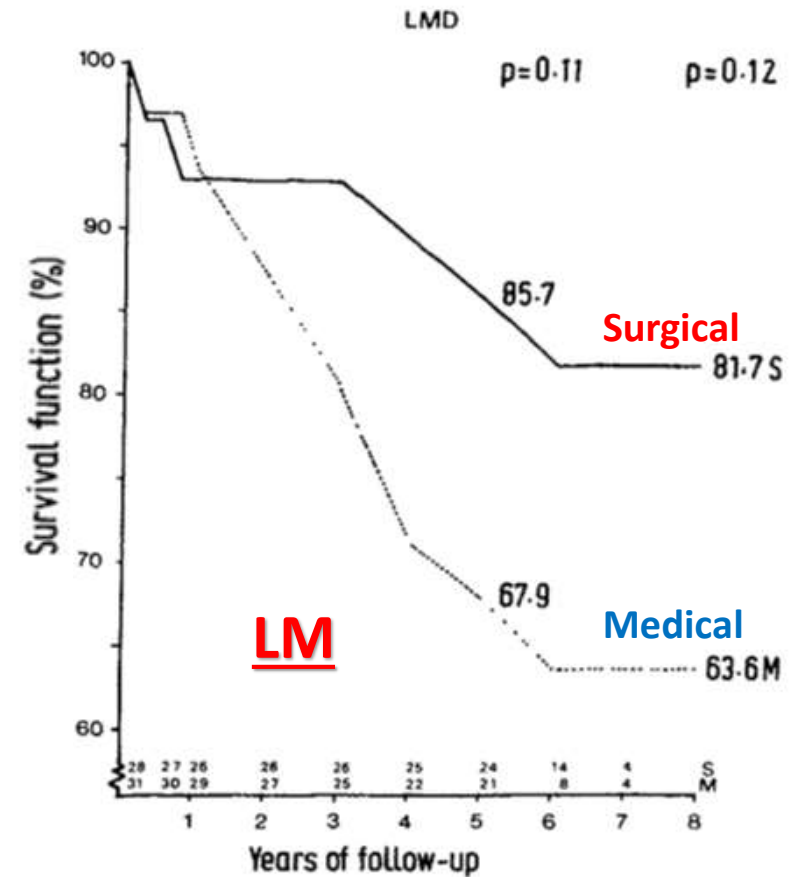
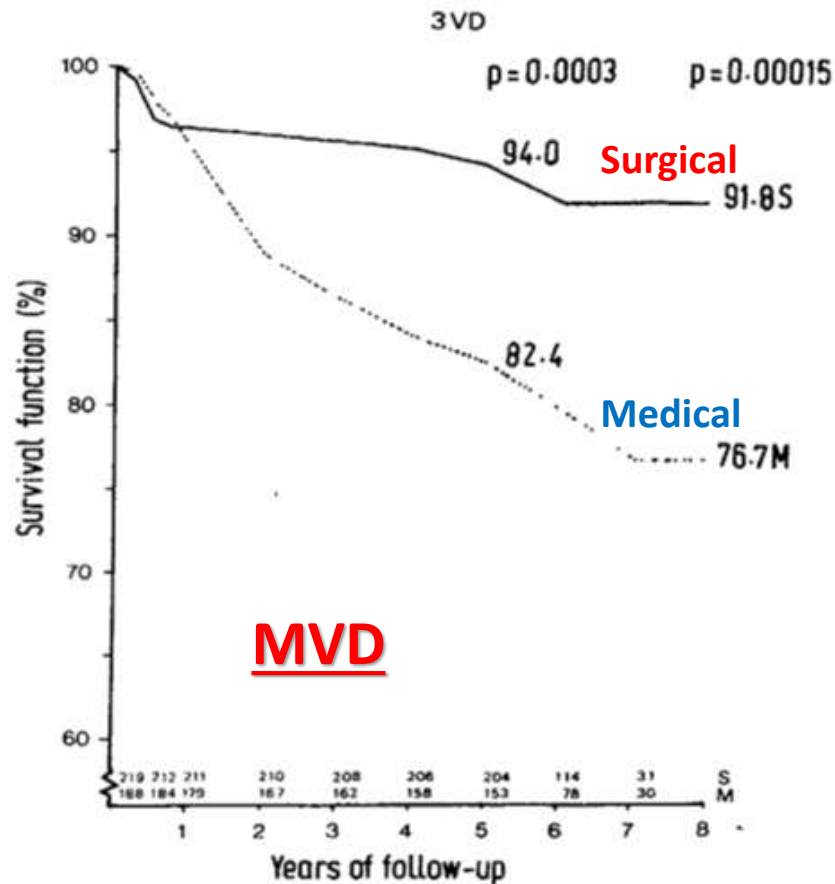
Left main disease with stenosis >50%. ^{c 68-71}	I	A
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Classical evidence

“Long-term results of prospective randomised study of coronary artery bypass surgery in stable angina pectoris”

ECSS Group **Lancet 1982 Nov 27;2(8309):1173-80**



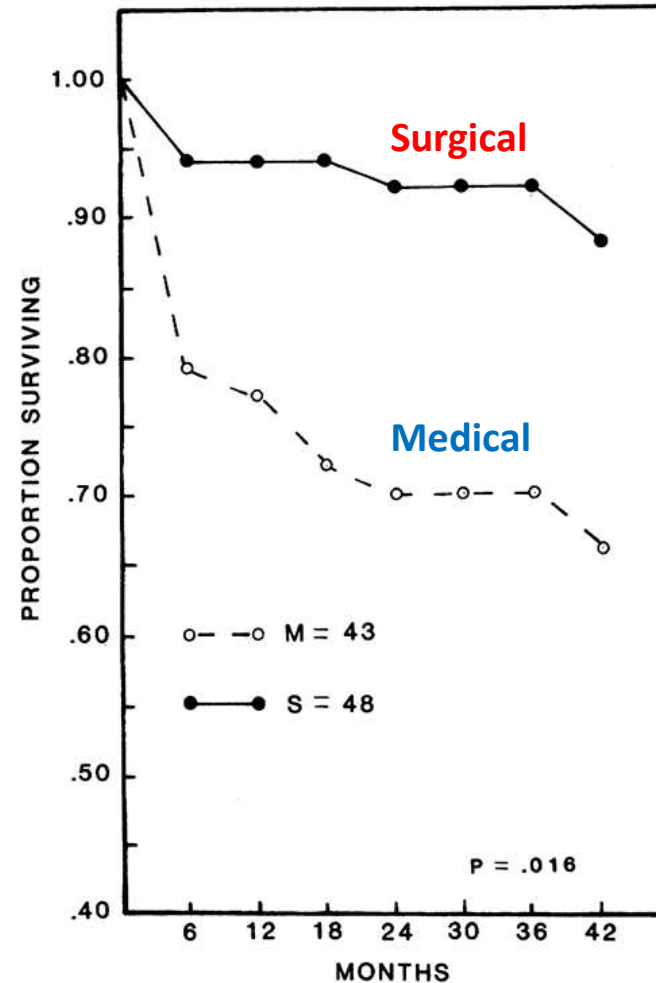


Classical evidence

“Survival in Subgroups of Patients with Left Main Coronary Artery Disease
Veterans Administration Cooperative Study of Surgery for Coronary Arterial
Occlusive Disease”

Takaro et al. **Circulation** 1982;66:14-22

- **VA** report on 91 patient with left main coronary artery stenosis from the Veterans Administration Cooperative Study of Coronary Bypass Surgery, found that survival was significantly better in patients treated with CABG compared to medical therapy.

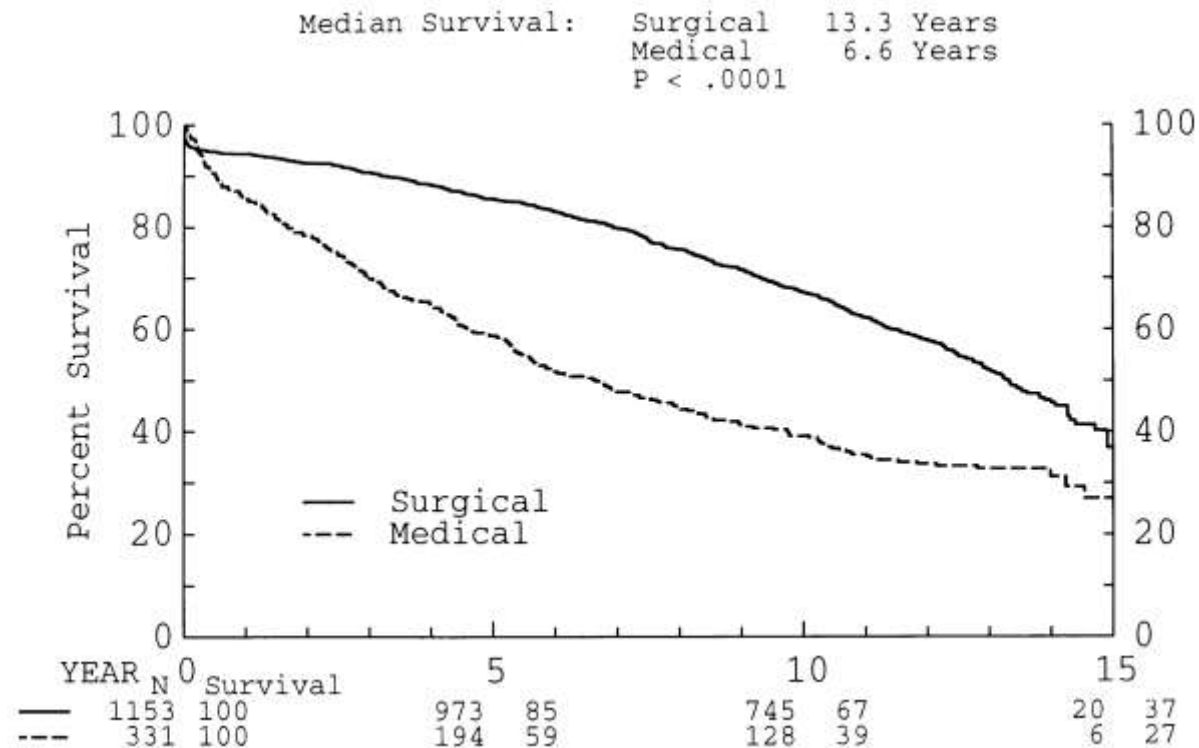




Classical evidence

“Comparison of Surgical and Medical Group Survival in Patients With Left Main Coronary Artery Disease”

Caracciolo et al. **Circulation**. 1995;91:2325–2334



- **CASS** follow up of 1,484 patients from the CASS registry with $\geq 50\%$ left main CAD stenosis who were either treated surgically or non-surgically; after 15 years, the study found increase survival in the surgical group compared to the medical group.

Future studies



- “Although the evidence to support revascularization with CABG is derived mainly from older RCTs, there are no new data to refute this evidence, as all of the contemporary clinical trials comparing revascularization with medical therapy have excluded patients with significant stenoses of the left main artery.”

ISCHEMIA Trial

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812

APRIL 9, 2020

VOL. 382 NO. 15

Initial Invasive or Conservative Strategy for Stable Coronary Disease

D.J. Maron, J.S. Hochman, H.R. Reynolds, S. Bangalore, S.M. O'Brien, W.E. Boden, B.R. Chaitman, R. Senior, J. López-Sendón, K.P. Alexander, R.D. Lopes, L.J. Shaw, J.S. Berger, J.D. Newman, M.S. Sidhu, S.G. Goodman, W. Ruzyllo, G. Gosselin, A.P. Maggioni, H.D. White, B. Bhargava, J.K. Min, G.B.J. Mancini, D.S. Berman, M.H. Picard, R.Y. Kwong, Z.A. Ali, D.B. Mark, J.A. Spertus, M.N. Krishnan, A. Elghamaz, N. Moorthy, W.A. Hueb, M. Demkow, K. Mavromatis, O. Bockeria, J. Peteiro, T.D. Miller, H. Szwed, R. Doerr, M. Keltai, J.B. Selvanayagam, P.G. Steg, C. Held, S. Kohsaka, S. Mavromichalis, R. Kirby, N.O. Jeffries, F.E. Harrell, Jr., F.W. Rockhold, S. Broderick, T.B. Ferguson, Jr., D.O. Williams, R.A. Harrington, G.W. Stone, and Y. Rosenberg, for the ISCHEMIA Research Group*

Most enrolled trial patients underwent coronary computed tomographic (CT) angiography to rule out left main coronary disease and nonobstructive coronary disease. The primary exceptions



Survival benefit of CABG over medical therapy for LM CAD



COR 1, LOE **B-R** ???



COR 1, LOE A

Is there a survival benefit of CABG
for multivessel disease or left main
CAD compared to PCI?





CABG vs PCI for the treatment of multivessel disease

US 8.1 Patients With Complex Disease

2a

B-R

2. In patients who require revascularization for multivessel CAD with complex or diffuse CAD (e.g., SYNTAX score >33), it is reasonable to choose CABG over PCI to confer a survival advantage (2-5).

EU 5.3 Percutaneous coronary intervention vs. coronary artery bypass grafting

	CABG		PCI	
Three-vessel CAD without diabetes mellitus				
Three-vessel disease with low SYNTAX score (0 - 22). ^{102,105,121,123,124,135,149}	I	A	I	A
Three-vessel disease with intermediate or high SYNTAX score (>22). ^{c 102,105,121,123,124,135,149}	I	A	III	A

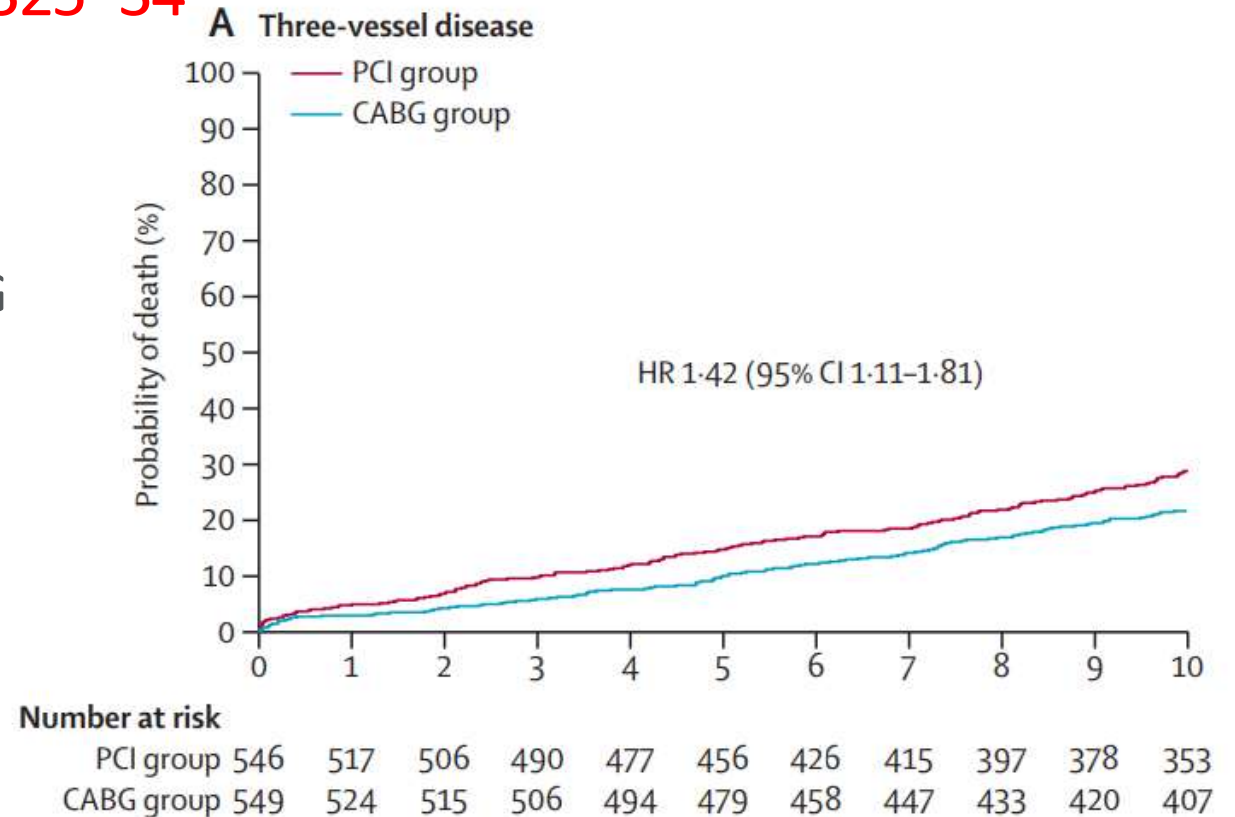


Evidence in support of CABG for MVD

“Percutaneous coronary intervention versus coronary artery bypass grafting in patients with three-vessel or left main coronary artery disease: 10-year follow-up of the multicentre randomised controlled SYNTAX trial”

Thuijs et al. **Lancet 2019; 394: 1325–34**

- **SYNTAX** 10 year follow up of 1,800 patients who were randomly assigned to PCI or CABG treatment groups, found a significant survival benefit of CABG for the treatment of multivessel disease.





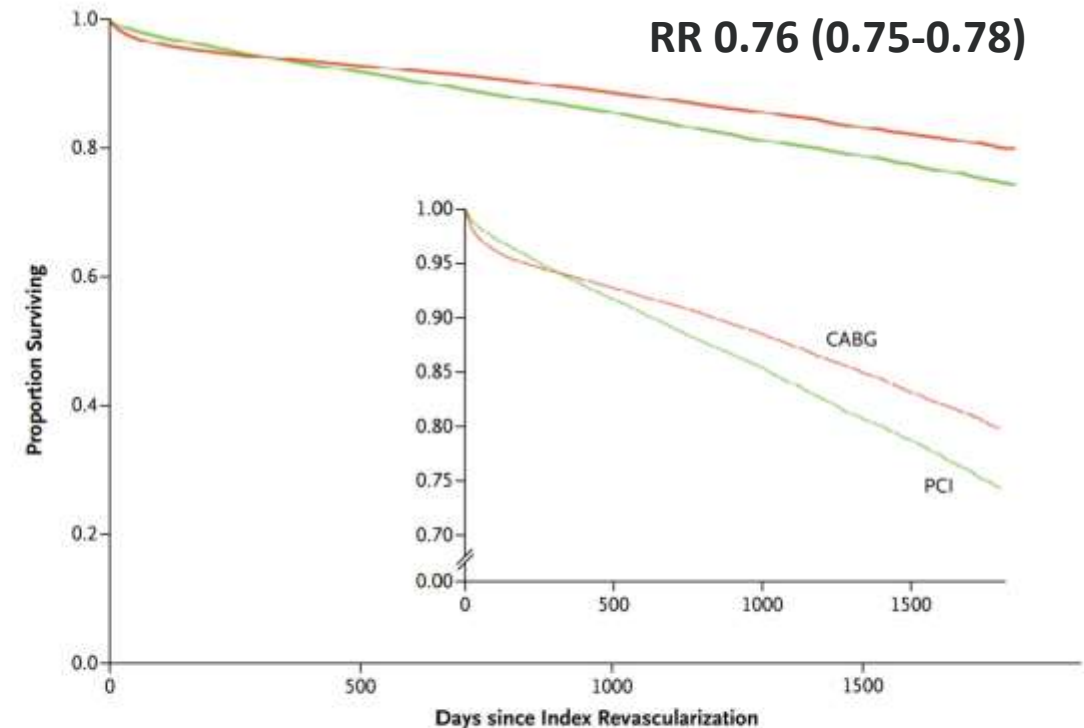
Evidence in support of CABG for MVD

“Comparative Effectiveness of Revascularization Strategies”

Weintraub et al. **N Engl J Med** 2012; 366:1467-1476

- **ASCERT** observational study consisting of 189,793 patients with 2 or 3 vessel CAD who underwent CABG or PCI; after 1 year, results were similar but after 4 years, the study concluded that there was lower mortality with CABG than with PCI.

16.0% CABG vs 20.9% PCI
RR 0.76 (0.75-0.78)



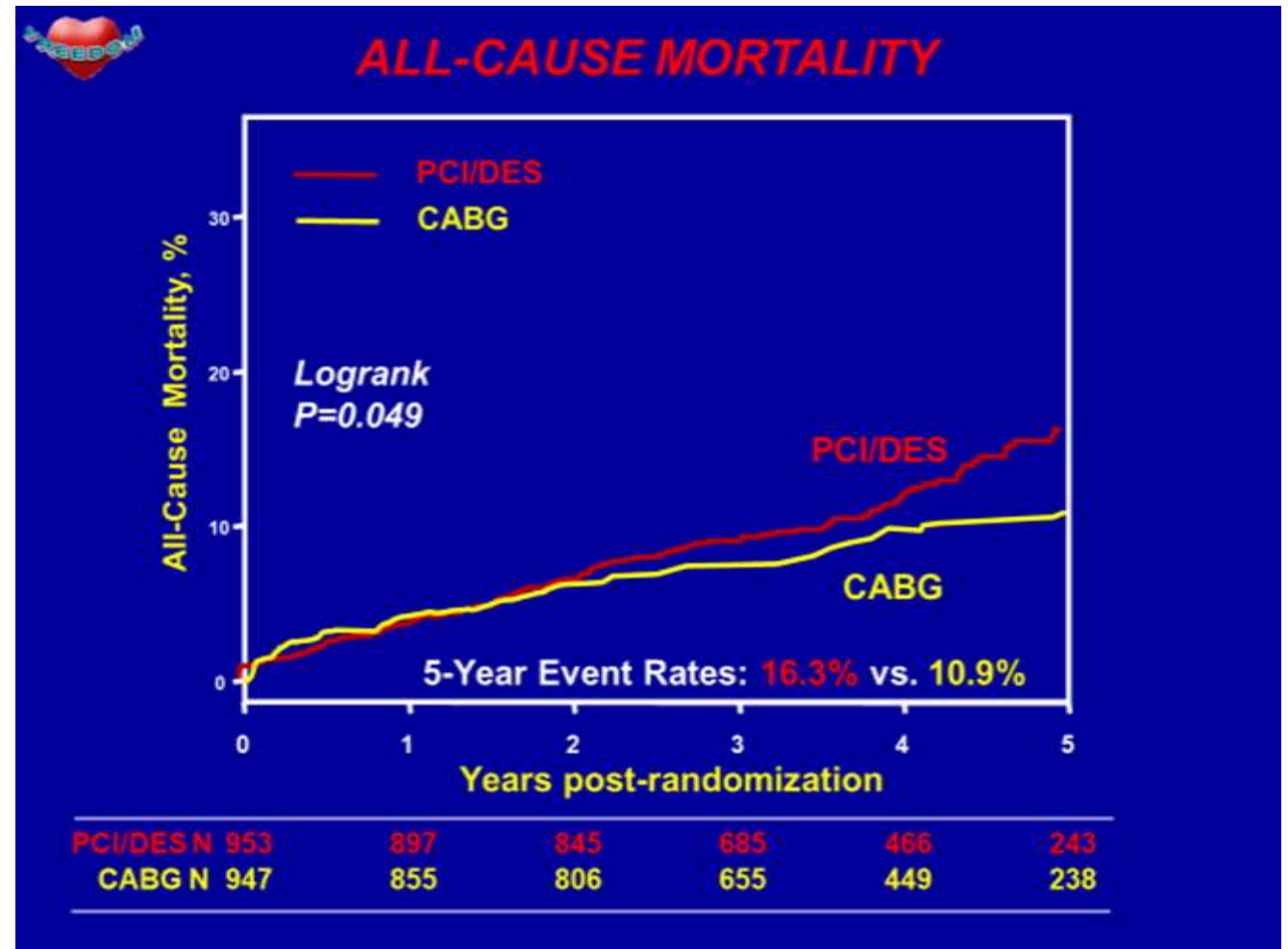
	30-Day	1-Yr	2-Yr	3-Yr	4-Yr
Mortality after CABG, % (95% CI)	2.07 (1.98–2.17)	6.00 (5.58–6.17)	8.76 (8.56–8.94)	12.1 (11.9–12.4)	16.0 (15.7–16.3)
Mortality after PCI, % (95% CI)	1.21 (1.14–1.27)	6.36 (6.22–6.51)	11.2 (11.0–11.4)	16.0 (15.7–16.2)	20.9 (20.6–21.3)
Relative risk with CABG (95% CI)	1.72 (1.58–1.84)	0.94 (0.91–0.97)	0.78 (0.76–0.80)	0.76 (0.74–0.78)	0.76 (0.75–0.78)



Evidence in support of CABG for MVD

“Strategies for Multivessel Revascularization in Patients with Diabetes”
Farkouh et al. **N Engl J Med** 2012;367:2375-84

- **FREEDOM** study following 1,900 patients with MVD and diabetes divided into CABG and PCI treatment groups, found that, after 5 years, CABG led to a significantly lower mortality rate compared to PCI.



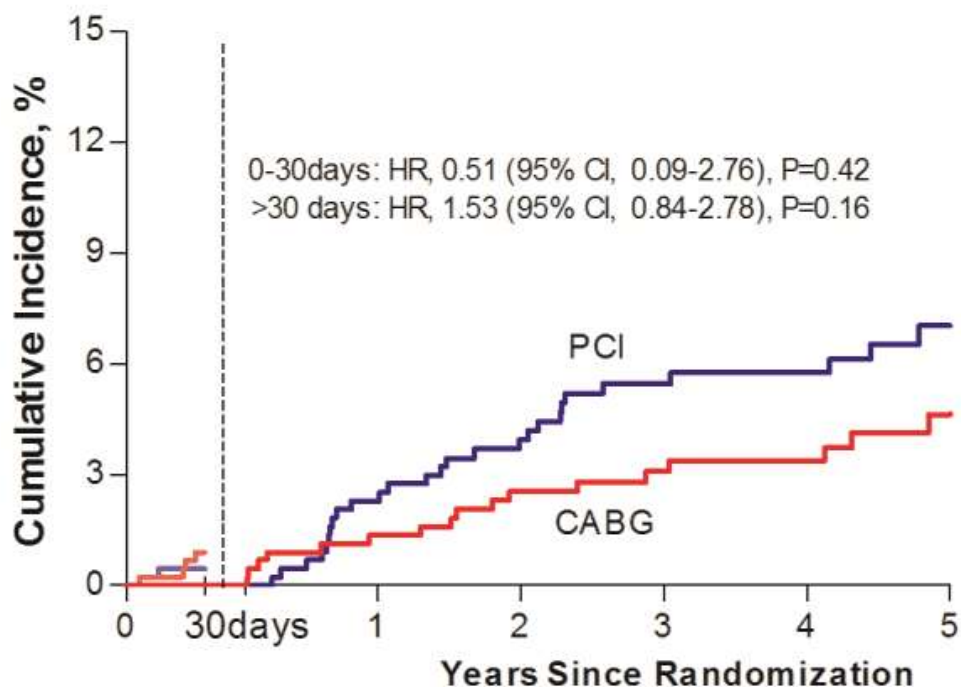


Evidence in support of CABG for MVD

“Trial of Everolimus-Eluting Stents or Bypass Surgery for Coronary Disease”

Park et al. *N Engl J Med* 2015;372:1204-12

(A) Death from any cause



- **BEST** trial consisting of 880 patients with multivessel disease randomly assigned to PCI and CABG treatment groups; after a median of 4.6 years follow up, results of the primary end point showed a higher rate of adverse events in the PCI treated group.

Survival benefit of CABG over PCI for multivessel CAD



COR 2a, LOE B

AATS/STS did not endorse



COR 1, LOE A



CABG vs PCI for the treatment of LM CAD

US 8.1 Patients With Complex Disease

1	B-R	1. In patients who require revascularization for significant left main CAD with high-complexity CAD, it is recommended to choose CABG over PCI to improve survival (1,2).
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EU 5.3 Percutaneous coronary intervention vs. coronary artery bypass grafting

	CABG		PCI	
Left main CAD				
Left main disease with low SYNTAX score (0 - 22). ^{69,121,122,124,145-148}	I	A	I	A
Left main disease with intermediate SYNTAX score (23 - 32). ^{69,121,122,124,145-148}	I	A	IIa	A
Left main disease with high SYNTAX score (≥ 33). ^{c 69,121,122,124,146-148}	I	A	III	B

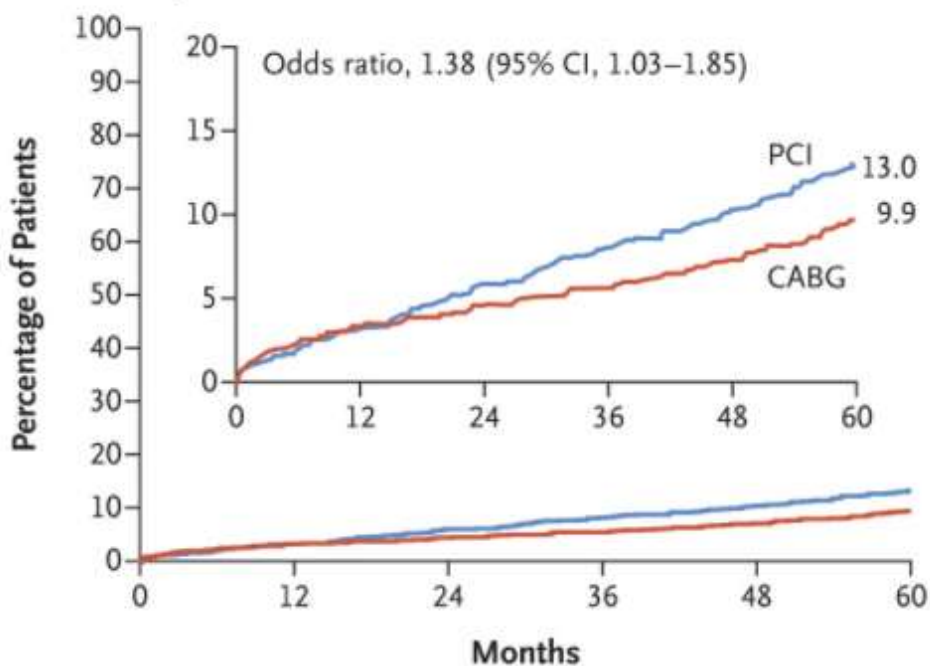


Evidence in support of CABG for LM CAD

“Five-Year Outcomes after PCI or CABG for Left Main Coronary Disease”

Stone et al. **N Engl J Med** 2019;381:1820-30

A Death from Any Cause



- The 5 year results on the EXCEL trial, consisting of 1,905 patients with left main coronary artery disease divided into PCI and CABG treated groups, showed overall mortality was higher in the PCI treated group.

No. at Risk

PCI	948	902	868	841	810	545
CABG	957	889	865	844	815	596



“Council withdrew its support from the current recommendations on treatment of left main disease in the 2018 joint ESC-EACTS Myocardial Revascularization Guidelines.”

Survival benefit of CABG over PCI for left main CAD



COR 1, LOE B

EACTS did not endorse



COR 1, LOE A for CABG
COR 1, LOE A for PCI (SYNTAX <22)



Conclusion

1. Evidence demonstrates survival benefit for CABG over medical in both MVD and LM CAD
2. Guidelines differ in the interpretation of the data and appear to undervalue the benefit of CABG
3. AATS/STS and EACTS have not endorsed their respective continental CPG