TCTAP 2022

Can PCI save lives in patients with severe LV dysfunction?

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No conflict of interests to declare

KING'S College LONDON
University of London

Guy's and St Thomas' NHS
NHS Foundation Trust

Can PCI save lives in patients with **ACUTE** severe LV dysfunction?

(Cardiogenic Shock)

ESC European Society of Cardiology
European Heart Journal (2019) 40, 2671–2683
doi:10.1093/eurheartj/ehz363

CLINICAL REVIEW
Clinical update

Management of cardiogenic shock complicating myocardial infarction: an update 2019

Holger Thiele[1,2]*, E. Magnus Ohman[3], Suzanne de Waha-Thiele[4], Uwe Zeymer[5], and Steffen Desch[1,2]

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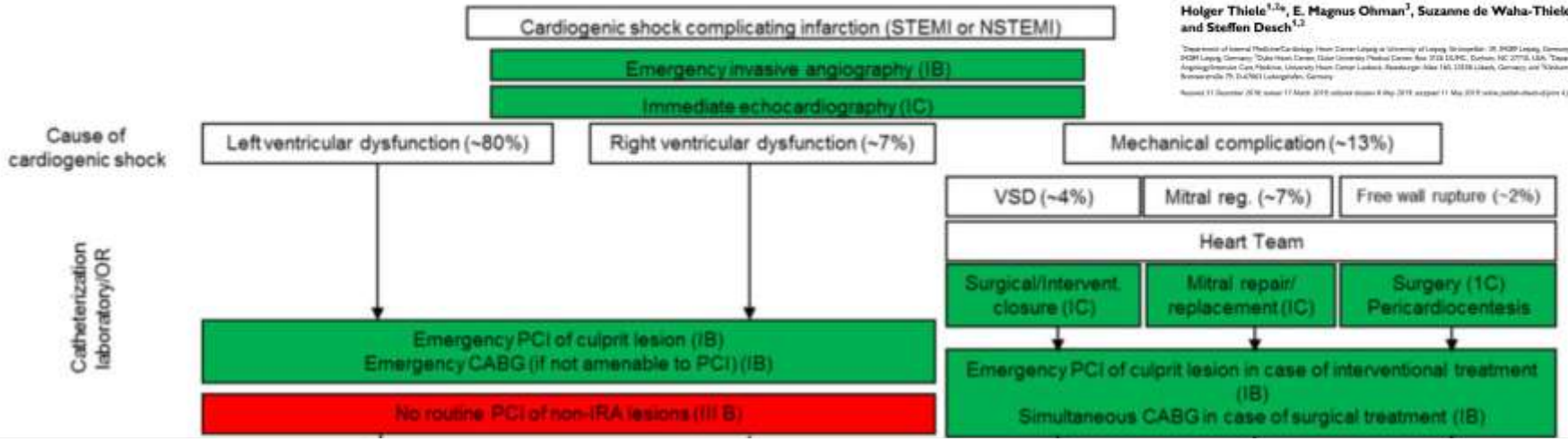
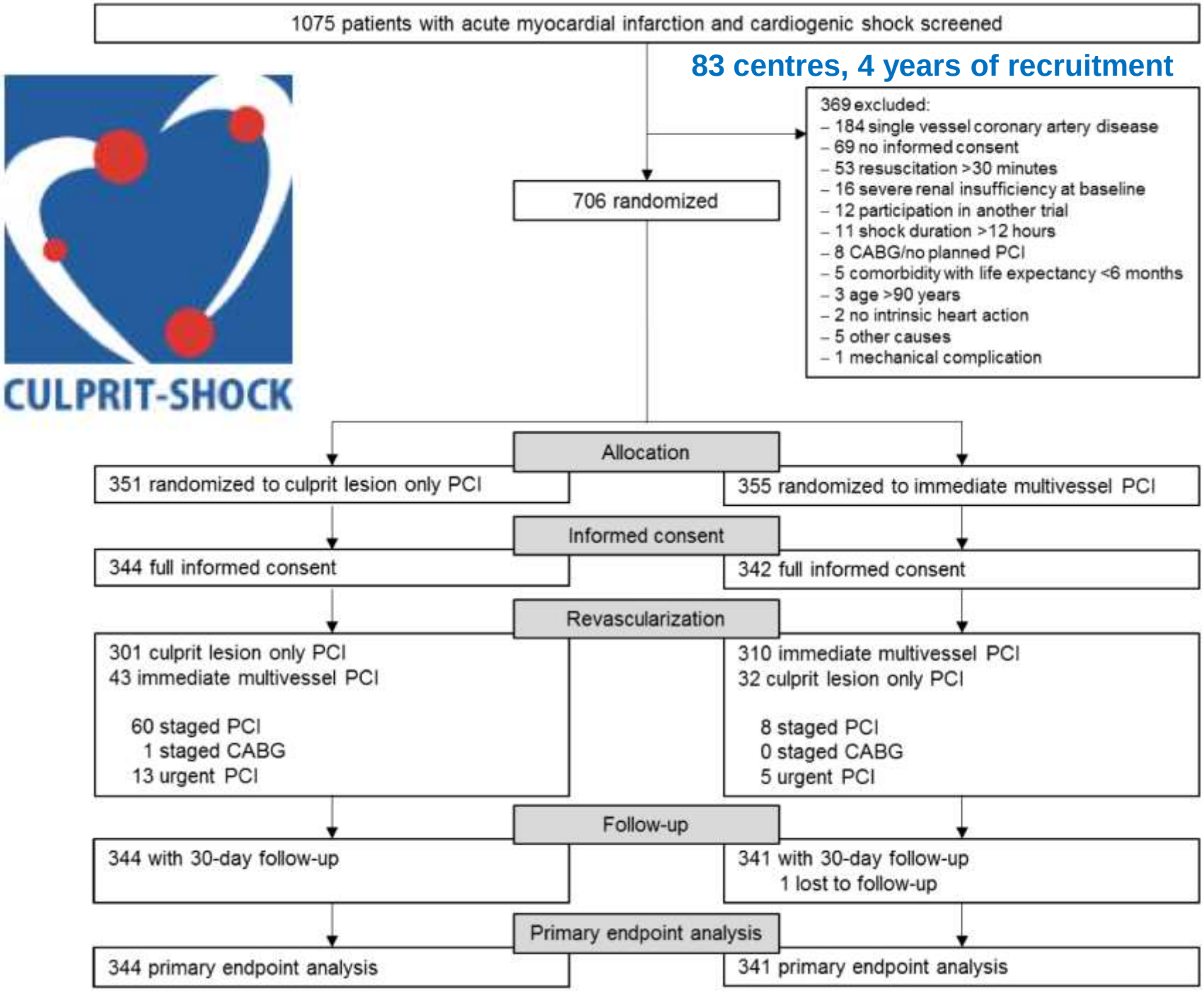
Received 11 December 2018; revised 17 March 2019; editorial decision 8 May 2019; accepted 11 May 2019; online publish-ahead-of-print 4 July 2019




1075 patients with acute myocardial infarction and cardiogenic shock screened
83 centres, 4 years of recruitment
369 excluded:
– 184 single vessel coronary artery disease
– 69 no informed consent
– 53 resuscitation >30 minutes
– 16 severe renal insufficiency at baseline
– 12 participation in another trial
– 11 shock duration >12 hours
– 8 CABG/no planned PCI
– 5 comorbidity with life expectancy <6 months
– 3 age >90 years
– 2 no intrinsic heart action
– 5 other causes
– 1 mechanical complication
706 randomized
CULPRIT-SHOCK
Allocation
351 randomized to culprit lesion only PCI
355 randomized to immediate multivessel PCI
Informed consent
344 full informed consent
342 full informed consent
Revascularization
301 culprit lesion only PCI
43 immediate multivessel PCI
60 staged PCI
1 staged CABG
13 urgent PCI
310 immediate multivessel PCI
32 culprit lesion only PCI
8 staged PCI
0 staged CABG
5 urgent PCI
Follow-up
344 with 30-day follow-up
341 with 30-day follow-up
1 lost to follow-up
Primary endpoint analysis
344 primary endpoint analysis
341 primary endpoint analysis

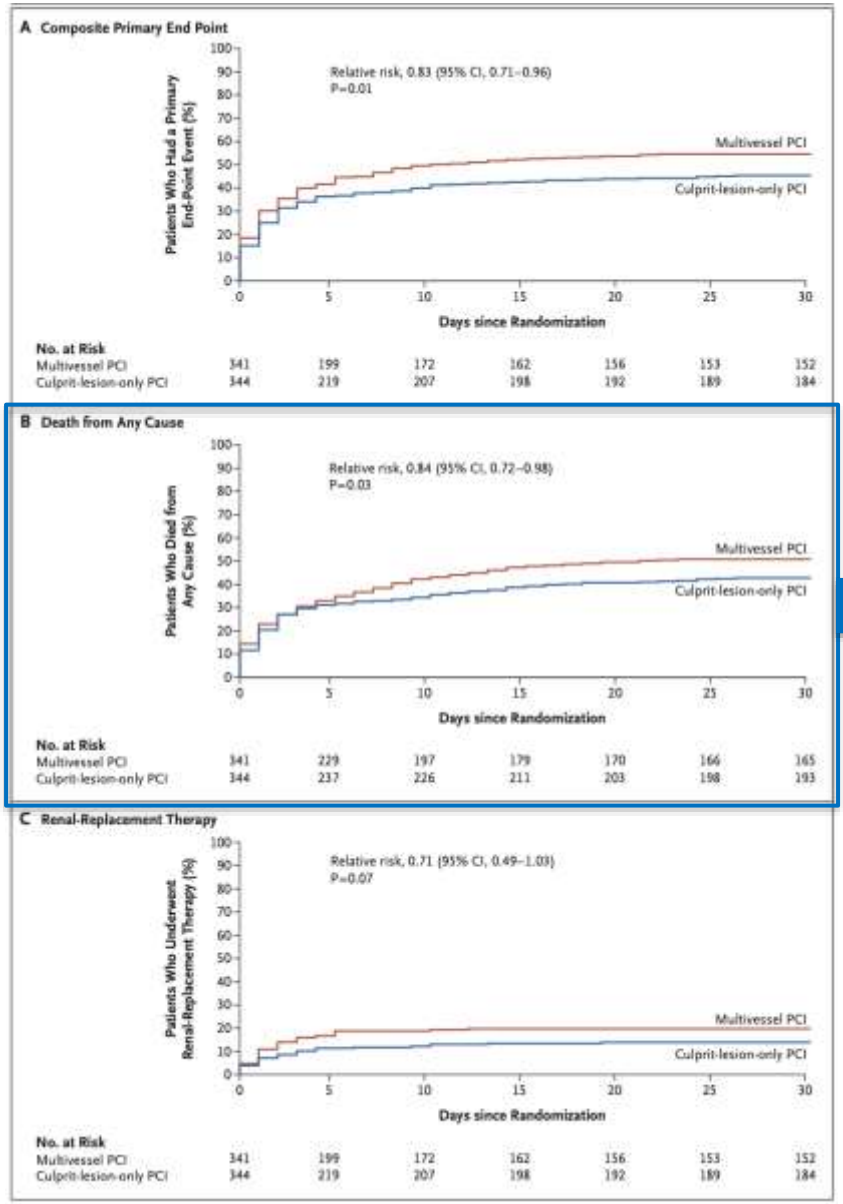
Characteristic	Culprit-Lesion-Only PCI Group (N=344)	Multivessel PCI Group (N=342)
Heart rate — beats/min		
Median	90	91
Interquartile range	73–109	72–107
Creatinine — mg/dl‡		
Median	1.17	1.20
Interquartile range	0.90–1.66	0.90–1.68
Creatinine clearance — ml/min		
Median	64	66
Interquartile range	42–95	43–93
No. of affected vessels — no./total no. (%)		
1	3/343 (0.9)	2/342 (0.6)
2	122/343 (35.6)	124/342 (36.3)
3	218/343 (63.6)	216/342 (63.2)
Vessel related to the infarction — no./total no. (%)		
Left anterior descending artery	132/343 (38.5)	156/342 (45.6)
Left circumflex artery	76/343 (22.2)	70/342 (20.5)
Right coronary artery	102/343 (29.7)	89/342 (26.0)
Left main artery	31/343 (9.0)	22/342 (6.4)
Bypass graft	2/343 (0.6)	5/342 (1.5)
≥1 Chronic total occlusion — no./total no. (%)	77/344 (22.4)	82/342 (24.0)
Left ventricular ejection fraction — %		
Median	33	30
Interquartile range	25–40	21–40

CULPRIT-SHOCK

CULPRIT-SHOCK

Immediate PCI of nonculprit lesions — no./total no. (%)	43/344 (12.5)	310/342 (90.6)	<0.001
Immediate complete revascularization achieved — no./total no. (%)	26/344 (7.6)	277/342 (81.0)	<0.001
Total dose of contrast material — ml			<0.001
Median	190	250	
Interquartile range	140–250	200–350	
Total duration of fluoroscopy — min			<0.001
Median	13	19	
Interquartile range	7–20	12–29	
Staged PCI of nonculprit lesions — no./total no. (%)	60/344 (17.4)	8/341 (2.3)	<0.001
Staged coronary-artery bypass grafting — no./total no. (%)	1/344 (0.3)	0/341	>0.99
Mechanical circulatory support — no./total no. (%)			
Any	99/344 (28.8)	95/342 (27.8)	0.77
Intraaortic balloon pump	25/99 (25.3)	26/95 (27.4)	0.74
Impella 2.5 percutaneous ventricular assist device	16/99 (16.2)	18/95 (18.9)	0.61
Impella CP percutaneous ventricular assist device	30/99 (30.3)	18/95 (18.9)	0.07
TandemHeart percutaneous ventricular assist device	2/99 (2.0)	0/95	0.50
Extracorporeal membrane oxygenation	18/99 (18.2)	27/95 (28.4)	0.09
Other	12/99 (12.1)	8/95 (8.4)	0.40

CULPRIT-SHOCK



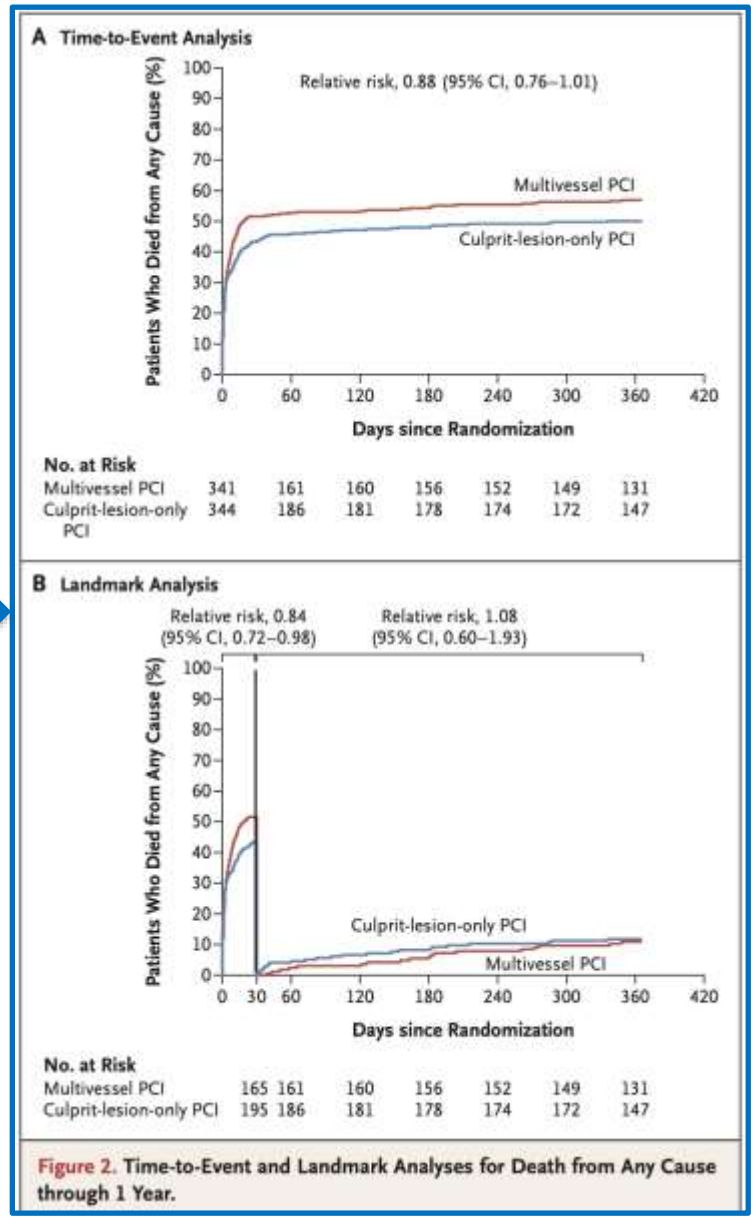


Figure 2. Time-to-Event and Landmark Analyses for Death from Any Cause through 1 Year.

Conclusions:
MV-PCI in Cardiogenic Shock

Current guidelines DO NOT recommend routine multivessel PCI (Class III)
… during the index procedure

HOWEVER, the safety and efficacy of STAGED non-culprit PCI is not known

In my own practice, the decision to treat non-culprit disease (and if so, when) is based on the risk: benefit of treating EACH lesion *and* the state of the subtended myocardium

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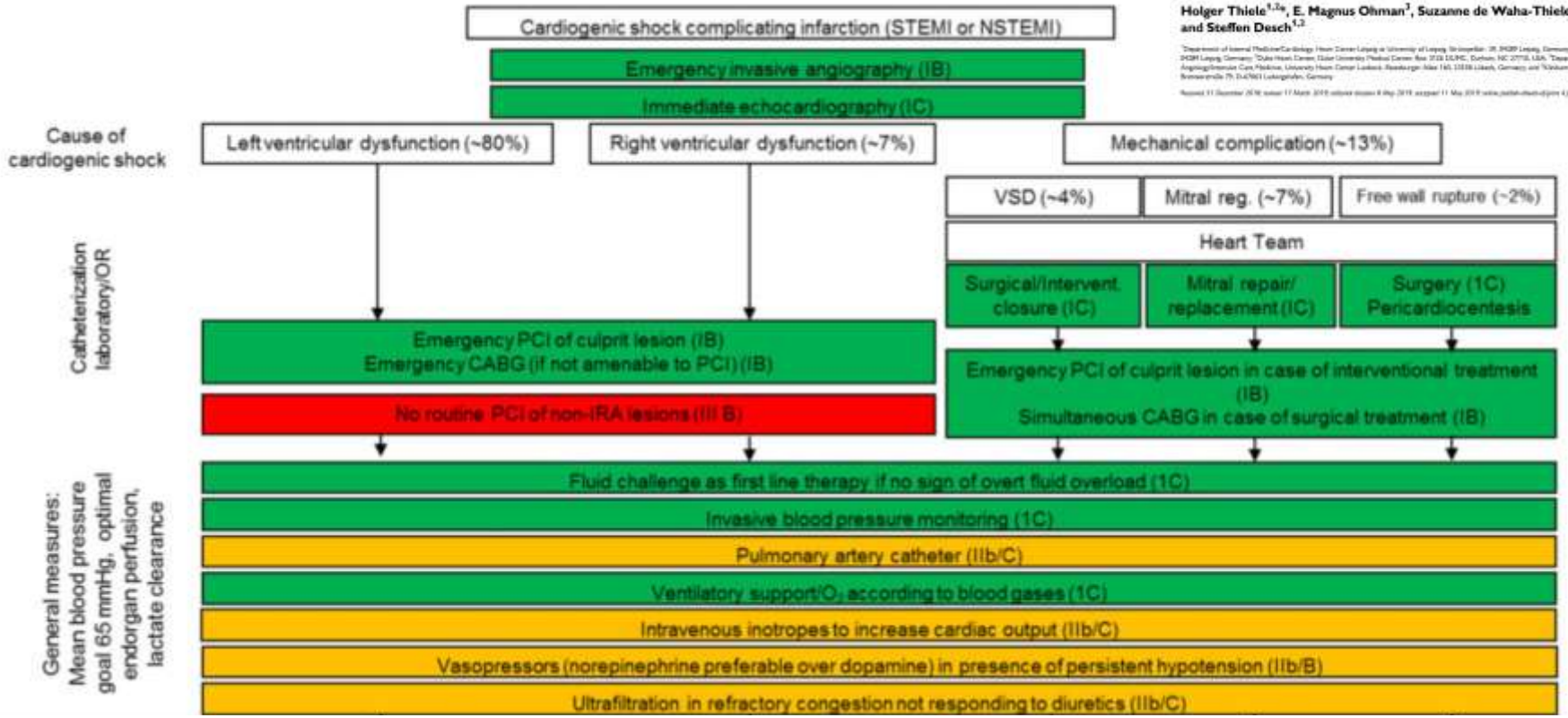

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Clinical update

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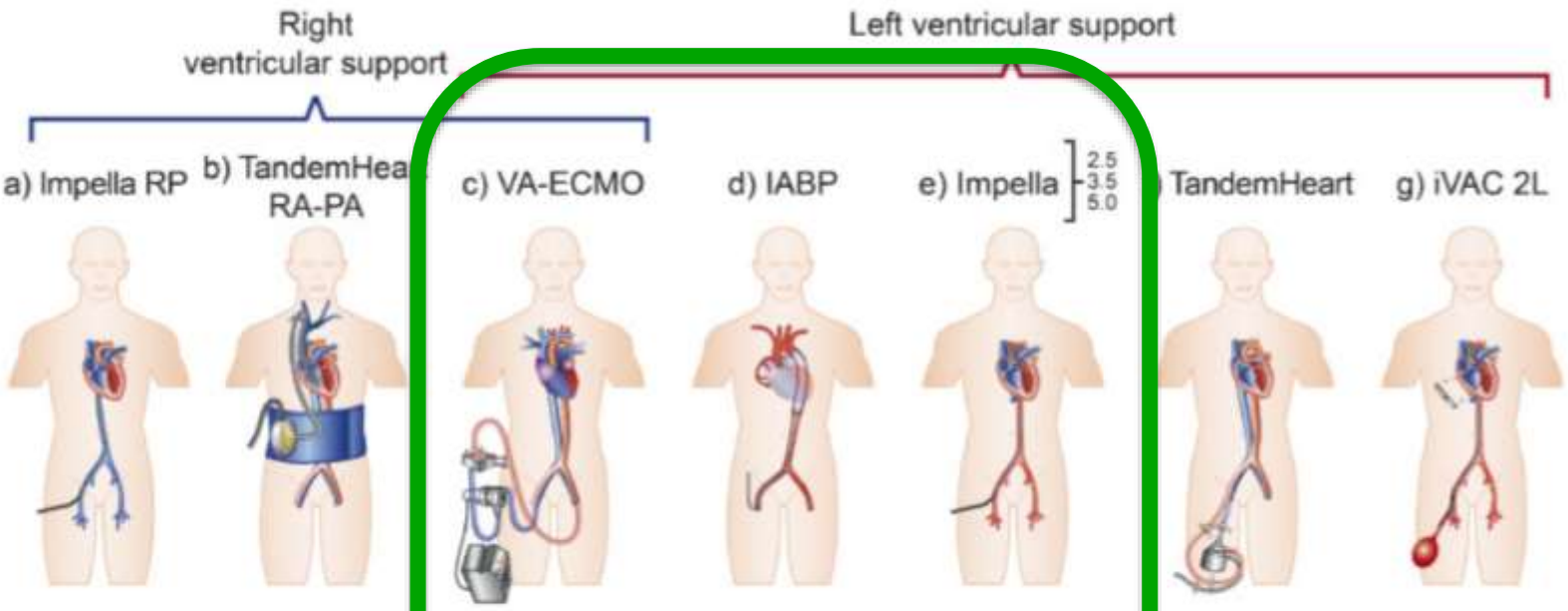
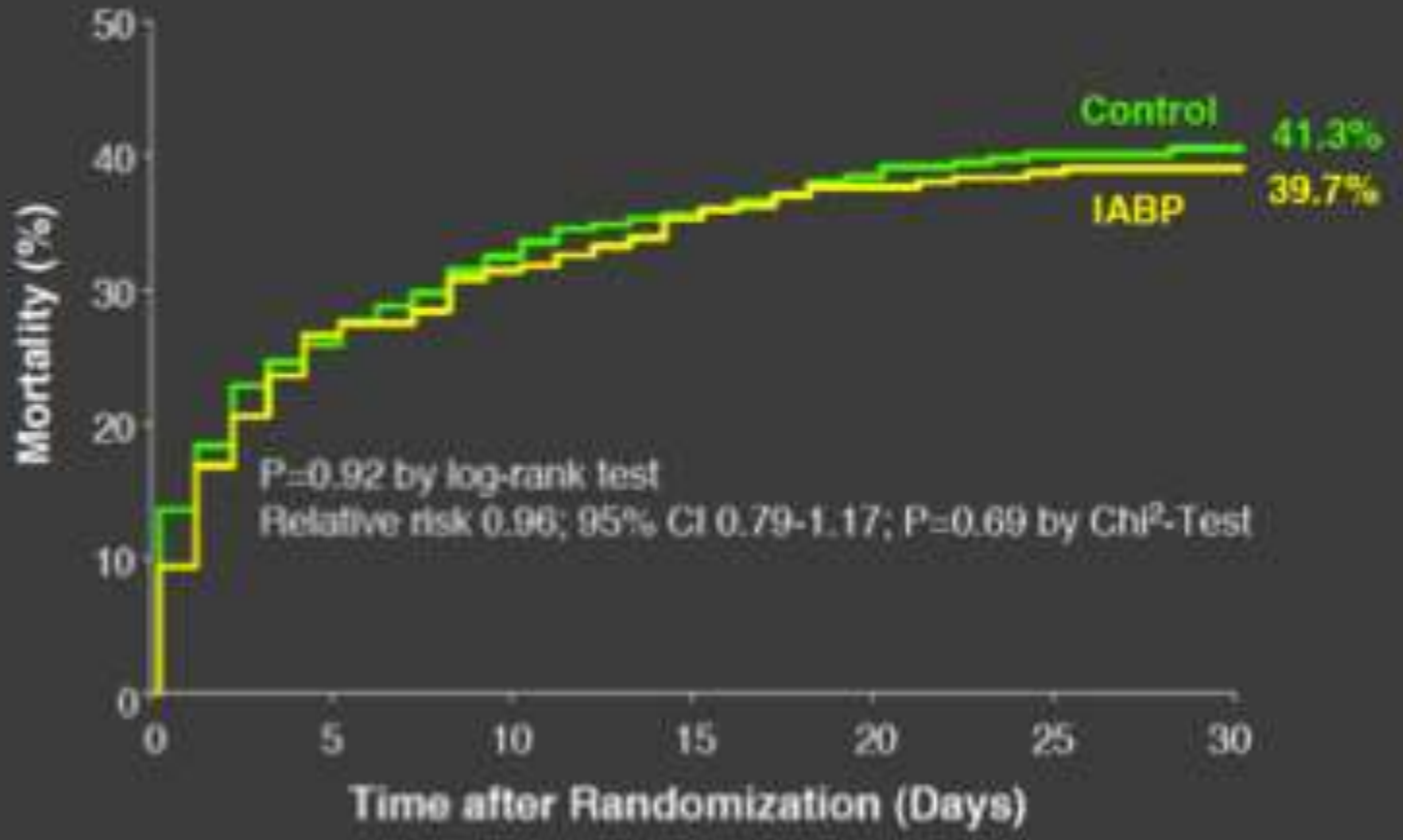


	a) Impella RP	b) TandemHeart RA-PA	c) VA-ECMO	d) IABP	e) Impella	TandemHeart	g) iVAC 2L
Flow:	max. 4.0 L	max. 4.0 L	max. 7.0 L		2.5-5.0 L	max. 4.0 L	max. 2.8 L
Pump speed:	33.000 rpm	max. 7.500 rpm	max. 5000 rpm		max. 51.000 rpm	max. 7.500 rpm	40 ml/beat
Cannula size:	22 F	29 F	14-19 F arterial 17-21F venous	7-8 F	12-14 F	12-19 F arterial 21F venous	17 F
Insertion/ Placement	Femoral vein	Internal jugular vein	Femoral artery Femoral vein	Femoral artery	Femoral artery	Femoral artery Femoral vein for LA access	Femoral artery
LV Unloading	-	-	-	(+)	+ - ++	++	+
RV Unloading	+	+	++	-	-	-	-

Results

Primary Study Endpoint (30-Day Mortality)



Thiele et al. NEJM 2012;367:1287-96

NOT AN RCT

Table I
Characteristics of the patient populations.

Characteristic	IQ Database (N = 15,259)	cVAD Registry (N = 479)	p-value
Age, mean ± SD, y	63.51 ± 12.3	64.61 ± 12.10	0.061
Male sex	73%	76%	0.255
Diabetes	N/A	43%	N/A
Cerebrovascular disease	N/A	13%	N/A
Renal Insufficiency	N/A	24%	N/A
Peripheral vascular disease	N/A	15%	N/A
Pulmonary wedge catheter use	37%	43%	0.007
Impella 2.5	33%	57%	<0.001
Impella CP	61%	42%	<0.001
Impella 5.0	5.2%	1%	<0.001
IABP use prior to Impella	20%	35%	<0.001
Impella use pre-PCI	48%	46%	0.310
Duration of support, mean ± SD, days	3.78 ± 4.8	1.51 ± 1.8	<0.001
Outcomes			
Survival to explant	53%	73%	<0.001
In-hospital survival	N/A	49%	N/A
30-day survival	N/A	40%	N/A

IABP indicated intra-aortic balloon pump; PCI, percutaneous coronary intervention; SD, standard deviation.

65% in patients with AMICS when an Impella was used. There was a sig-

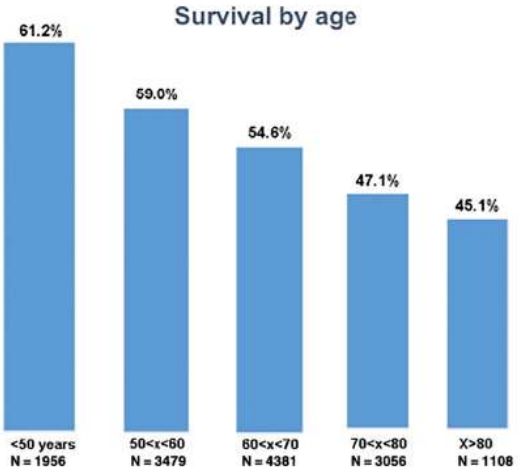


Figure 1. Survival at the time of explant by age. Data on age available in 13,980 patients.

Clinical Investigation

Analysis of outcomes for 15,259 US patients with acute myocardial infarction cardiogenic shock (AMICS) supported with the Impella device

William W. O'Neill, MD, FACC[a], Cindy Grines, MD, FACC[b], Theodore Schreiber, MD, FACC[c], Jeffrey Moses, MD, FACC[d], Brijeshwar Maini, MD, FACC[e], Simon R. Dixon, MBChB, FACC[f], E. Magnus Ohman, MD, FACC[g,*]

American Heart Journal 202 (2018) 33–38

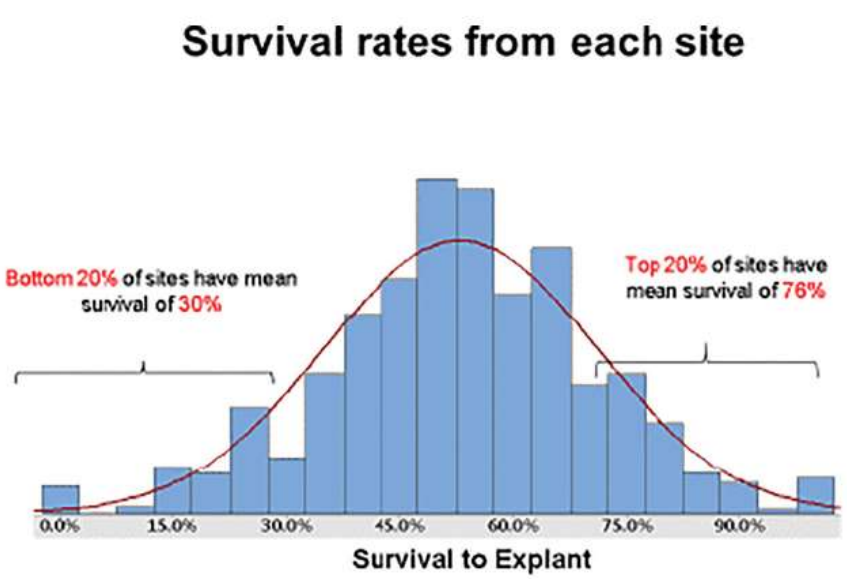


Figure 2. The distribution of survival across the 791 sites who implanted ≥4 Impella.

Circulation. 2019;139:1249–1258.

Circulation

ORIGINAL RESEARCH ARTICLE

Impella Support for Acute Myocardial Infarction Complicated by Cardiogenic Shock

Matched-Pair IABP-SHOCK II Trial 30-Day Mortality Analysis

Editorial, see p 1259

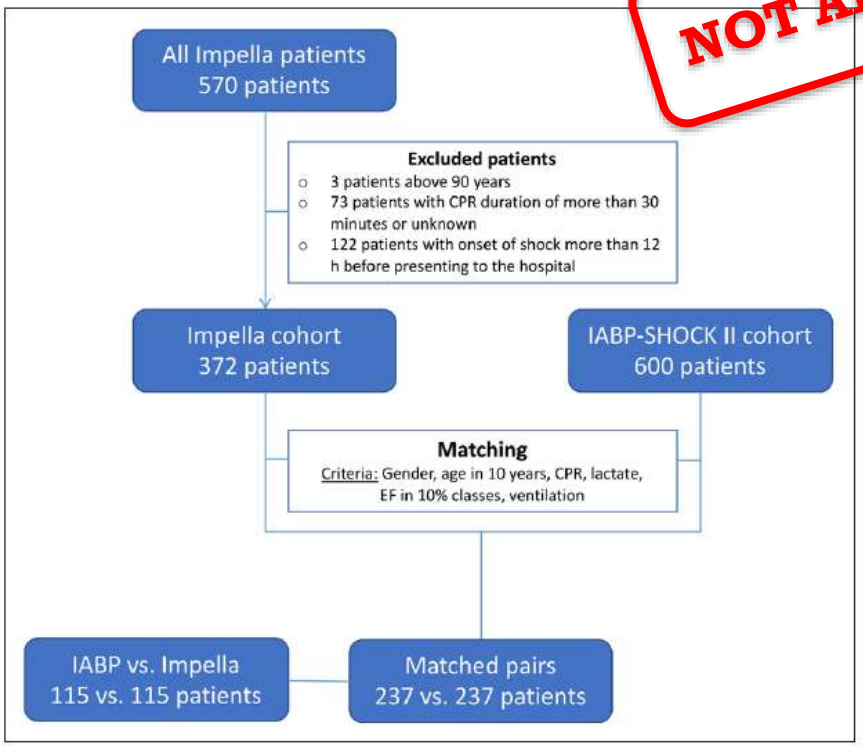
Benedikt Schrage, MD et al

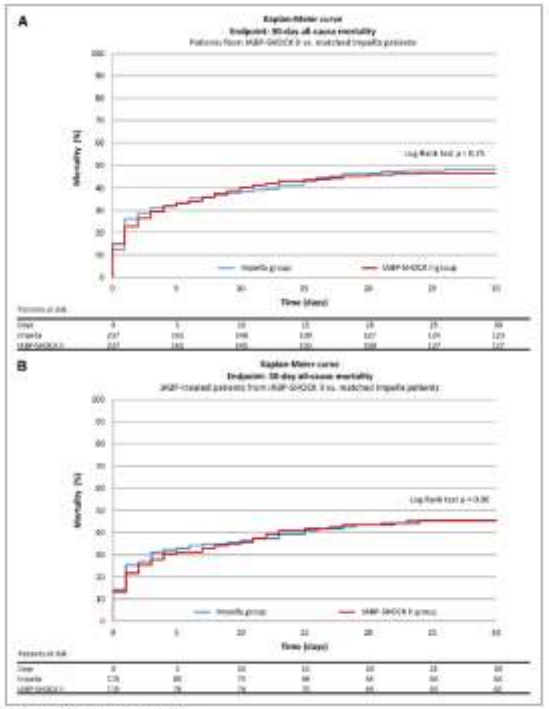
Table 3. Clinical Outcome of the Matched Patients

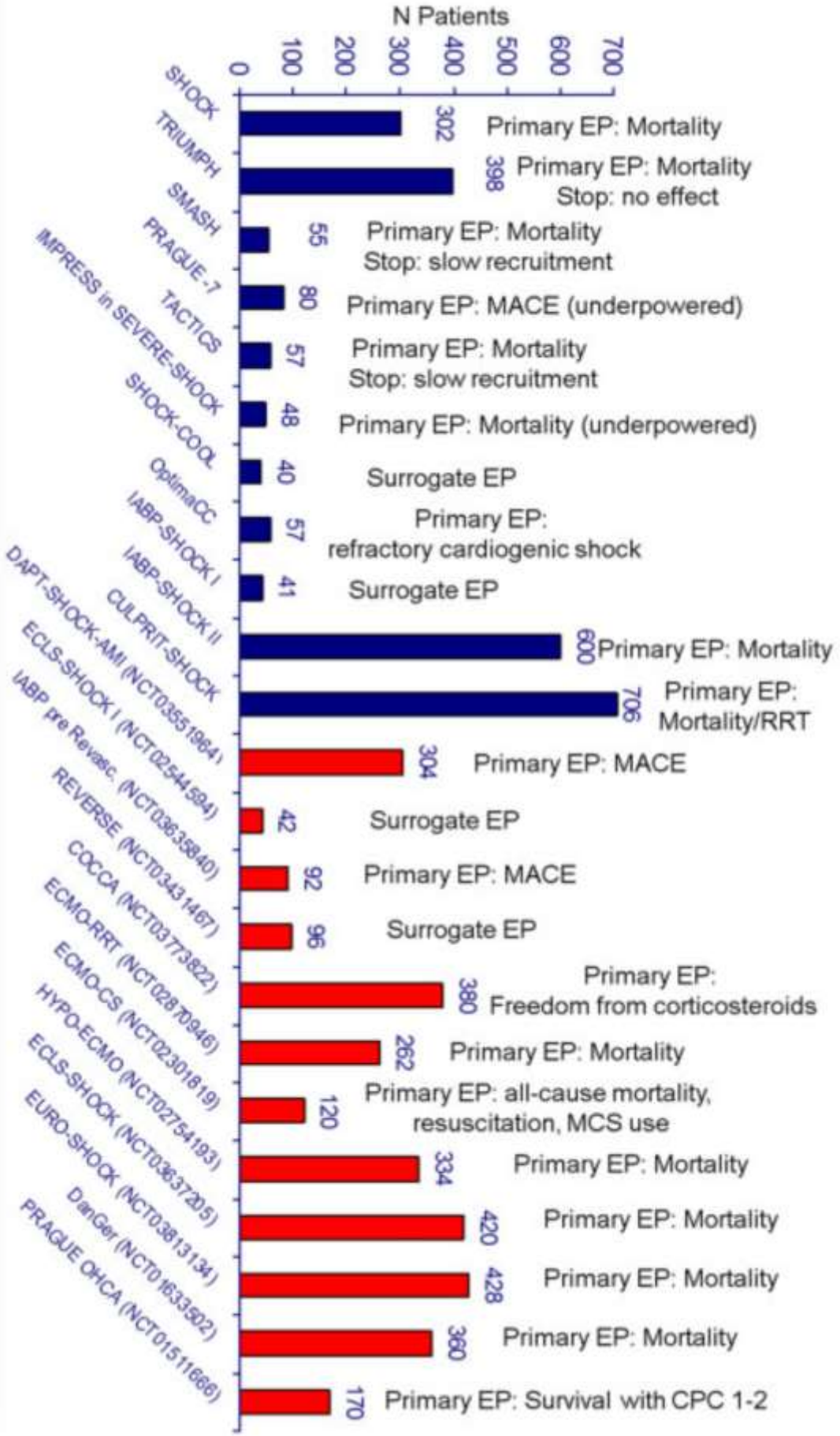
	Impella vs IABP-SHOCK II Trial Patients			Impella vs IABP-Treated Patients From the IABP-SHOCK II Trial		
	Impella Group (n=237)	Control (n=237)	*P* Value	Impella Group (n=115)	Control (n=115)	*P* Value
30-day all-cause mortality	115 (48.5)	110 (46.4)	0.64	53 (46.1)	52 (45.2)	0.90
Reinfarction in hospital	7 (3.5)	6 (2.5)	0.56	4 (4.0)	4 (3.5)	0.71
Stent thrombosis in hospital	1 (0.6)	3 (1.3)	0.32	0 (0.0)	2 (1.7)	0.22
Stroke in hospital	6 (3.5)	6 (2.5)	0.76	2 (2.3)	1 (0.9)	0.56
Peripheral ischemic complications requiring intervention in hospital	23 (9.8)	9 (3.8)	0.01	11 (9.6)	4 (3.5)	0.05
Moderate bleeding in hospital	48 (20.3)	40 (16.9)	0.32	22 (19.1)	24 (20.9)	0.72
Life-threatening or severe bleeding in hospital	20 (8.5)	7 (3.0)	<0.01	12 (10.4)	2 (1.7)	<0.01
Sepsis in hospital	73 (35.3)	46 (19.4)	<0.01	39 (38.2)	20 (17.4)	<0.01

Values are presented as frequencies (percentages) or median (interquartile range). IABP-SHOCK II indicates Intraaortic Balloon Pump in Cardiogenic Shock.

NOT AN RCT






N Patients
0
100
200
300
400
500
600
700
SHOCK
302
Primary EP: Mortality
TRIUMPH
398
Primary EP: Mortality
Stop: no effect
SMASH
55
Primary EP: Mortality
Stop: slow recruitment
PRAGUE-7
80
Primary EP: MACE (underpowered)
IMPRESS in SEVERE-SHOCK
57
Primary EP: Mortality
Stop: slow recruitment
TACTICS
48
Primary EP: Mortality (underpowered)
SHOCK-COOL
40
Surrogate EP
OptimaCC
57
Primary EP:
refractory cardiogenic shock
IABP-SHOCK I
41
Surrogate EP
IABP-SHOCK II
600
Primary EP: Mortality
CULPRIT-SHOCK
706
Primary EP:
Mortality/RRT
DAPT-SHOCK-AMI (NCT03551964)
304
Primary EP: MACE
ECLS-SHOCK I (NCT02544594)
42
Surrogate EP
IABP pre Revasc. (NCT03633840)
92
Primary EP: MACE
REVERSE (NCT03431467)
96
Surrogate EP
COCCA (NCT03773822)
380
Primary EP:
Freedom from corticosteroids
ECMO-RRT (NCT02870946)
262
Primary EP: Mortality
ECMO-CS (NCT02301819)
120
Primary EP: all-cause mortality,
resuscitation, MCS use
HYPO-ECMO (NCT02754193)
334
Primary EP: Mortality
ECLS-SHOCK (NCT03637205)
420
Primary EP: Mortality
EURO-SHOCK (NCT03813134)
428
Primary EP: Mortality
DanGer (NCT01633502)
360
Primary EP: Mortality
PRAGUE OHCA (NCT01511666)
170
Primary EP: Survival with CPC 1-2

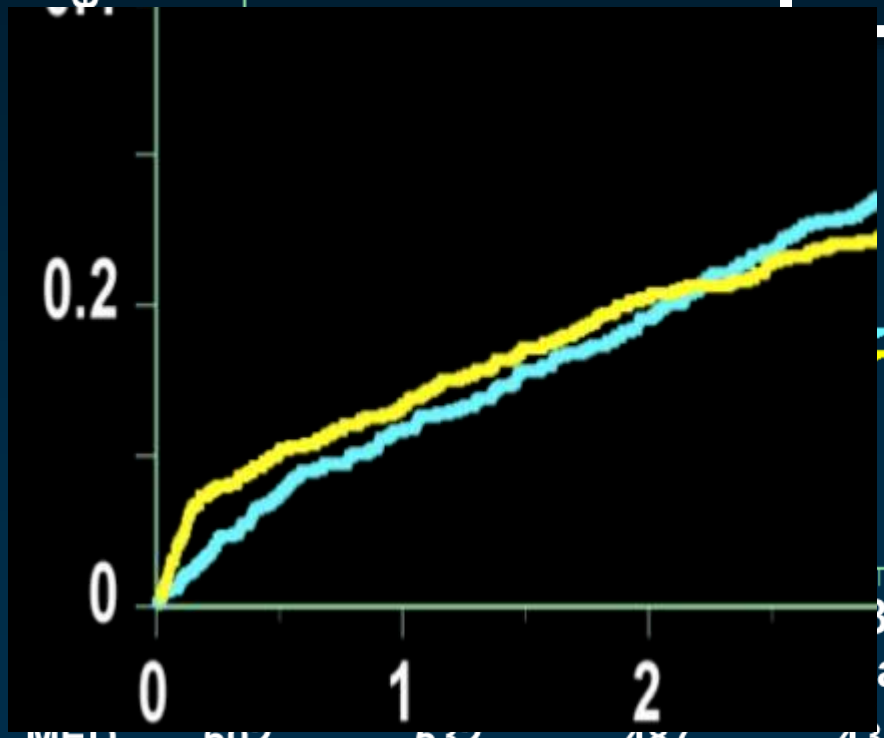
Can PCI save lives in patients with **CHRONIC** severe LV dysfunction?

(in stable CAD)

All-Cause Mortality

STICH

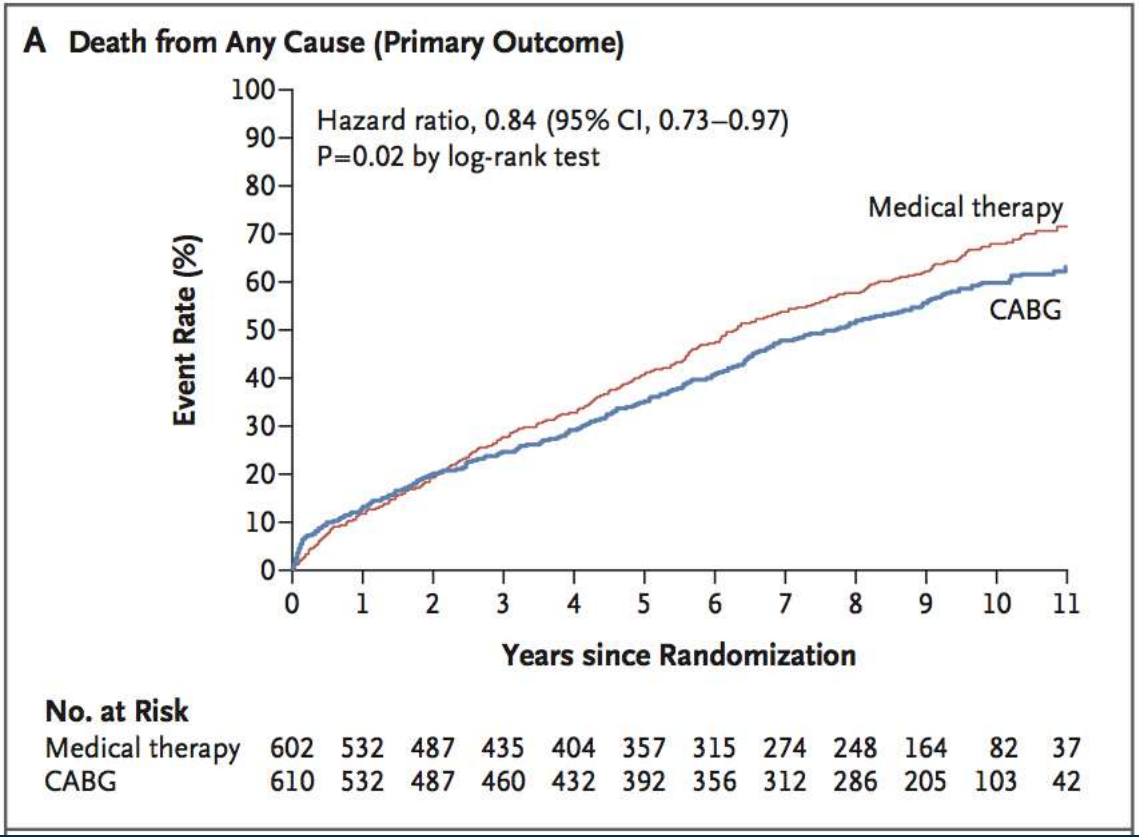
NEJM April 2012



Coronary-Artery Bypass Surgery in Patients with Ischemic Cardiomyopathy

Eric J. Velazquez, M.D., Kerry L. Lee, Ph.D., Robert H. Jones, M.D., Hussein R. Al-Khalidi, Ph.D., James A. Hill, M.D., Julio A. Panza, M.D., Robert E. Michler, M.D., Robert O. Bonow, M.D., Torsten Doenst, M.D., Mark C. Petrie, M.D., Jae K. Oh, M.D., Lilin She, Ph.D., Vanessa L. Moore, A.A.S., Patrice Desvigne-Nickens, M.D., George Sopko, M.D., M.P.H., and Jean L. Rouleau, M.D., for the STICHES Investigators*

NEJM 3rd April 2016



STICH

EXCEL: Periprocedural Events

	PCI (n=948)	CABG (n=957)	RR [95%CI]	P-value
30-Day peri-procedural MAE, any	8.1%	23.0%	0.35 [0.28, 0.45]	<0.001
- Death*	0.9%	1.0%	0.91 [0.3	0.83
- Stroke*	0.6%	1.3%		0.16
- Myocardial infarction*	3.9%			0.02
- Ischemia-driven revascularizati			[0.18, 1.22]	0.11
- TIMI major/mino		3.9%	0.42 [0.28, 0.61]	<0.001
- Transf	4.0%	17.0%	0.24 [0.17, 0.33]	<0.001
- Major a	2.0%	15.8%	0.13 [0.08, 0.20]	<0.001
- Surgery diologic procedure	1.1%	4.0%	0.27 [0.13, 0.53]	<0.001
- Renal failure†	0.5%	2.4%	0.22 [0.08, 0.57]	<0.001
- Sternal wound dehiscence	0.0%	1.9%	0.03 [0.00, 0.45]	<0.001
- Infection requiring antibiotics	2.3%	13.6%	0.17 [0.11, 0.27]	<0.001
- Prolonged intubation (>48 hours)	0.4%	2.9%	0.14 [0.05, 0.41]	<0.001
- Post-pericardiotomy syndrome	0.0%	0.4%	0.11 [0.01, 2.08]	0.12

LVEF in Excel was 57 ± 9%

*Adjudicated events; others are site-reported. **SVT requiring cardioversion, VT or VF requiring treatment, or bradyarrhythmia requiring temporary or permanent pacemaker. †Serum creatinine increased by ≥0.5 mg/dL from baseline or need for dialysis.

Stone GW, et al. NEJM 2016

European Heart Journal (2014) **35**, 3004–3012
doi:10.1093/eurheartj/ehu303

CLINICAL RESEARCH
Interventional cardiology

Impact of left ventricular function in relation to procedural outcomes following percutaneous coronary intervention: insights from the British Cardiovascular Intervention Society

Mamas A. Mamas[1,2†], Simon G. Anderson[1,2†], Peter D. O'Kane[3], Bernard Keavney[1,2], James Nolan[4], Keith G. Oldroyd[5], Divaka Perera[6], Simon Redwood[6], Azfar Zaman[7], Peter F. Ludman[8], and Mark A. de Belder[9], on behalf of the British Cardiovascular Intervention Society and the National Institute for Cardiovascular Outcomes Research

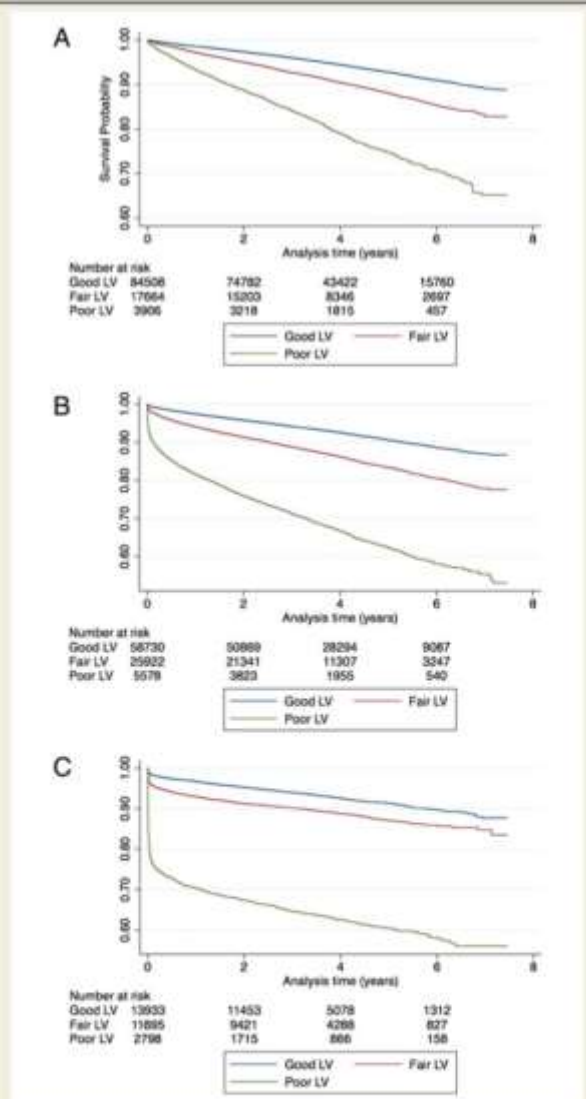


Figure 3 (*A*) Unadjusted Kaplan–Meier survival curves for patients undergoing percutaneous coronary intervention in the elective setting stratified by left ventricular function. (*B*) Unadjusted Kaplan–Meier survival curves for patients undergoing percutaneous coronary intervention for non-ST elevation myocardial infarction stratified by left ventricular function. (*C*) Unadjusted Kaplan–Meier survival curves for patients undergoing percutaneous coronary intervention for ST elevation myocardial infarction stratified by left ventricular function.

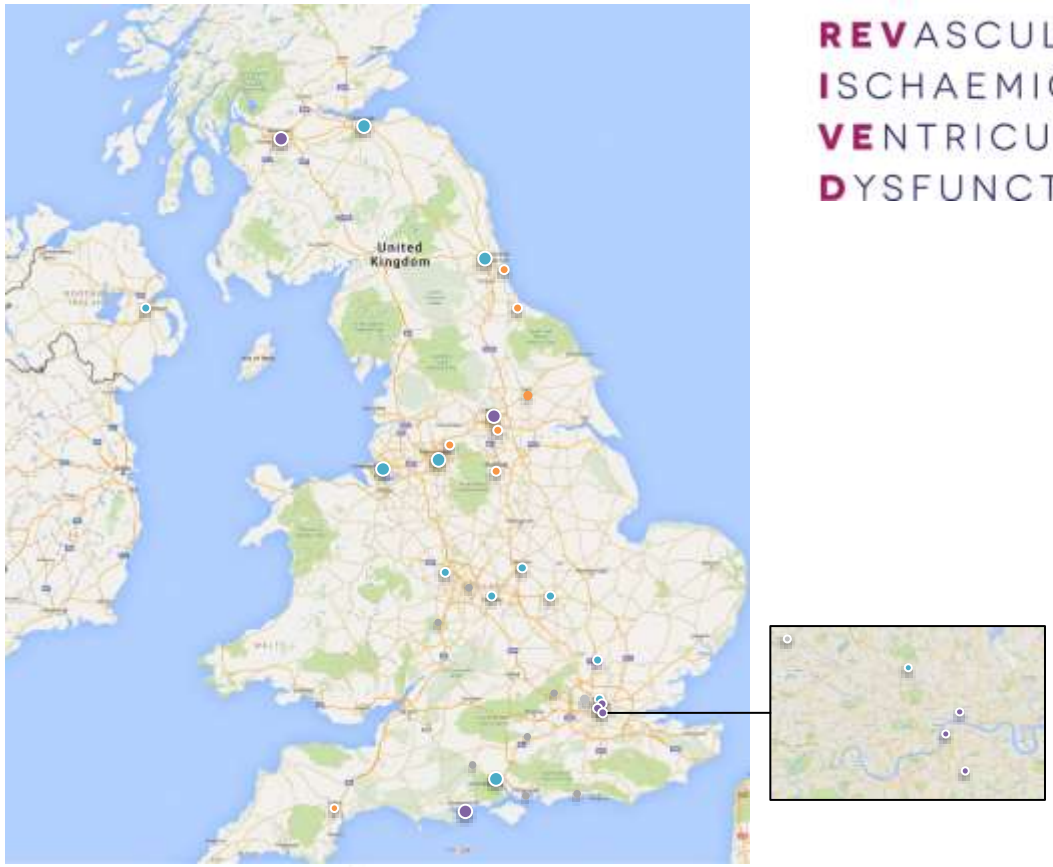
Guidelines for Revascularisation (LVEF<35%)

2014

Recommendations	Class[a]	Level[b]	Ref[c]
CABG is recommended for patients with significant LM stenosis and LM equivalent with proximal stenosis of both LAD and LCx arteries.	I	C	-
CABG is recommended for patients with significant LAD artery stenosis and multivessel disease to reduce death and hospitalization for cardiovascular causes.	I	B	112,288
Myocardial revascularization should be considered in the presence of viable myocardium.	IIa	B	55
CABG with surgical ventricular restoration may be considered in patients with scarred LAD territory, especially if a post-operative LVESV index < 70 mL/m^2 can be predictably achieved.	IIb	B	291–295
PCI may be considered if anatomy is suitable, in the presence of viable myocardium, and surgery is not indicated.	IIb	C	

REVIVED

REVASCULARISATION FOR
ISCHAEMIC
VENTRICULAR
DYSFUNCTION



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ISRCTN45979711
NCT01920048

NHS
National Institute for Health Research

JACC Heart Failure
A Journal of the American College of Cardiology
June 2017
Volume 6, No. 6
517-26

Percutaneous Revascularization for Ischemic Ventricular Dysfunction: Rationale and Design of the REVIVED-BCIS2 Trial

Percutaneous Coronary Intervention for Ischemic Cardiomyopathy

Divaka Perera, MA, MD,[a] Tim Clayton, MSc,[b] Mark C. Petrie, MBChB, MD,[c] John P. Greenwood, MBChB, PhD,[d] Peter D. O'Kane, MBBS, MD,[e] Richard Evans, BA,[b] Mark Sculpher, MA, PhD,[f] Theresa Mcdonagh, MBBS, MD,[g] Anthony Gershlick, MBBS,[h] Mark de Belder, MA, MD,[i] Simon Redwood, MBBS, MD,[a] Gerald Carr-White, MBBS, PhD,[a] Michael Marber, MBBS, PhD,[a] on behalf of the REVIVED investigators

Study Design

Hypothesis:

Compared to optimal medical therapy alone, PCI improves event free survival in patients with impaired LV function and myocardial viability

Primary endpoint:

All cause mortality or hospitalisation due to heart failure

Sample size: 700

Time to event analysis, minimum f/u: 2 yrs

Predicted event rate with OMT= 36% at 2 years

87% power to show 25% RR with PCI

ISRCTN45979711 *NCT01920048*

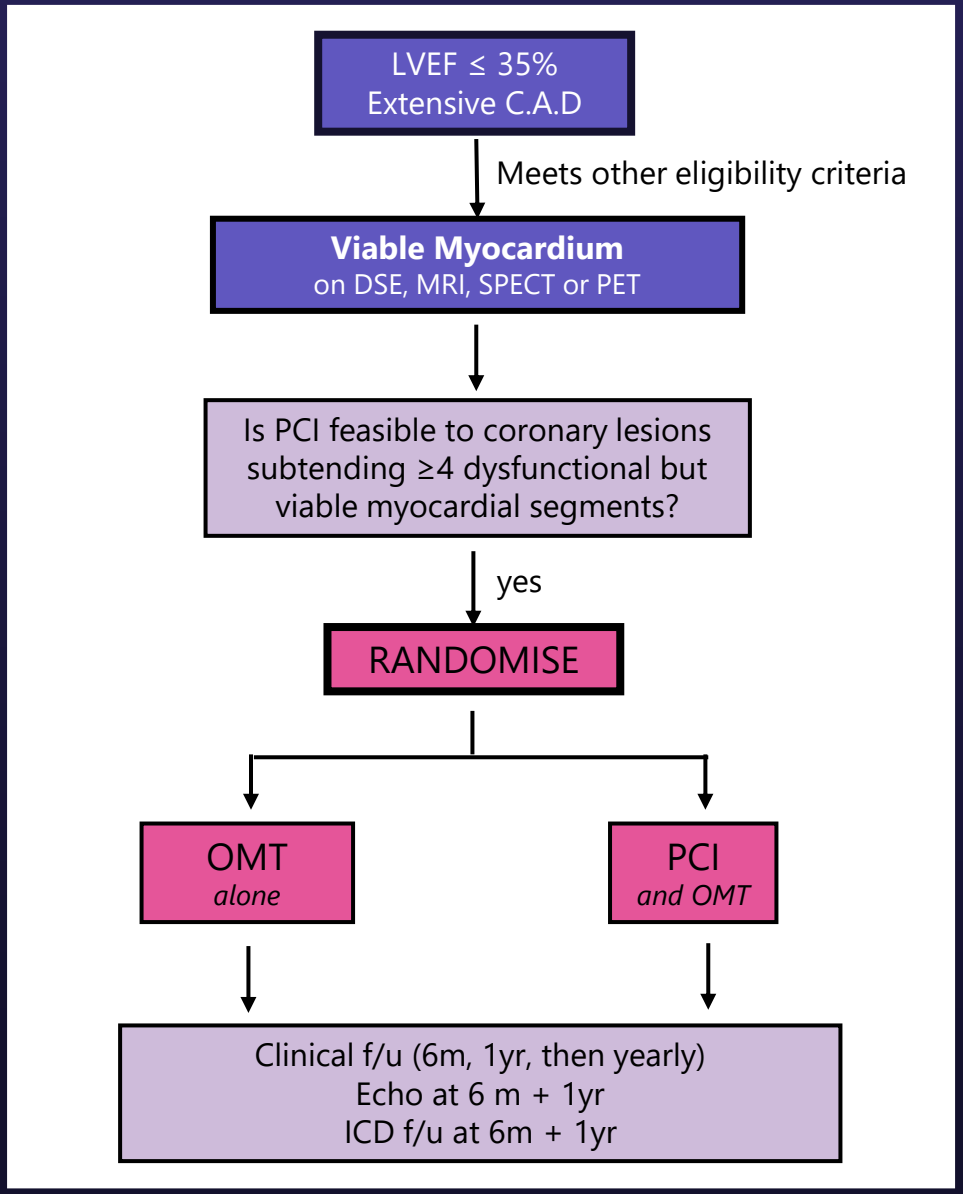
Study Design

Inclusion Criteria:

- LVEF≤35%
- Extensive CAD
- Viability in ≥4 dysfunctional segments that can be revascularised by PCI

Exclusion Criteria:

- AMI < 4 weeks previously



ISRCTN45979711 *NCT01920048*

Revascularisation in LV Dysfunction

Surgical revascularisation improves mortality and morbidity
… but at high procedu

Wheth **t such**

REVIVED follow-up (min. 2 years) will complete in March 2022

Results …. ESC 2022?

With PCI, segmental viability (+/- ischaemia) targeted complete revascularisation is most likely to deliver benefit
(relatively evidence free zone)