My Approach to Multi-Vessel Disease

Insight From ISCHEMIA study

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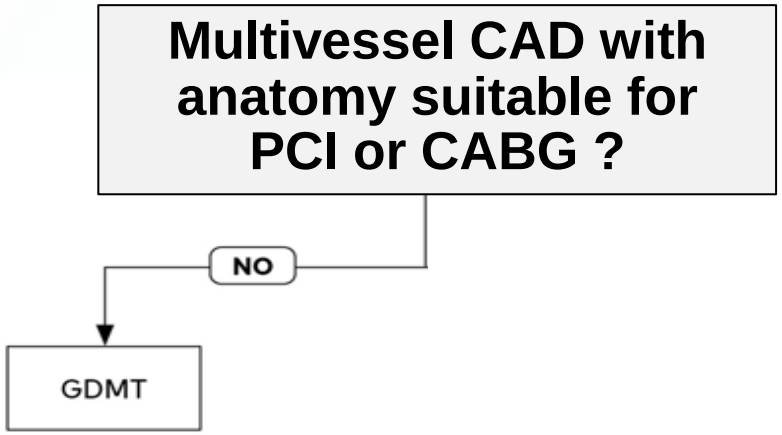
ESC Guidelines 2018
Elective PCI for 3 Vessel Disease

	CABG		PCI	
3-VD without Diabetes Mellitus	**Class**	**Level**	**Class**	**Level**
3 VD with low SYNTAX score (0-22)	**I**	**A**	**I**	**A**
3 VD with intermediate of high SYNTAX score (>22)	**I**	**A**	**III**	**A**
3-VD with Diabetes Mellitus				
3 VD with low SYNTAX score (0-22)	**I**	**A**	**IIb**	**A**
3 VD with intermediate of high SYNTAX score (>22)	**I**	**A**	**III**	**A**

2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization



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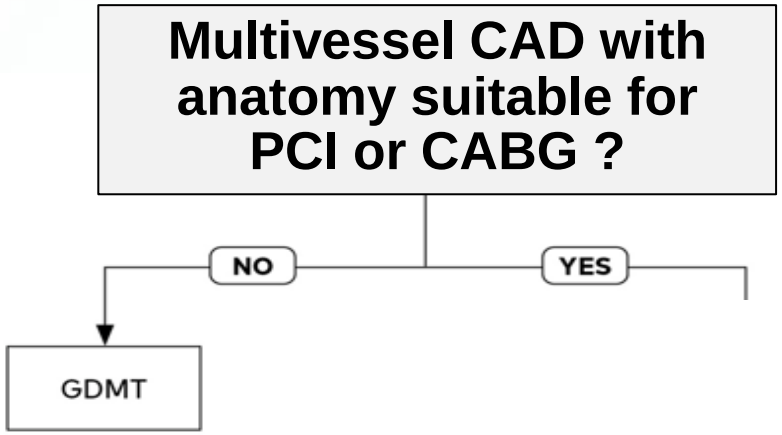

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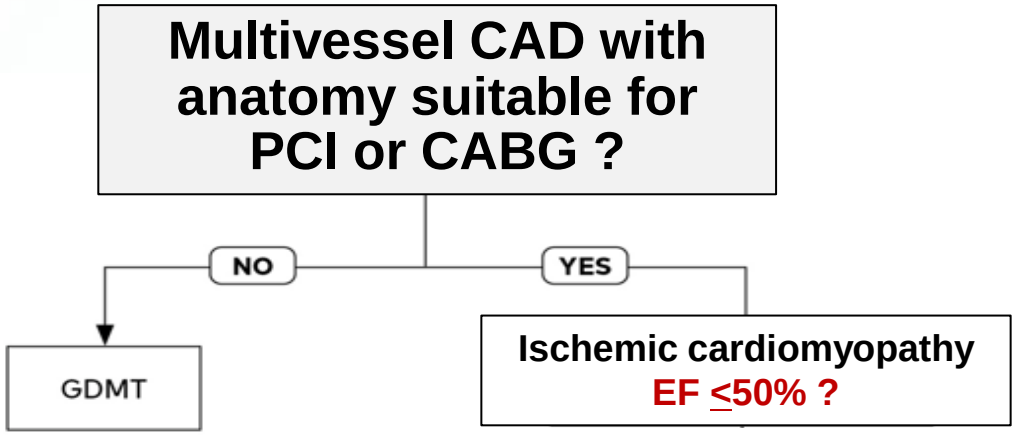
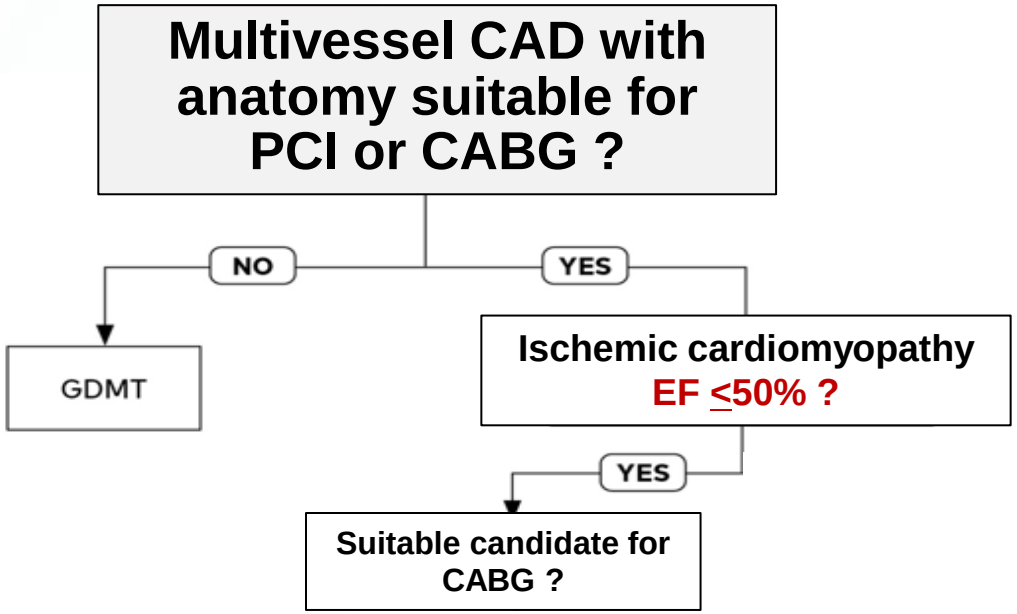
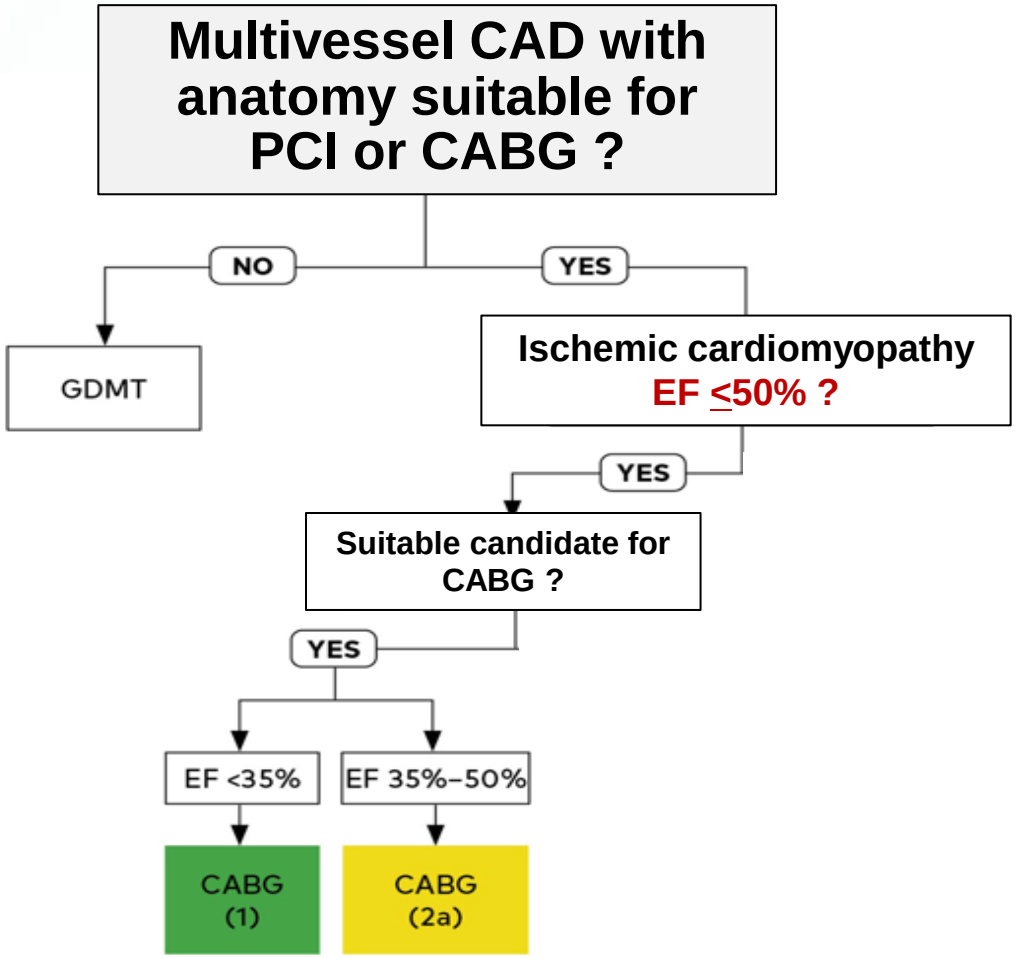


2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization



2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization



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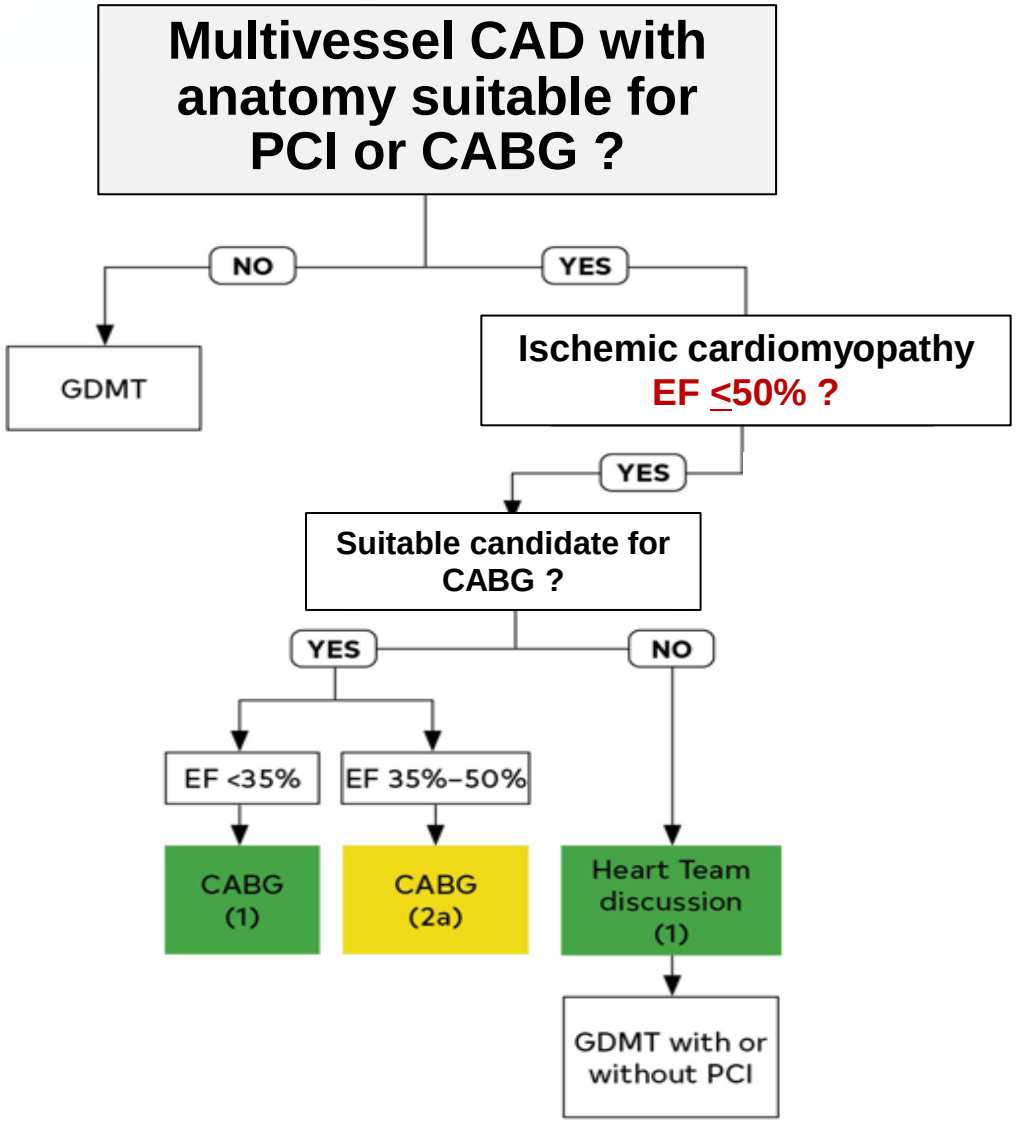
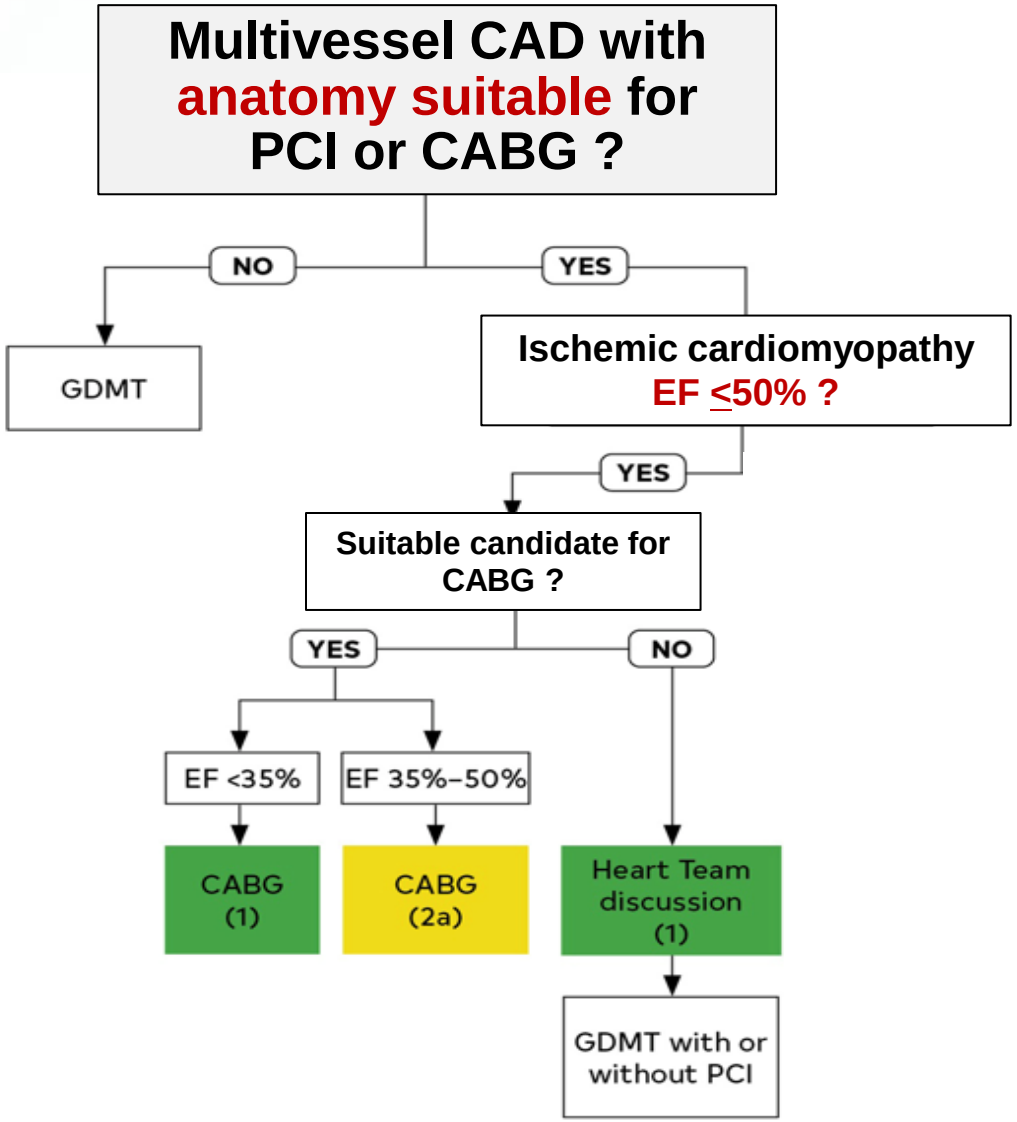


2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization



Anatomy Suitable for PCI

All Ischemic lesions,

Diameter Stenosis ≥80% and RVD ≥2.25 mm

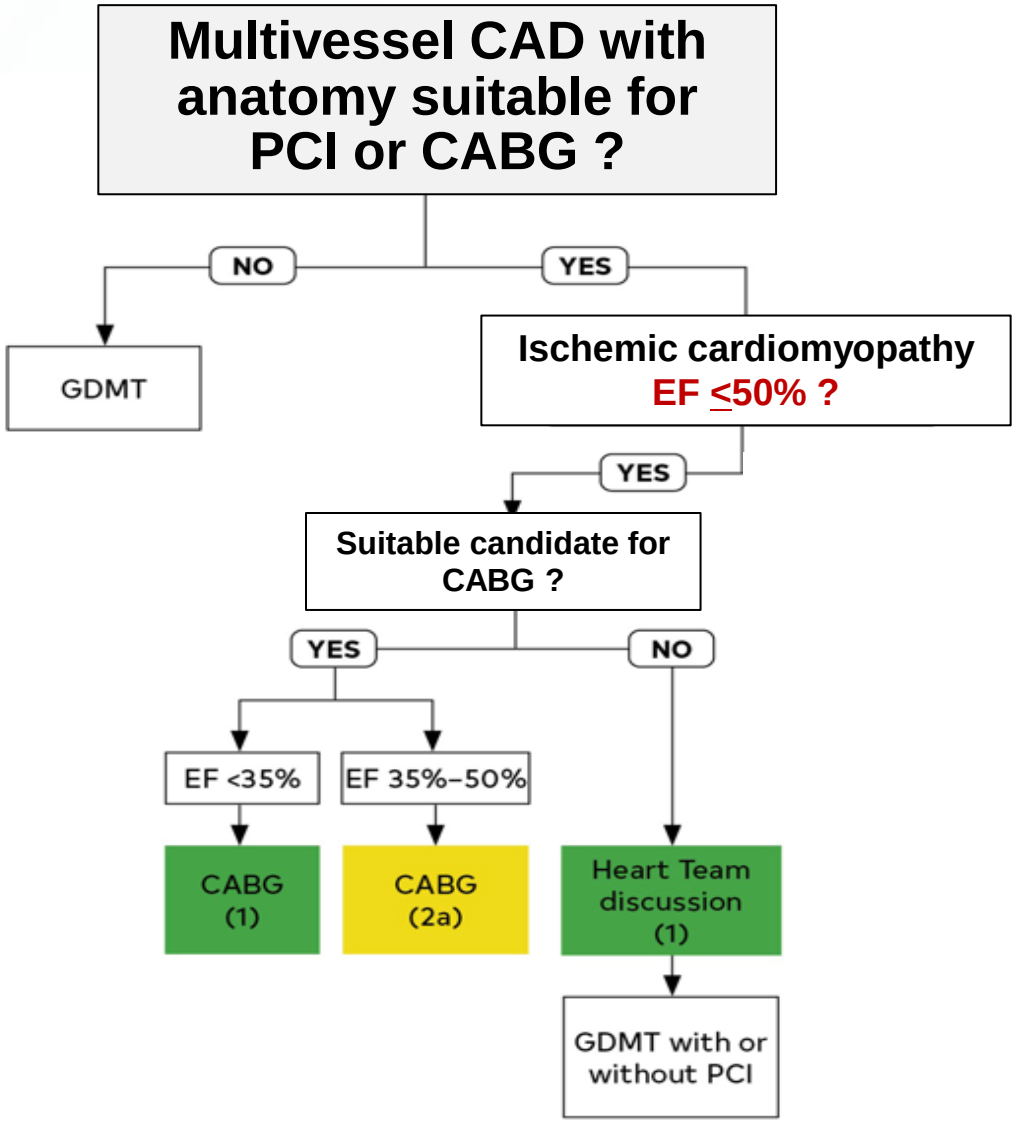
FFR and IVUS strongly recommended

Anatomy Suitable for CABG

Anatomically, all coronary arteries with ≥70% stenosis and >1.5 mm in diameter should be revascularized.

Functionally, all ischemic myocardial areas should be grafted.

2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization



EF ≤50%

Low EF Is Only Important Index to Do CABG!

Guideline did Not mention about SYNTAX Score.

2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization

Usefulness of SYNTAX Score Calculation in Treatment Decisions is Less Clear

because of the interobserver variability in its calculation and its absence of clinical variables.

Zhang YJ, Patrick SW et al. JACC 2014;64(5):423-432
J Am Coll Cardiol. Dec 09, 2021. Epublished DOI: 10.1016/j.jacc.2021.09.006

Underlying Data, 1

Low EF (<50%) Is
Only Important Index to Do CABG
for Multi Vessel Disease.

CABG vs. Medical Treatment

for Multi-Vessel Disease

1. CASS Trial
2. STICH

Very Limited Data !

CABG vs. Medical Treatment for MVD

1st Randomized Study, CASS Trial

Coronary Artery Surgery Study (CASS): a randomized trial of coronary artery bypass surgery

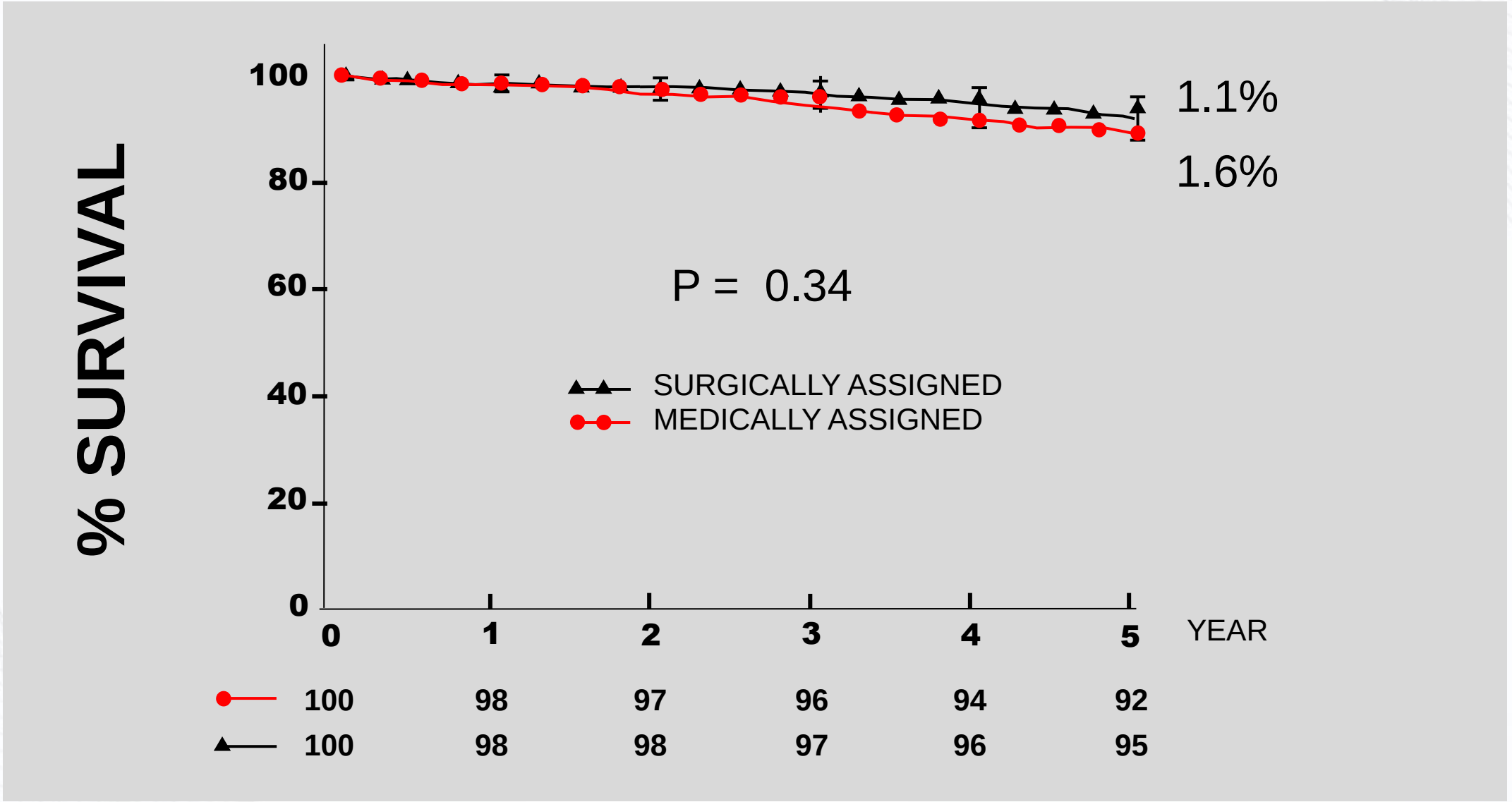
1. 780 patients,
2. Surgical (n=390) vs. Medical (n=390)
3. 70%, 1 or 2 vessel disease
4. Nitrate and Beta Blocker Available, <50%

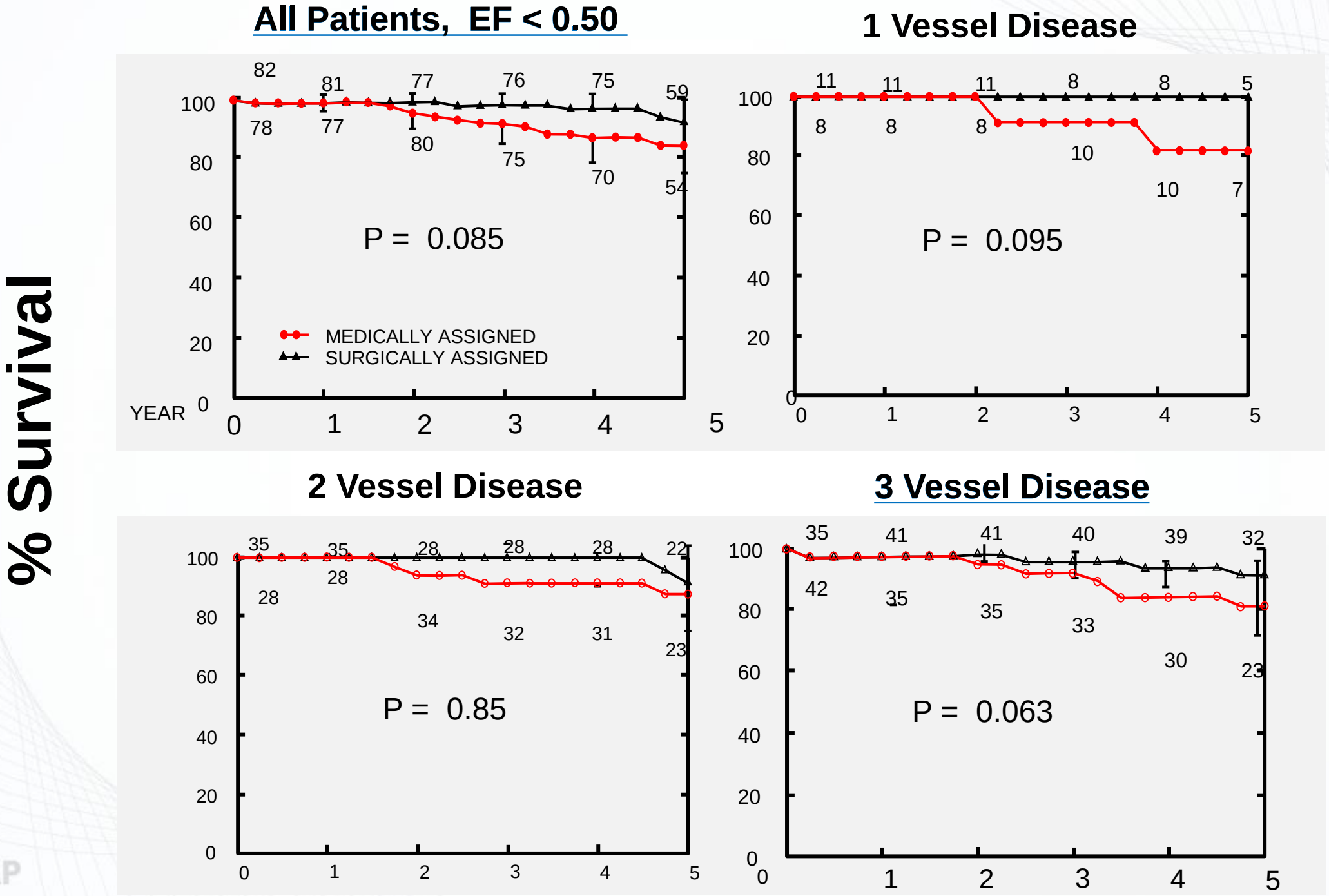
rates observed both in CASS patients assigned to receive medical and those assigned to receive surgical therapy and the similarity of survival rates in the two groups of patients in this randomized trial lead to the conclusion that patients similar to those enrolled in this trial can safely defer bypass surgery until symptoms worsen to the point that surgical palliation is required.

Circulation 68, No. 5, 939–950, 1983.

Circulation 1983 Nov;68(5):939-50. doi: 10.1161/01.cir.68.5.939.

All Cause Mortality




All Patients, EF < 0.50
1 Vessel Disease
2 Vessel Disease
3 Vessel Disease
% Survival
YEAR
P = 0.085
P = 0.095
P = 0.85
P = 0.063
MEDICALLY ASSIGNED
SURGICALLY ASSIGNED
82 81 77 76 75 59
78 77 80 75 70 54
11 11 11 8 8 5
8 8 8 10 10 7
35 35 28 28 28 22
28 28 34 32 31 23
35 41 41 40 39 32
42 35 35 33 30 23
0 20 40 60 80 100
0 1 2 3 4 5

CABG vs. Medical Treatment for MVD

From Coronary Artery Surgery (CASS) Study

CABG Is Better Over Medication in Patients with Stable Angina (<50% of LVEF)

CABG vs. Medical Treatment

Surgical Treatment for Ischemic Heart Failure (STICH) Trial

The NEW ENGLAND JOURNAL of MEDICINE

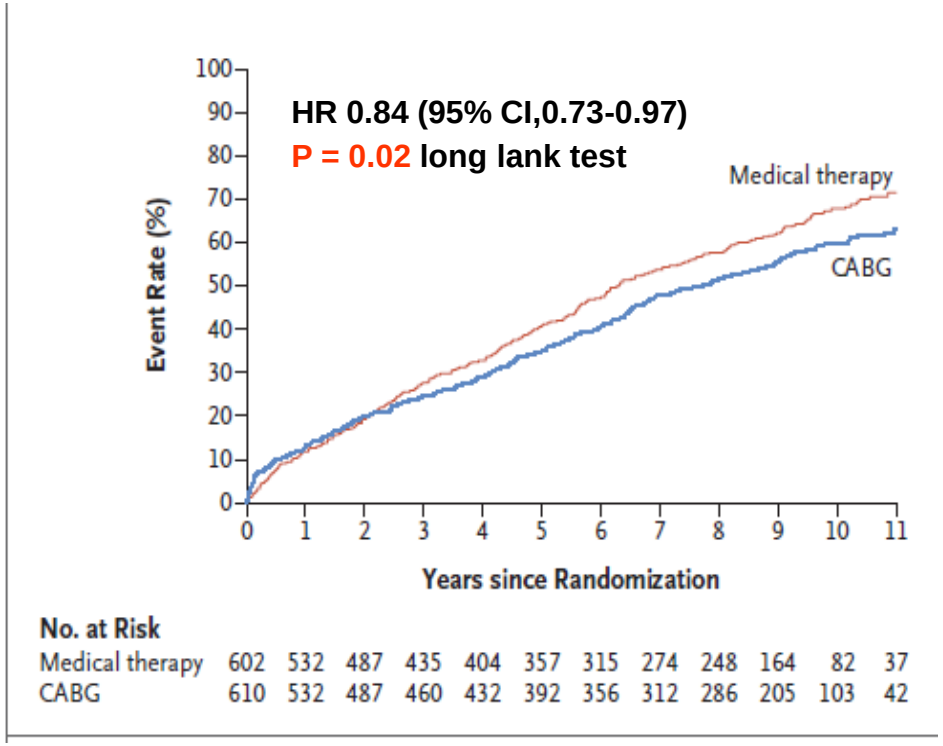
1. 1212 Patients with Stable Angina (<35% of LVEF),
2. Surgical (n=610, EF 27%) vs. Medical (n=602, EF 28%)
3. 3-VD 60%, 2VD 30%

Dorairaj Prabhakaran, M.D., D.M., Hanna Szwed, M.D., Paolo Ferrazzi, M.D.,
Mark C. Petrie, M.D., Christopher M. O'Connor, M.D.,
Pradit Panchavinnin, M.D., Lilin She, Ph.D., Robert O. Bonow, M.D.,
Gena Roush Rankin, M.P.H., R.D., Robert H. Jones, M.D.,
and Jean-Lucien Rouleau, M.D., for the STICH Investigators*

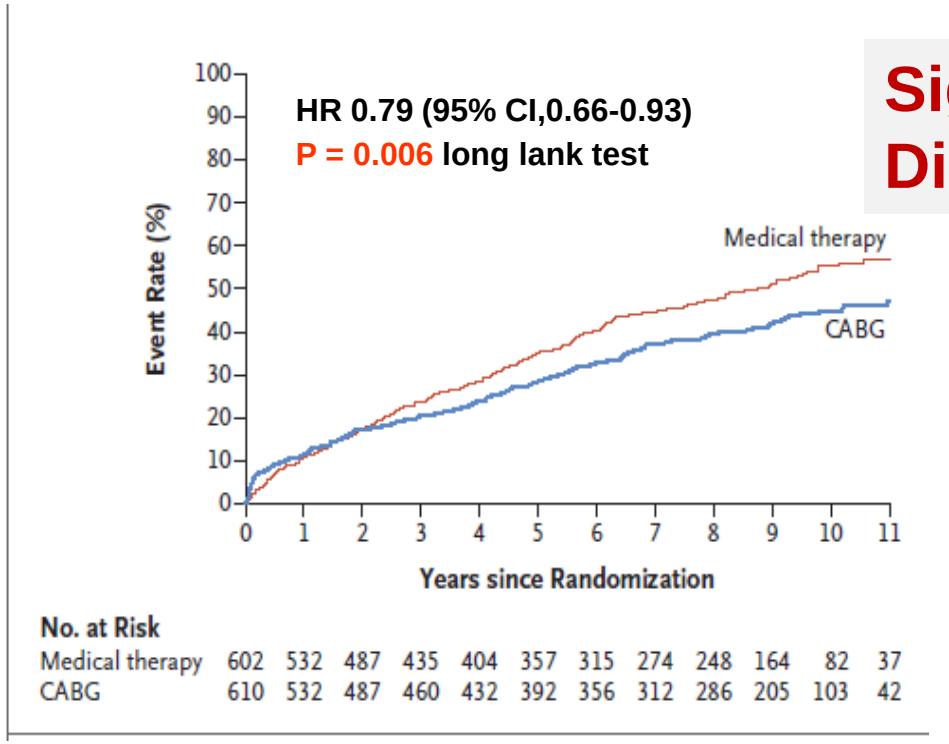
Velazquez EJ, et al. N Engl J Med 2016; 374:1511-1520 DOI: 10.1056/NEJMoa1602001

All Cause Mortality at 10 year

Any Death



Cardiovascular Death



Significantly Different !

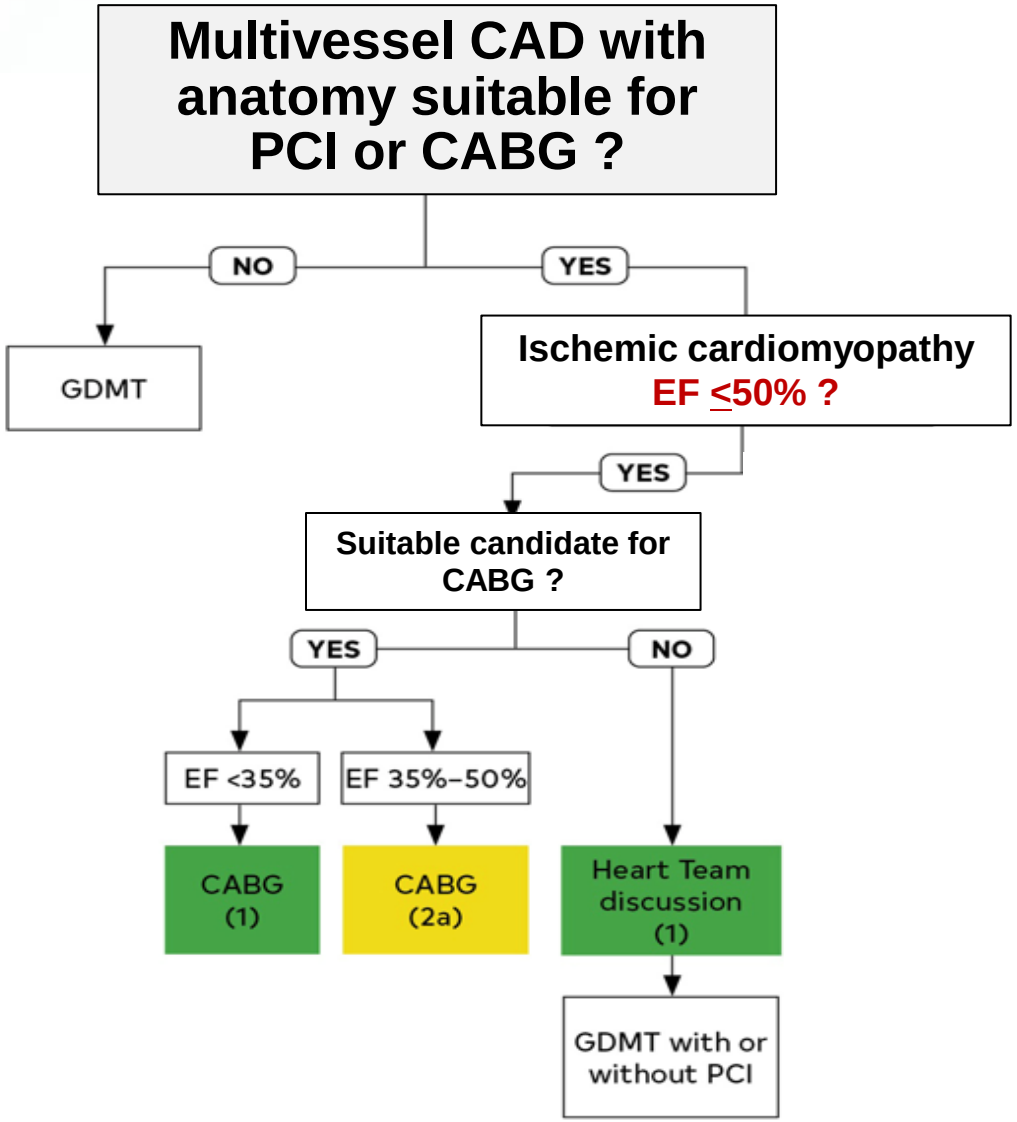
Velazquez EJ, et al. N Engl J Med 2016; 374:1511-1520 DOI: 10.1056/NEJMoa1602001

CABG vs. Medical Treatment for MVD

Surgical Treatment for Ischemic Heart Failure (STICH) Trial

CABG Is Better Over Medication in Patients with Stable Angina (<35% of LVEF)

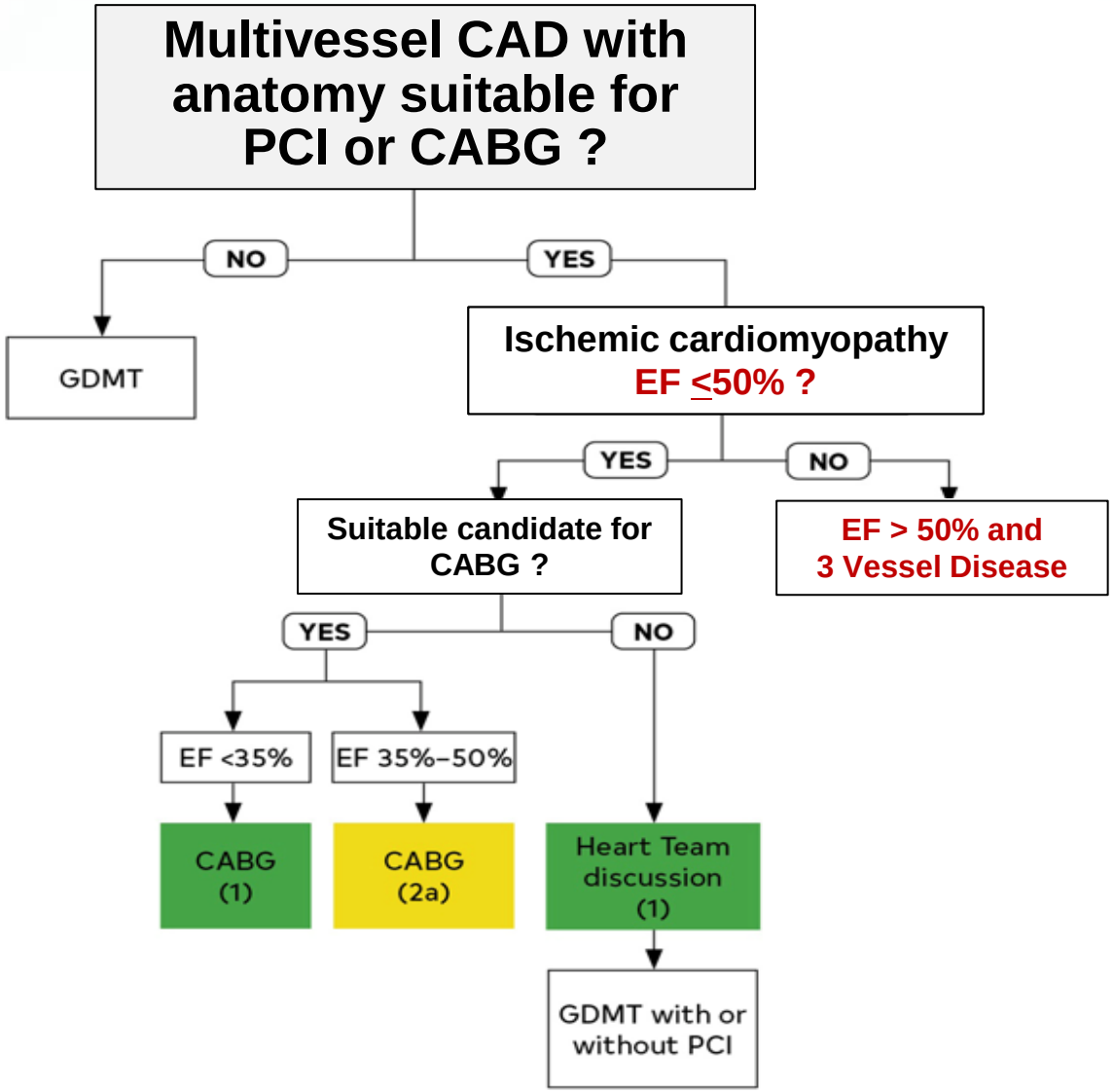
2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization



EF ≤50% and 3 Vessel Disease

CABG Is Better !

2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization



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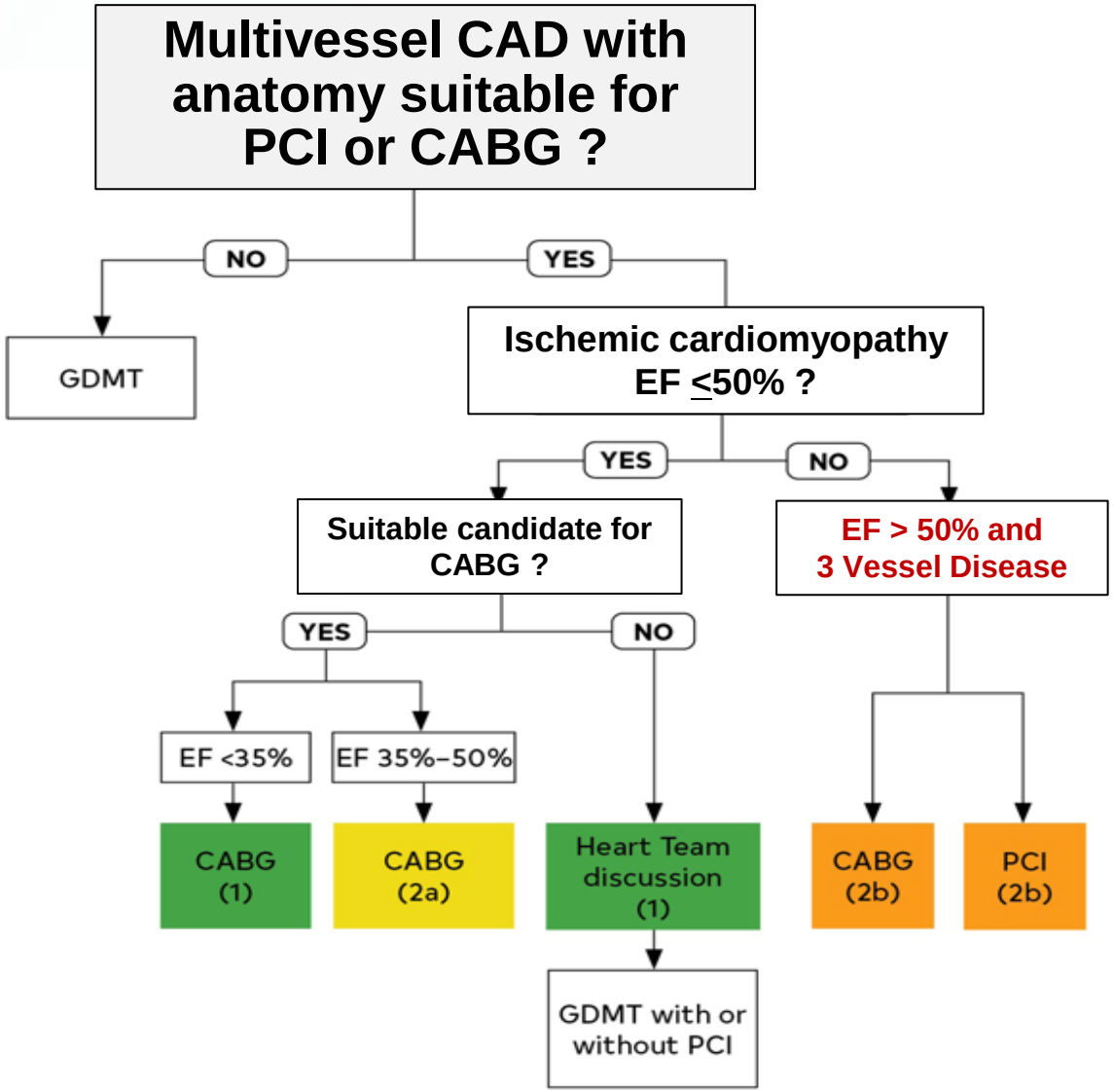


Any Revascularizations (2b)

Any Revascularizations (2b)

Class 2b (WEAK) **Benefit ≥ Risk**

Suggested phrases for writing recommendations:

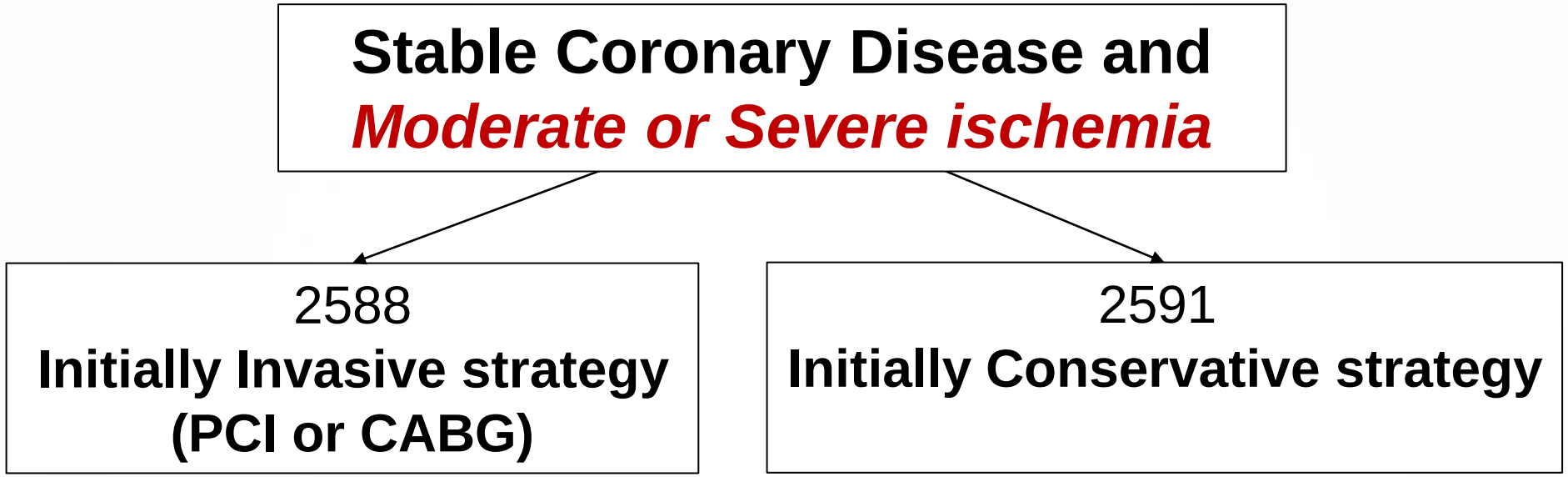
- May/might be reasonable
- May/might be considered
- Usefulness/effectiveness is unknown/unclear/uncertain or not well-established

Underlying Data, 2

Any Revascularizations (2b)

Why ?

ISCHEMIA Study



Primary Outcome; *Composite of* death from cardiovascular causes, myocardial infarction, or hospitalization for unstable angina, heart failure, or resuscitated cardiac arrest.

David J. Maron et al, for the ISCHEMIA Research Group, N Engl J Med 2020; 382:1395-1407
https://www-nejm-org-ssl.libproxy.amc.seoul.kr/doi/10.1056/NEJMoa1915922

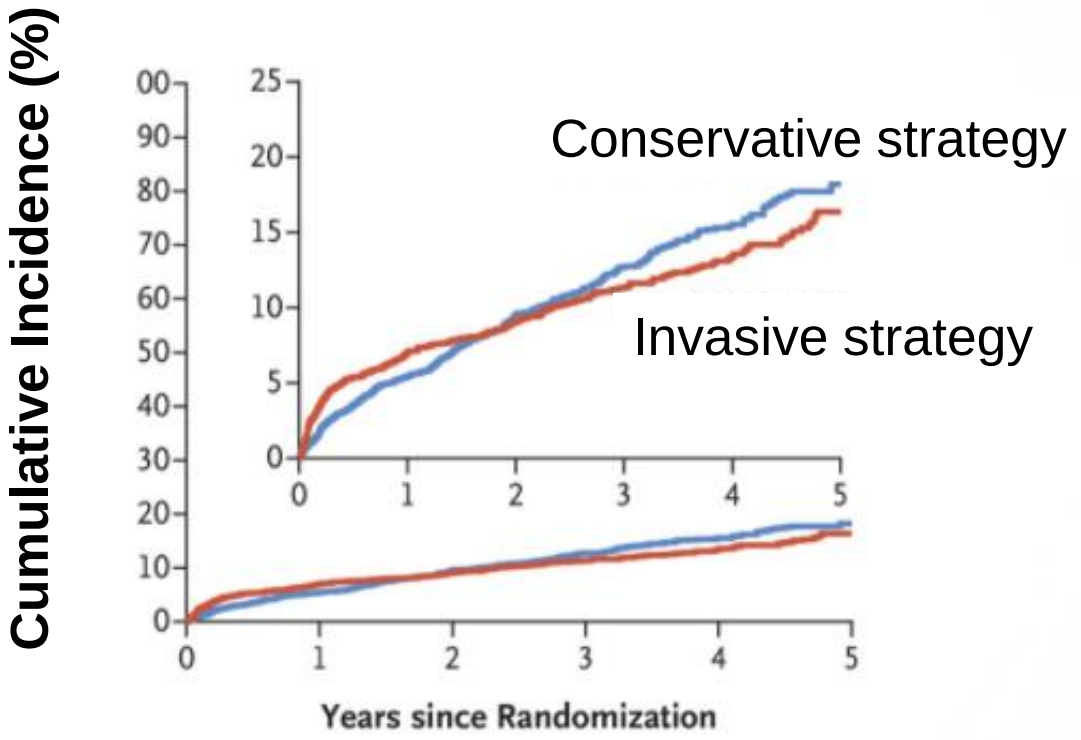
Coronary Anatomy by CCTA (≥ 50% stenosis)

	Total (N=5179)	INV (N=2588)	CON (N=2591)
0	0.1% (4/2986)	0.1% (2/1490)	0.1% (2/1496)
1	23.3% (697/2986)	24.2% (360/1490)	22.5% (337/1496)
2	31.4% (938/2986)	29.1% (434/1490)	33.7% (504/1496)
3	45.1% (1347/2986)	46.6% (694/1490)	43.6% (653/1496)

Multivessel Disease >75%

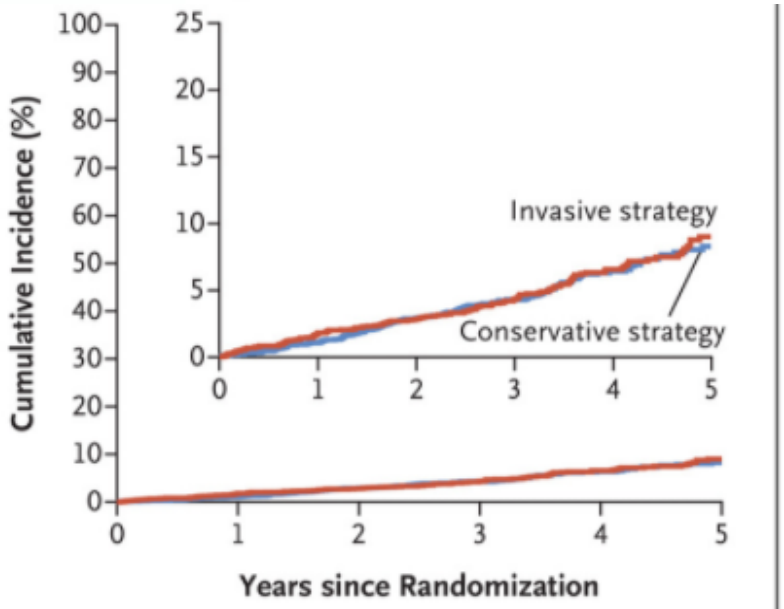
Primary Outcomes at 3.2 yrs

Death from cardiovascular causes, Myocardial infarction, or
Hospitalization for unstable angina, Heart failure, or Resuscitated cardiac arrest.



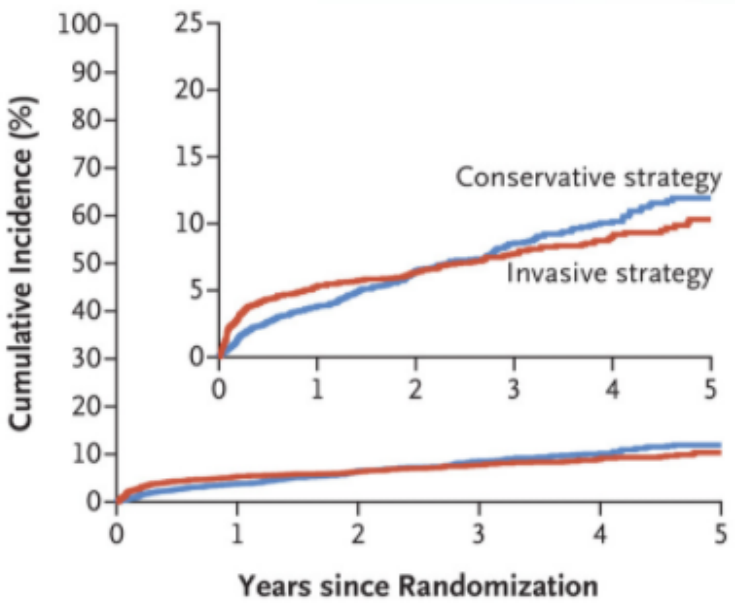
No. at Risk						
Conservative strategy	2591	2431	1907	1300	733	293
Invasive strategy	2588	2364	1908	1291	730	271

All Death



No. at Risk						
Conservative strategy	2591	2548	2065	1445	844	349
Invasive strategy	2588	2518	2061	1431	827	317

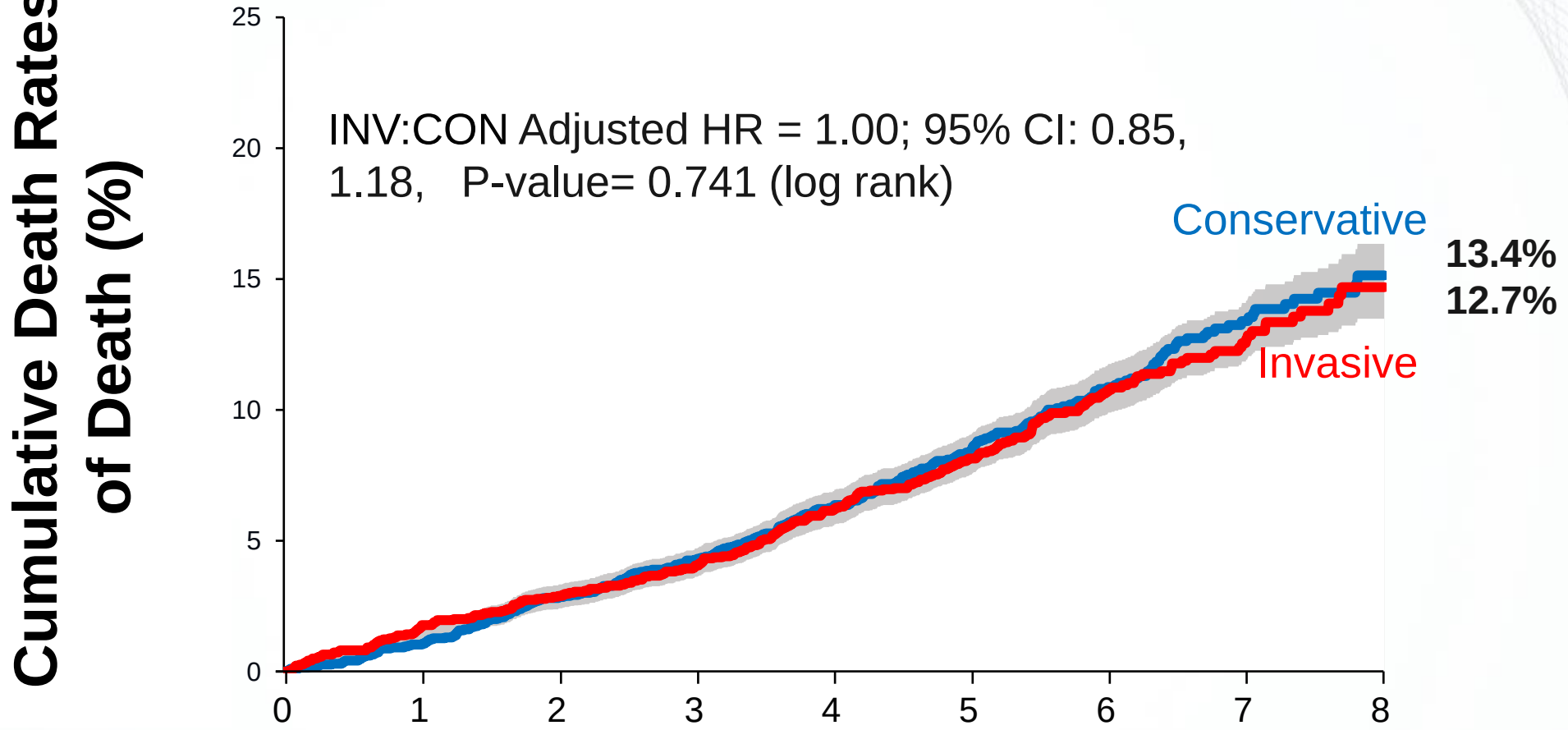
Myocardial Infarction



No. at Risk						
Conservative strategy	2591	2452	1931	1321	747	298
Invasive strategy	2588	2379	1931	1313	742	283

ISCHEMIA EXTENDED at 7 yrs

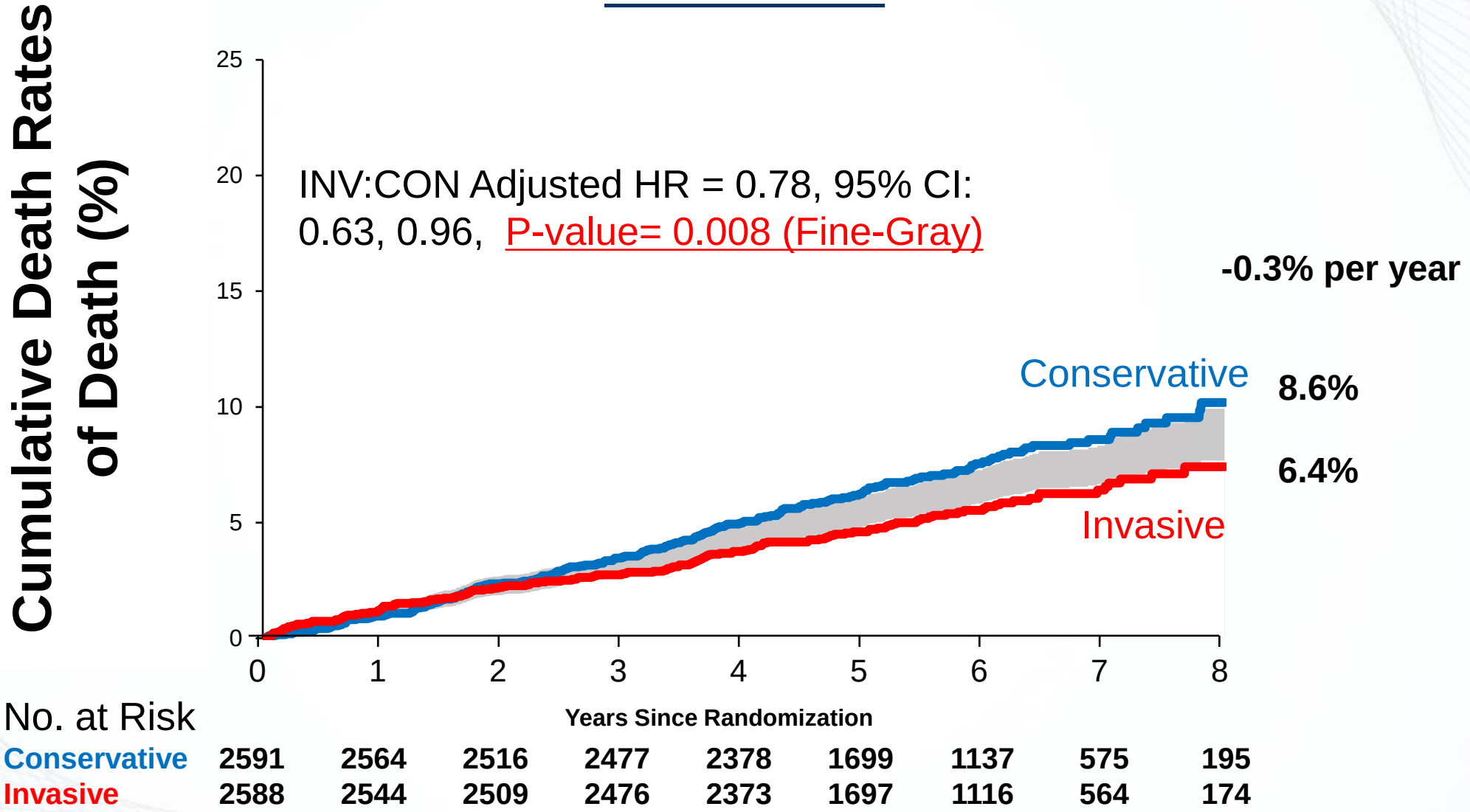
All Death



No. at Risk

Conservative	2591	2564	2517	2479	2381	1701	1139	575	195
Invasive	2588	2544	2512	2480	2375	1702	1120	566	174

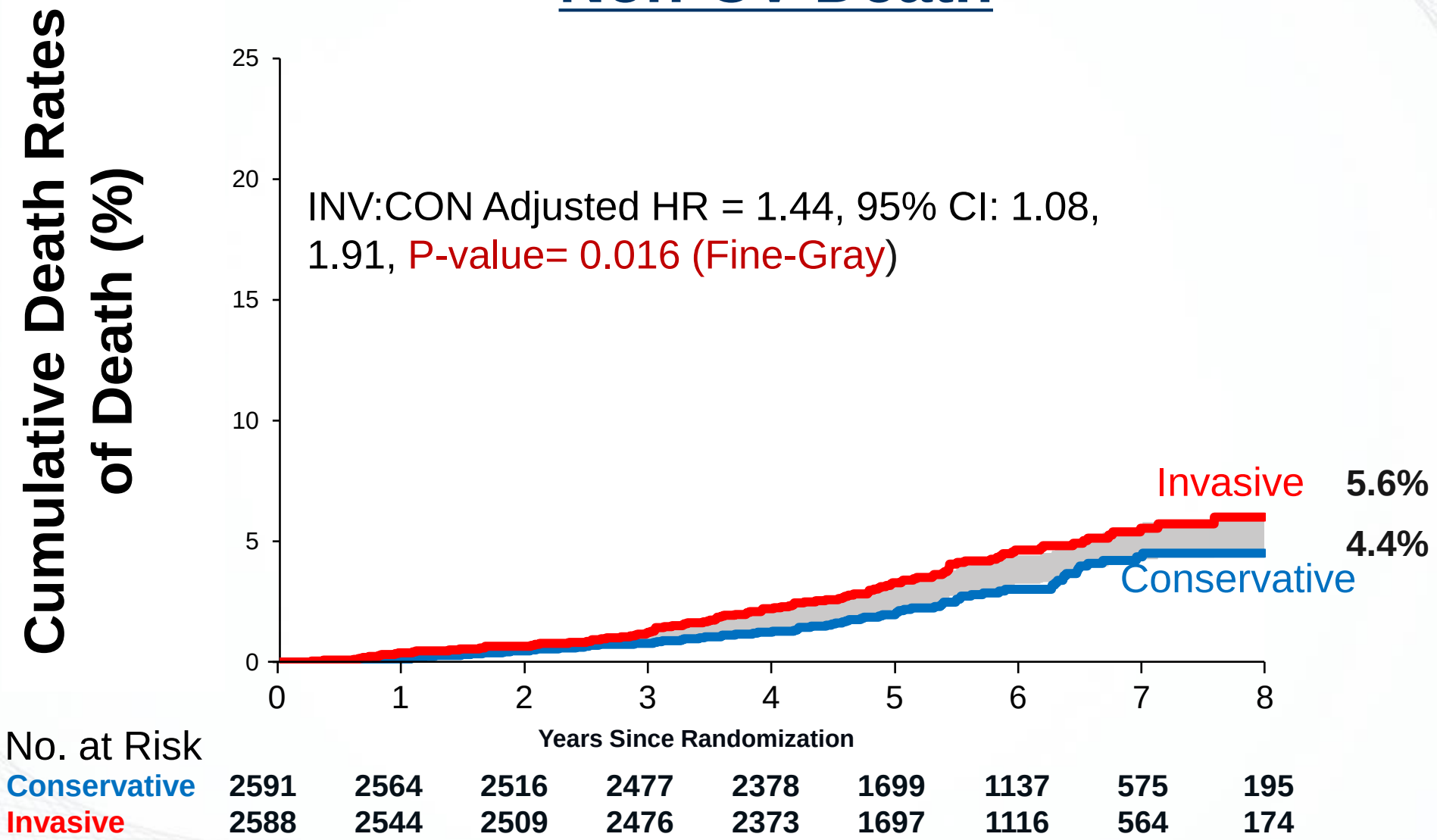
ISCHEMIA EXTENDED at 7 yrs
CV Death



No. at Risk

Conservative	2591	2564	2516	2477	2378	1699	1137	575	195
Invasive	2588	2544	2509	2476	2373	1697	1116	564	174

ISCHEMIA EXTENDED at 7 yrs
Non-CV Death



ISCHEMIA study

No Survival and Ischemic Event Benefit of Invasive Strategy, as Compared With Conservative Strategy for the Patients with Moderate or Severe Ischemia.

Judith S. Hochman et al, AHA, 2022, 10.1161/CIRCULATIONAHA.122.062714
David J. Maron et al, for the ISCHEMIA Research Group, N Engl J Med 2020; 382:1395-1407

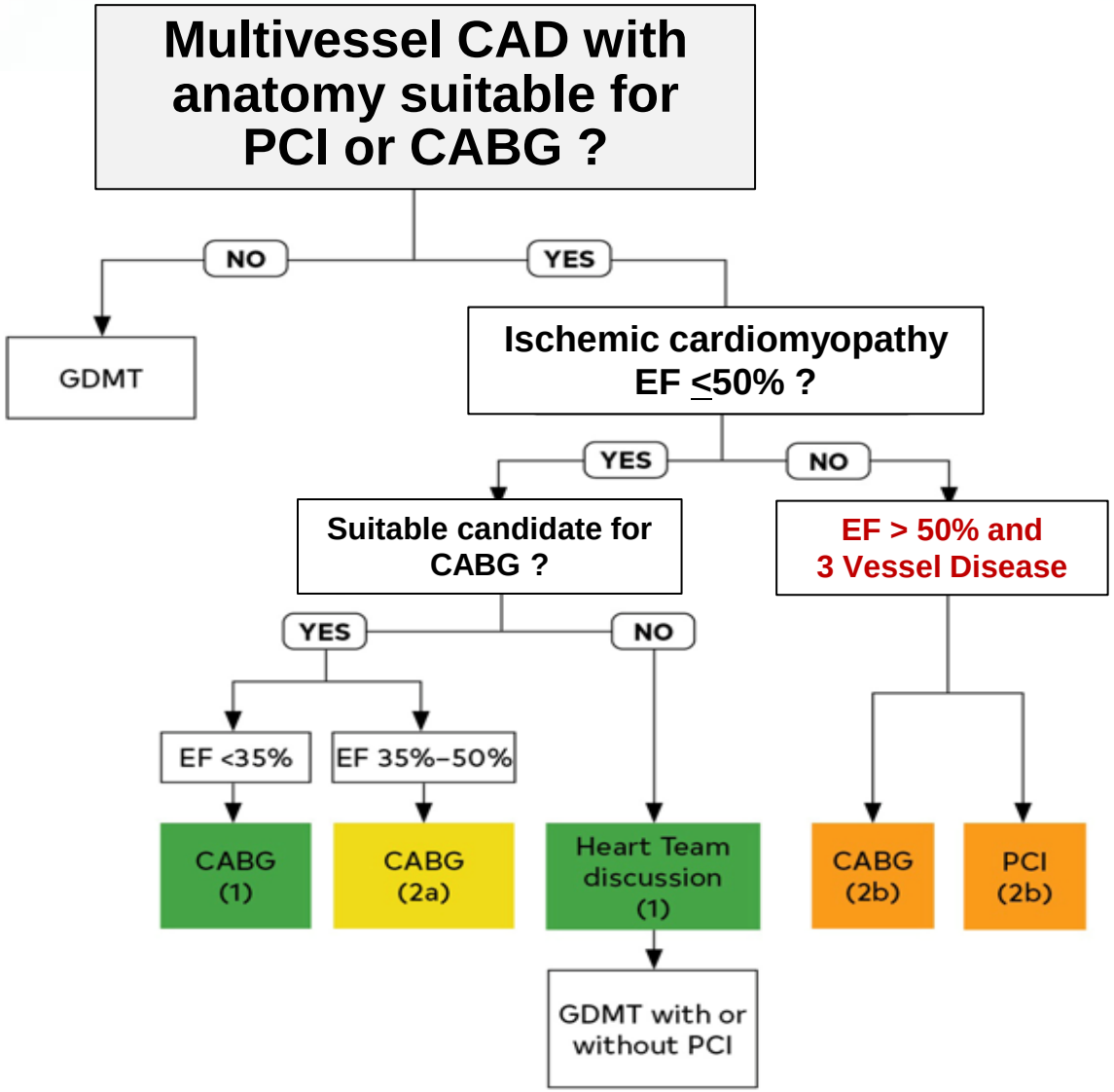
ISCHEMIA study

Optimal Medical Therapy Is Good Enough

for Majority Patients of Stable Coronary Disease

Judith S. Hochman et al, AHA, 2022, 10.1161/CIRCULATIONAHA.122.062714
David J. Maron et al, for the ISCHEMIA Research Group, N Engl J Med 2020; 382:1395-1407

2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization



Any Revascularizations (2b)

Underlying Data, 3

PCI vs. CABG

For Multi-Vessel Disease

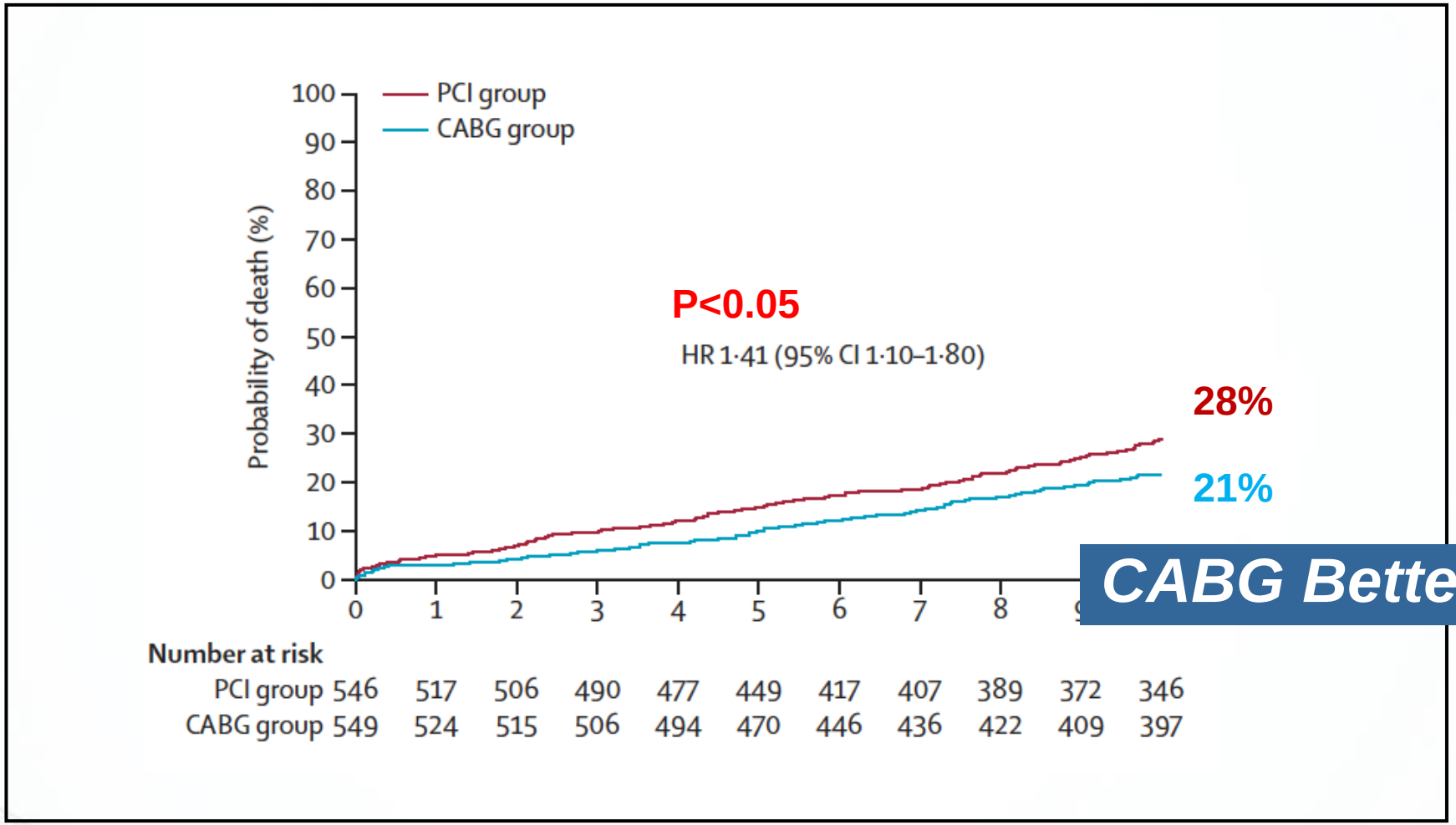
PCI vs. CABG

for Multi-vessel Disease

1. BARI 2D
2. FREEDOM
3. SYNTAX
4. BEST

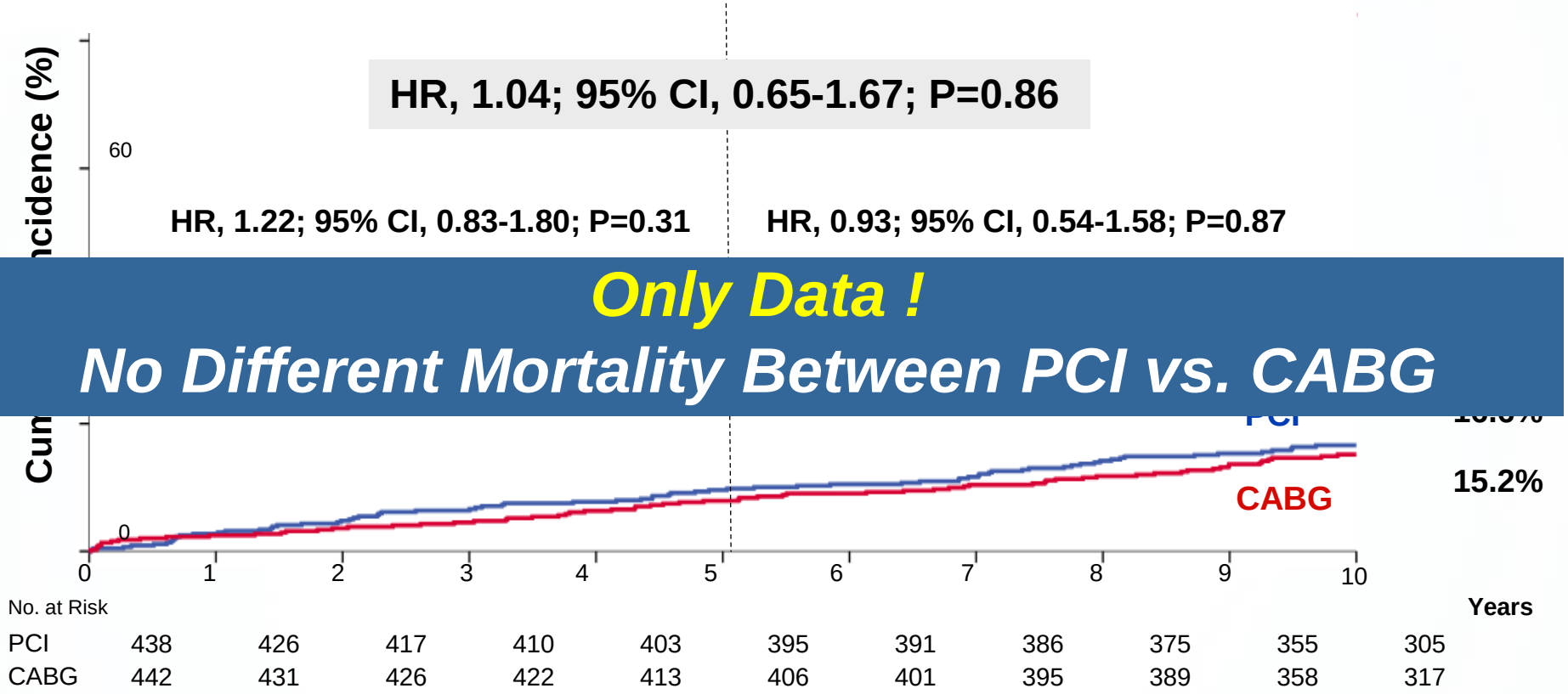
Very Limited Data !

SYNTAX *(3VD Subset)*
All Death at 10 Year



Lancet 2019; 394: 1325–34

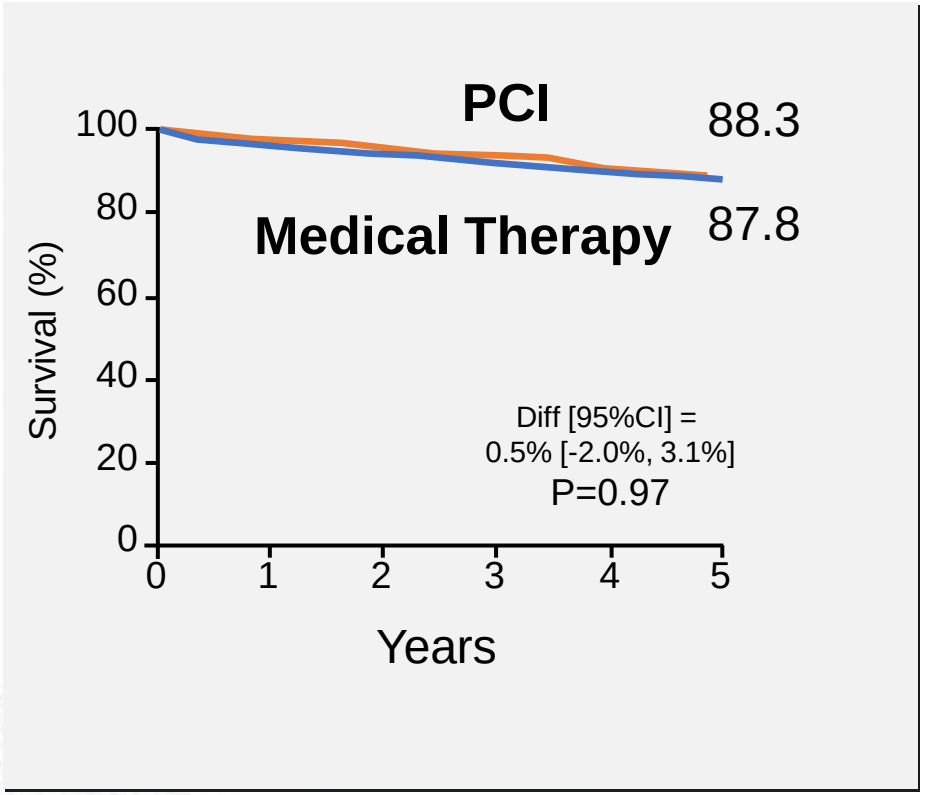
BEST
All Death at 10 Year



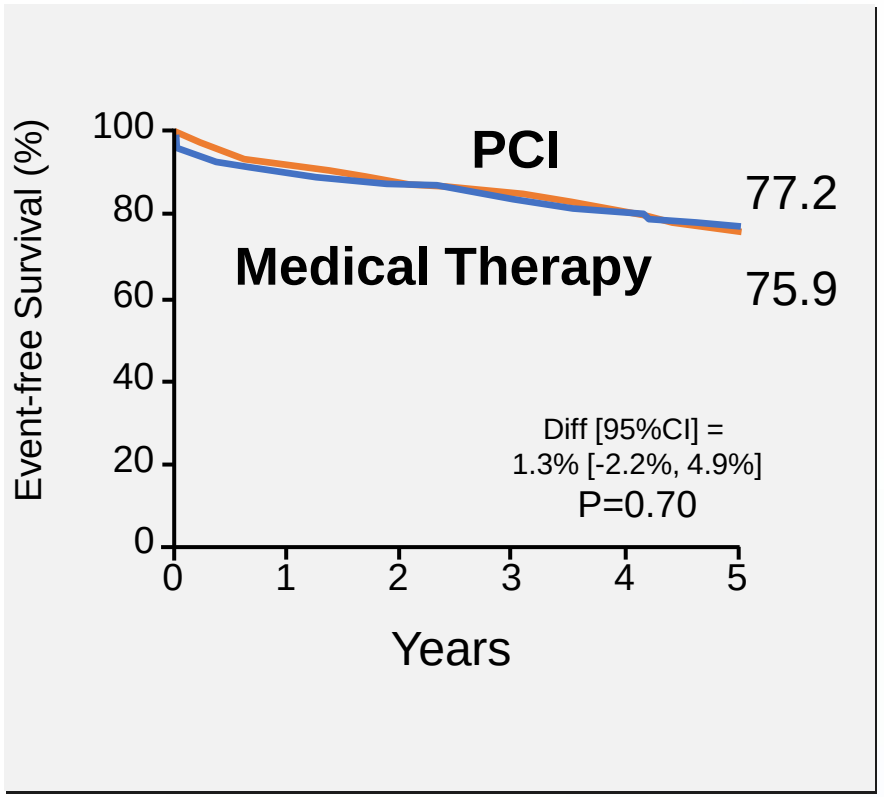
Ahn JM, Park SJ et al, Circulation 2022, Sep 19

BARI 2D (DM) *at 5 year*
PCI Had No Benefit Over Medical Treatment in Low Risk Patients

Survival



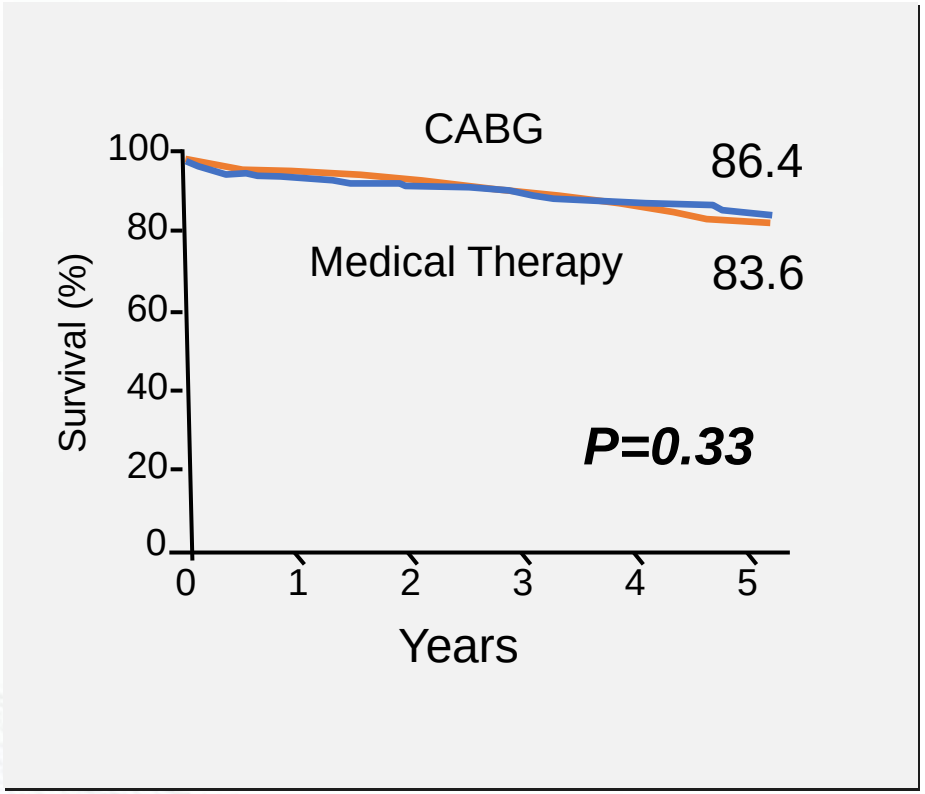
Freedom from MACE (Death, MI, or Stroke)



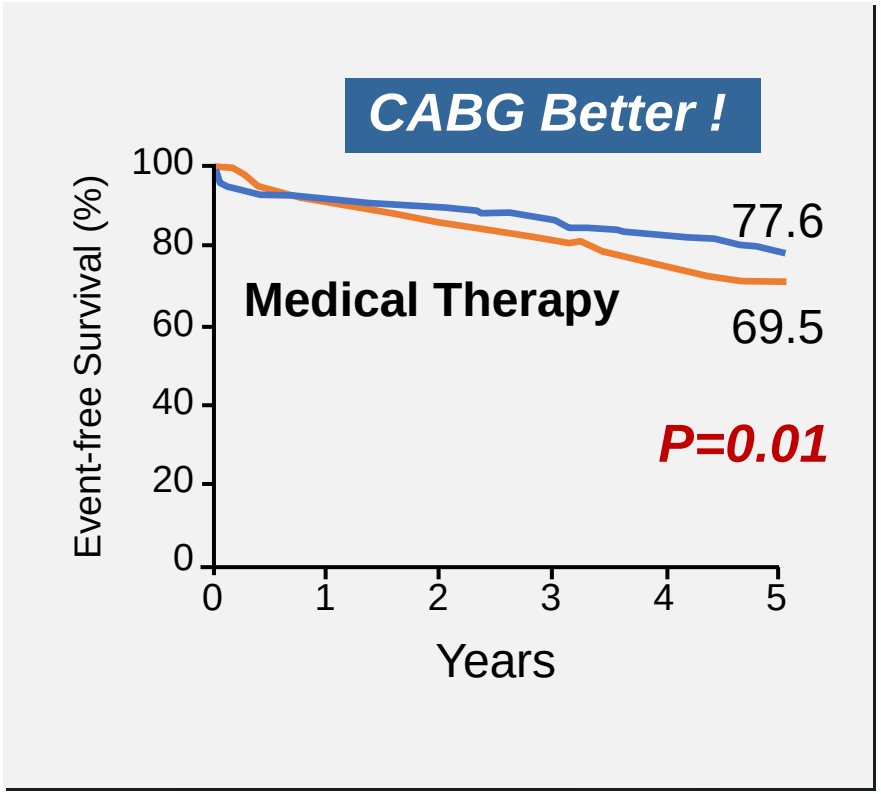
The BARI 2D Study Group.*NEJM* 2009;360:2503-15

BARI 2D (DM) *at 5 year*
CABG Is Better Over Medical Treatment in High Risk Patients

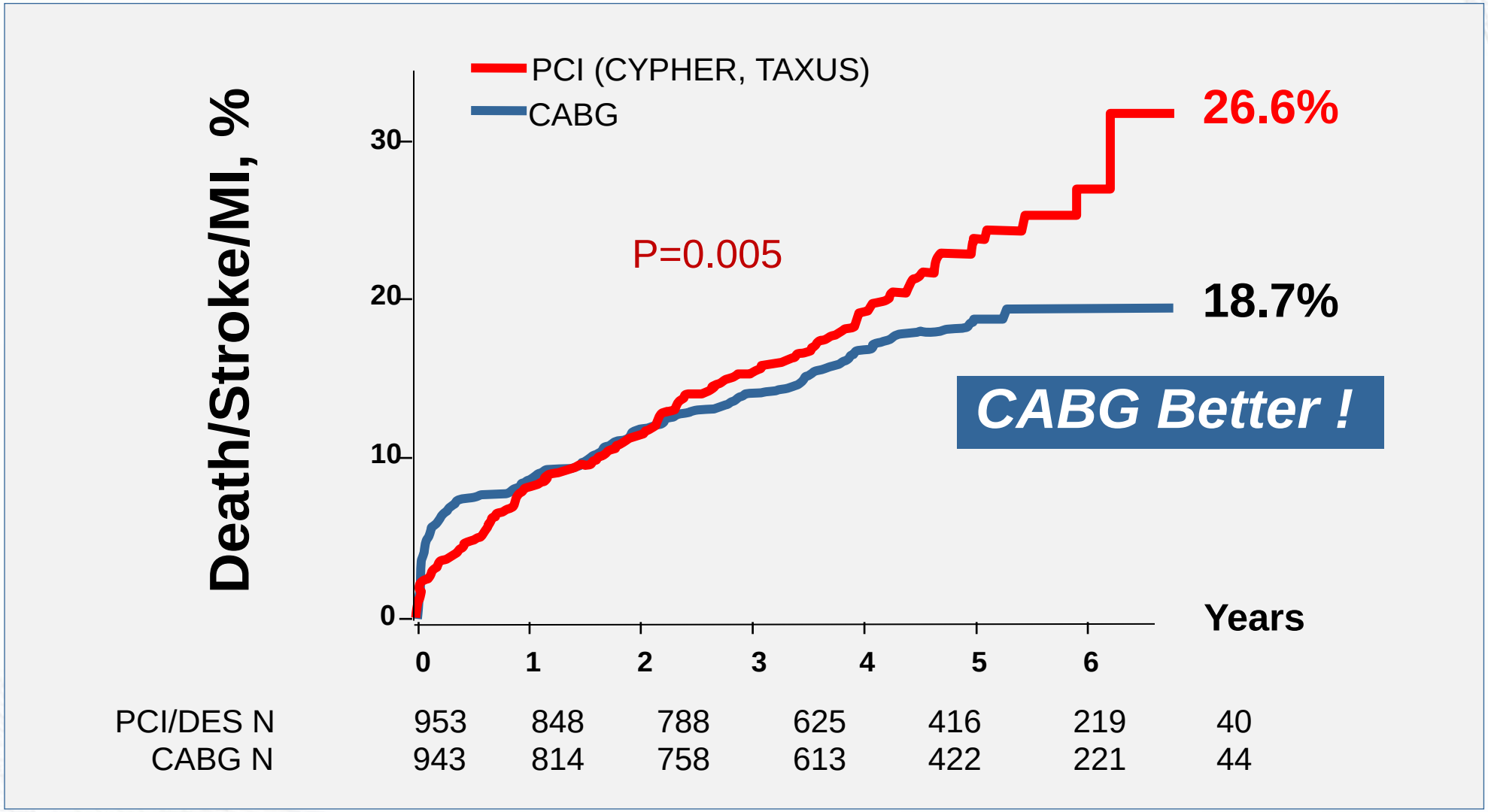
Survival



Freedom from MACE (Death, MI, or Stroke)



FREEDOM *(DM and MVD)*
Death / MI / Stroke at 5 Year

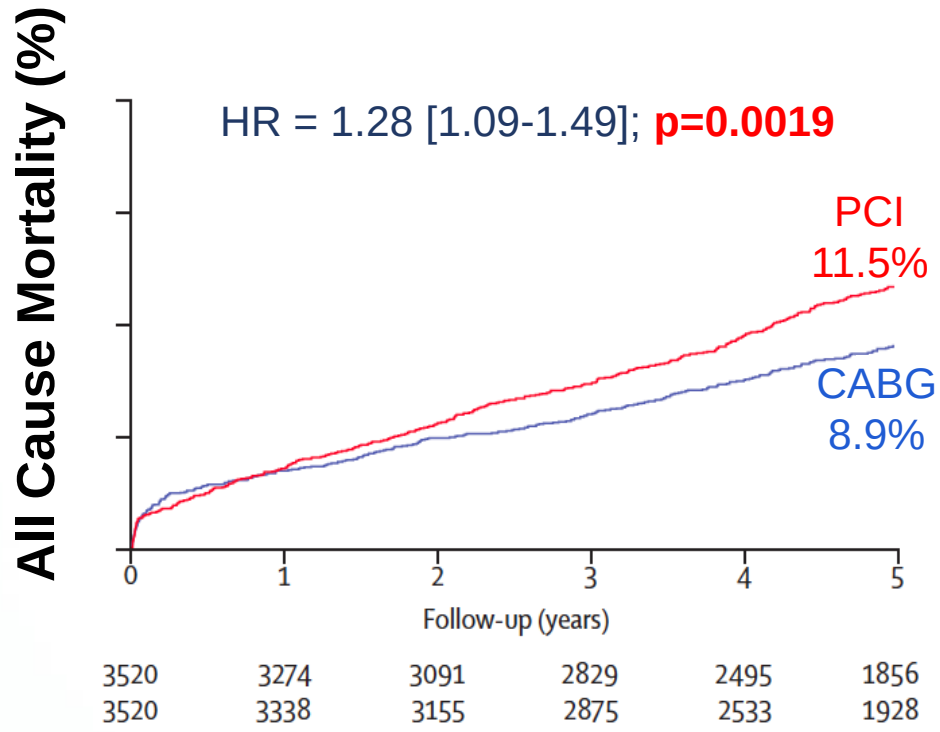


Farkouh et al, *NEJM* 2012 November 4

All Death

Individual Patient-Data Pooled Analysis
of 11,518 Patients From 11 Randomized Trials

Multivessel Disease (n=7040)



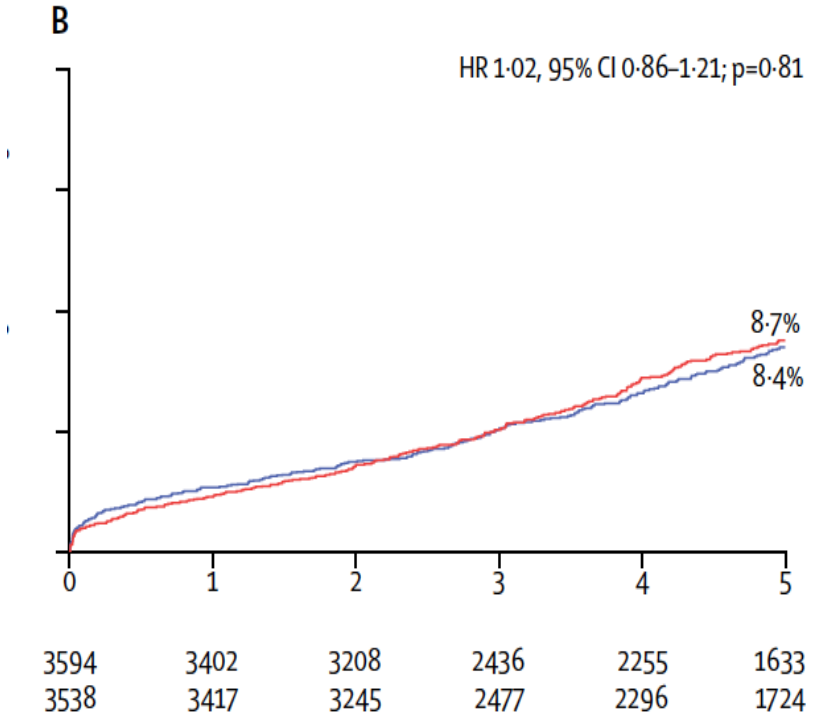
CABG Better !

Head SJ et al. Lancet 2018; 391: 939-48

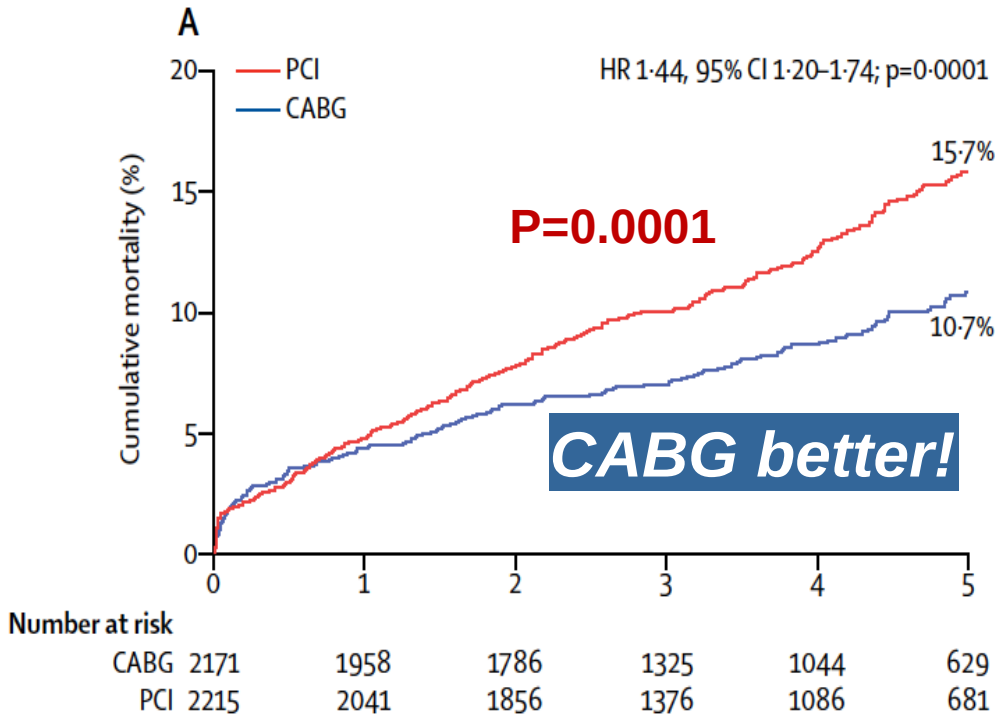
All Death

Individual Patient-Data Pooled Analysis
of 11,518 Patients From 11 Randomized Trials

Non-DM

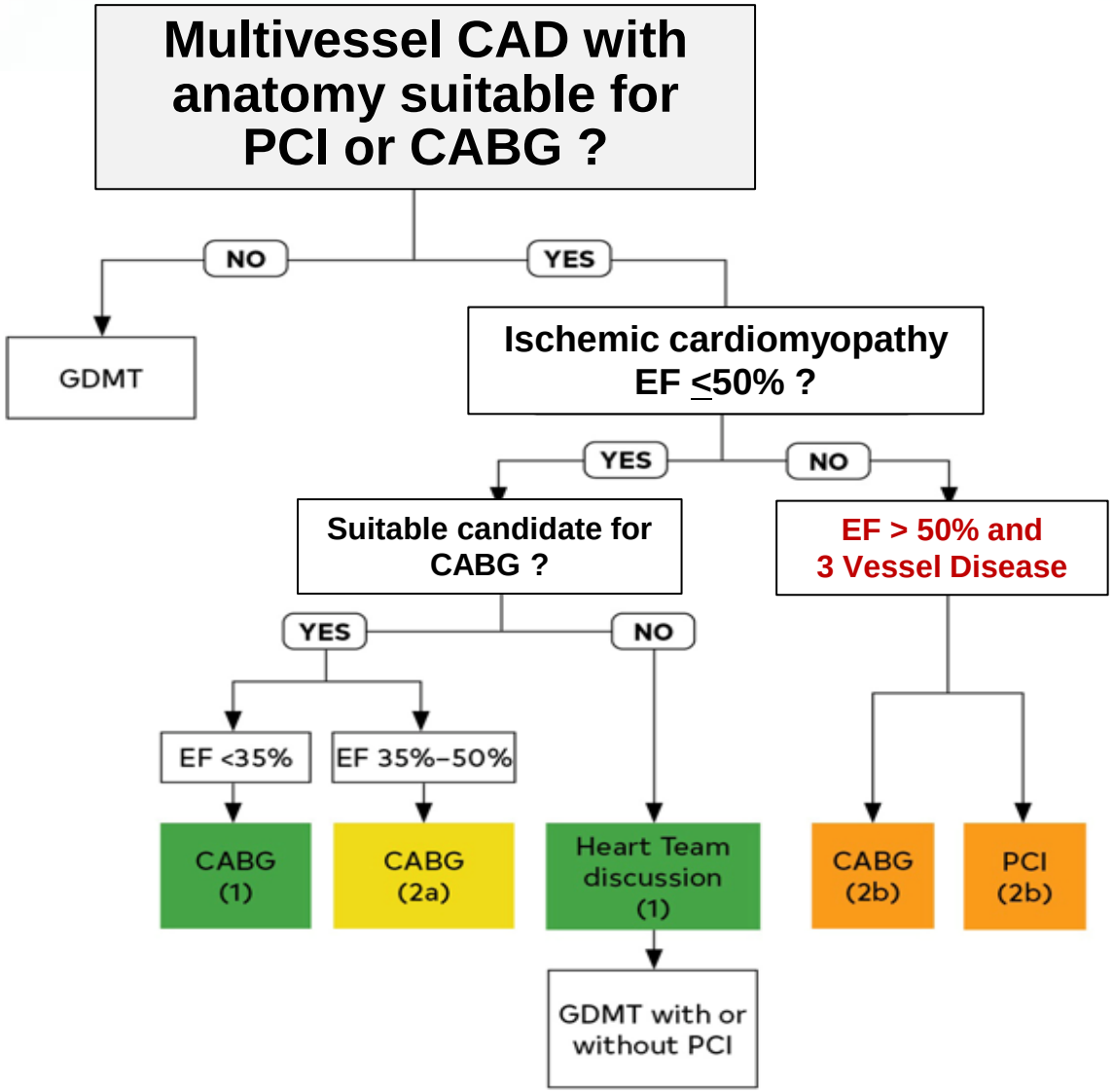


DM



Head SJ et al. Lancet 2018; 391: 939-48,

2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization



Any Revascularizations (2b)

2021 ***ACC/AHA/SCAI, Guideline***
for Multivessel Disease

1. CABG and/or PCI for Patients with Multi-VD *May be Considered (2b)*
2. Patients with Diabetes who Have 3 VD *Should Undergo CABG (1A).*
3. *If they are Poor Candidates for CABG, PCI May be Considered (2a, B-NR).*

J Am Coll Cardiol. Dec 09, 2021. Epublished DOI: 10.1016/j.jacc.2021.09.006

However, We Have Limited Data Interpretation !

1. **All Studies Used 1st Generation DES**
   - **BARI 2D:** DES 35% BMS 56%,
   - **FREEDOM:** Cypher 49%, TAXUS 41%,
   - **SYNTAX:** TAXUS 100%
2. **Lack of Concept of Physiology and Imaging of PCI**
3. **Issue of Complete Revascularization**

Future Perspective

We Have to Consider Physiology and Image Supported Contemporary PCI.

It Would Be Totally Different World !

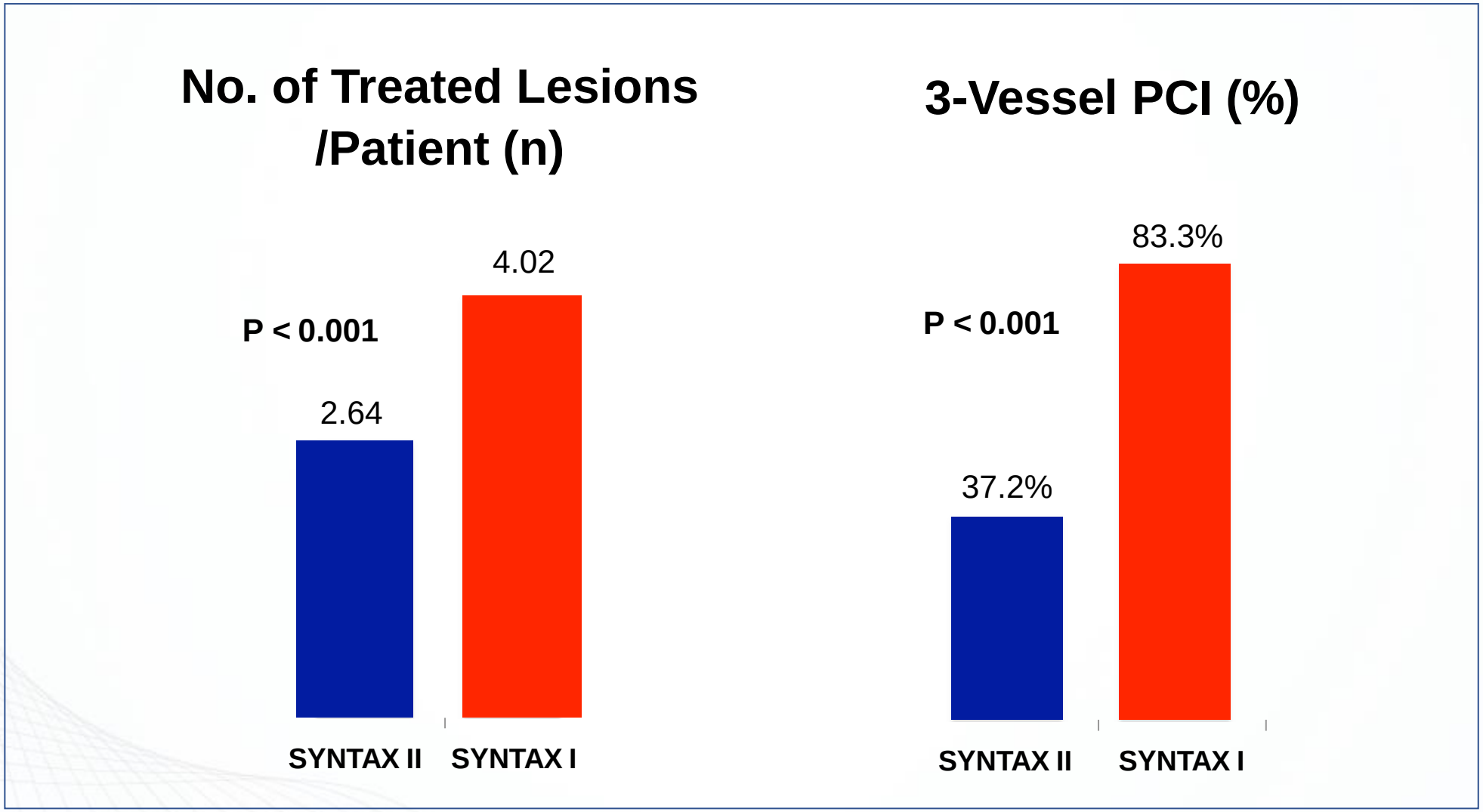
Impact of Physiology and Imaging on Revascularization Outcome for Multi-Vessel Disease (SYNTAX II)

- iFR/FFR Measured Lesions (n=1177),
- 84.1% of IVUS Used
- MACE (all-cause death, stroke, any myocardial infarction, or any revascularization)

Escaned J, Banning A, Serruys PW. Eur Heart J. 2017 Nov 7;38(42):3124-3134.

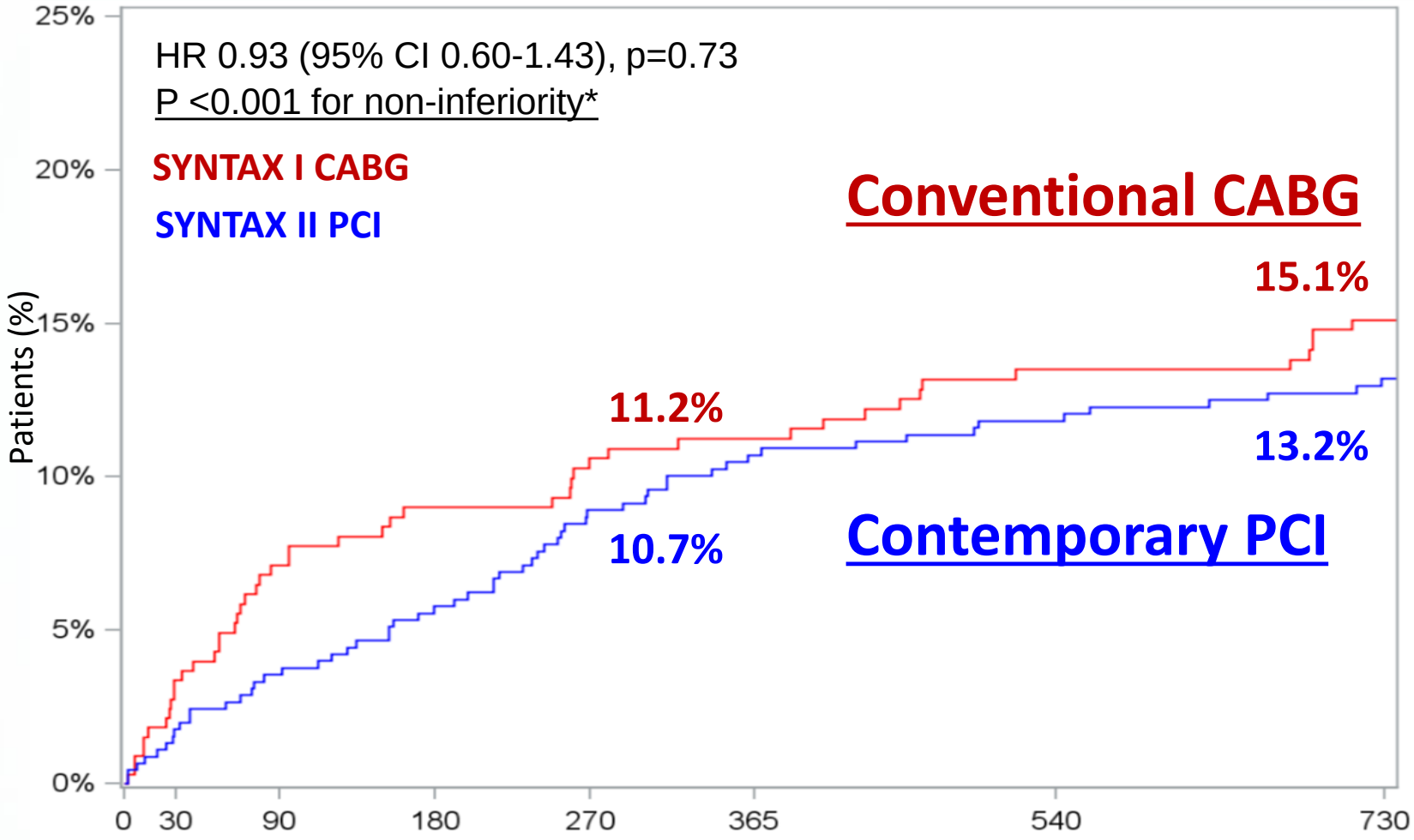
Impact of Physiology on PCI

31% of PCI Was Deferred After iFR/FFR



PCI vs. CABG at 2 years

MACCE



Not Different

Message From SYNTAX II

Contemporary PCI (physiology and Image supported) Is *Totally Different Strategy and Has Totally Different Clinical Outcomes* Compared to Conventional Angio-Guided PCI.

FFR Related Studies

FAME 3

FLOWER- MI

FUTURE

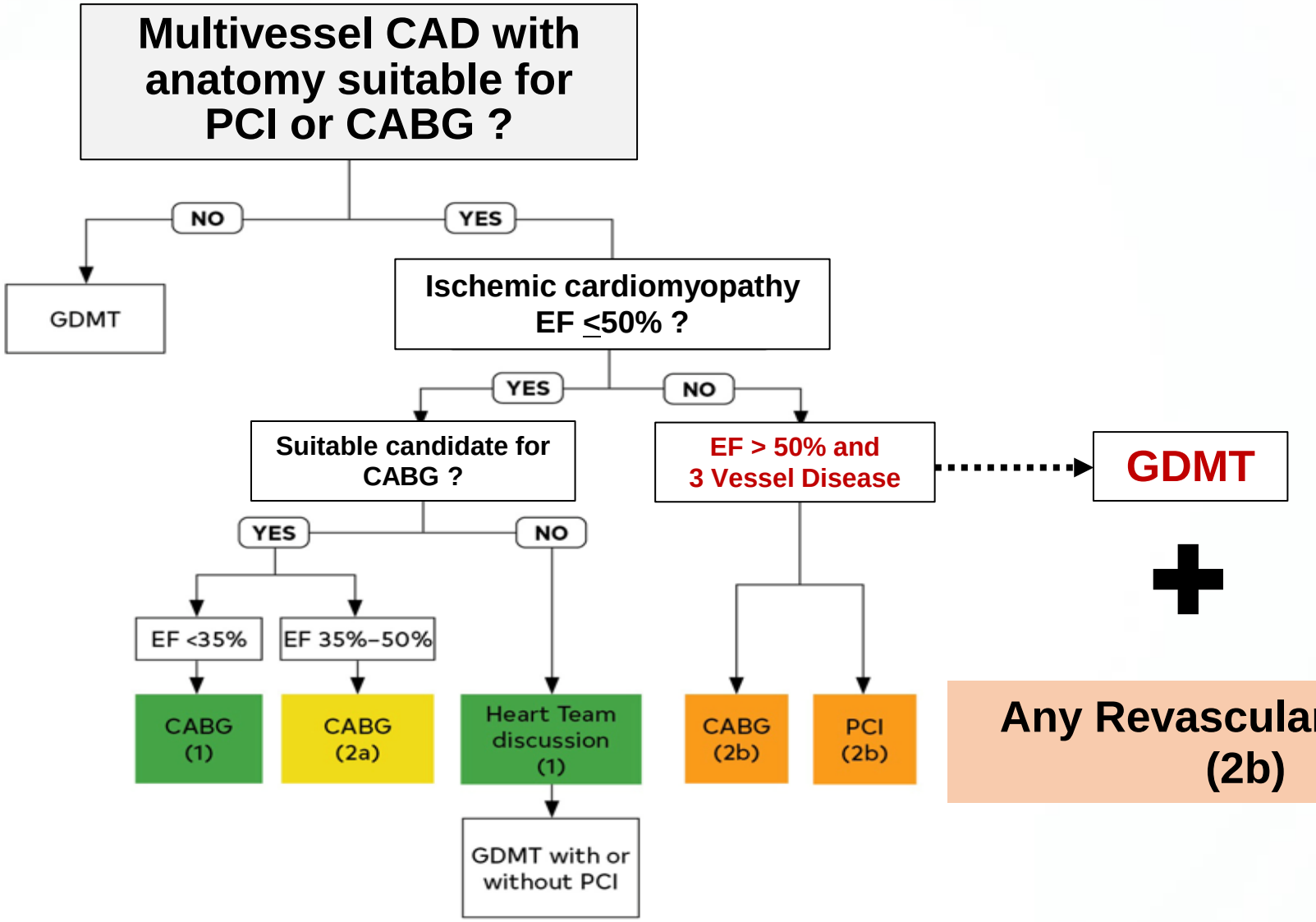
RIPCORD 2

FLAVOUR

Several Shapeless Studies
Can Not Break Up Basic Concept and Benefit of Contemporary PCI (Physiology and Image supported) !

My Approach
for Multivessel Disease

2021 ACC/AHA/SCAI, Guideline for Coronary Artery Revascularization



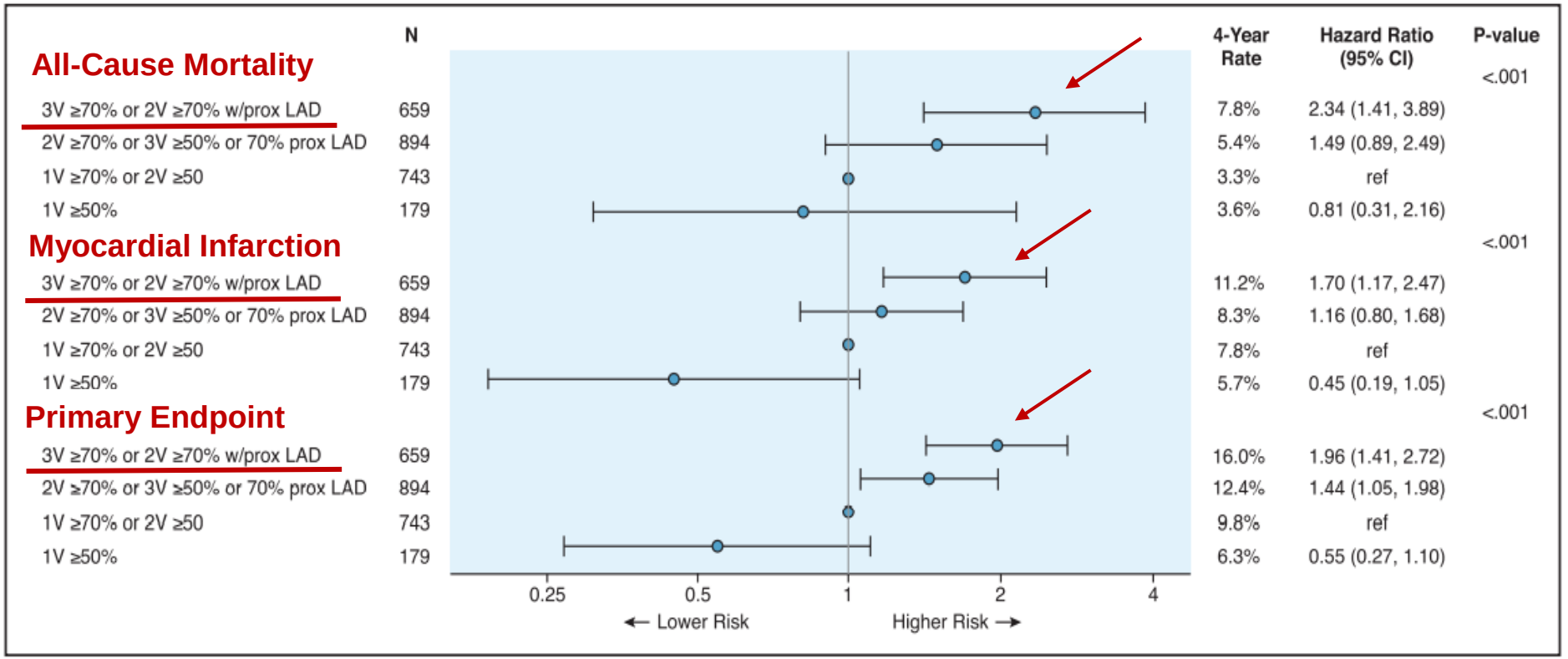
My Approach
for Multivessel Disease

Revascularization* + *Medical Therapy

We Have to Consider
Individualized Treatment Strategy !

According to
the different CAD severity, ischemic severity, different anatomic complexity or suitability for CABG or PCI, LV dysfunction and different clinical comorbidity status.

Coronary Artery Disease Severity and Clinical Outcomes



ISCHEMIA Study, Circulation. 2021;144:1024–1038. DOI: 10.1161/CIRCULATIONAHA.120.04975

Coronary Artery Disease Severity
and Clinical Outcomes

High Risk,
3VD >70% or
2VD >70% with pLAD,

Intermediate Risk,
2VD >70% or 3VD >50%
or >70% pLAD,

Low Risk,
1VD >70% or 2 D >50%
Any 1VD >50%

Revascularization
+ ***Medical Therapy***

Medical Therapy Alone

My Approach 1,
for Multivessel Disease

All Ischemic Lesions,

Favourable Anatomy for PCI,

RVD >2.5 mm and/or Lesion Length < 50 mm,

Complete Ischemic Revascularization with DES !

My Approach 2,
for Multivessel Disease

Unfavourable Anatomy for PCI,

Possible Major Vessels PCI (including pLAD) with Optimal Medical Treatment.

In Cases of Poor Anatomy and Low EF, and/or Diabetic Patients, I Consider CABG first !

In Fact, We Have No data Yet

1. ***Contemporary PCI*** **vs. CABG for Multivessel Disease Patients with *Ischemic Cardiomyopathy (<50% EF).***
2. ***Contemporary PCI*** **vs. CABG for for Multivessel Disease Patients with *Diabetes.***

We Need More Data!

DEFINE-DM Trial

Diabetes-Centered Evaluation of Revascularization Strategy of Functional and Imaging-CombiNEd State-of-the-Art Percutaneous Coronary Intervention or Coronary-Artery Bypass Grafting in Patients with Diabetes Mellitus and Multivessel Coronary Artery Disease

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Diabetes-Centered **E**valuation of **F**unctional and **I**maging-Combi**NE**d State-of-the-Art Percutaneous Coronary Intervention or Coronary-Artery Bypass Grafting in Patients with **D**iabetes **M**ellitus and Three-Vessel Coronary Artery Disease

DEFINE-DM Trial