Universitäres Herzzentrum Lübeck

WE ARE THE ESC

Why we need a consensus document on cardiogenic shock?

ACCA Masterclass 2017

Holger Thiele

Acute Cardiovascular Care Association ACCA
A Registered Branch of the ESC

EUROPEAN SOCIETY OF CARDIOLOGY®

Cardiogenic Shock – STEMI Guidelines

Oxygen/mechanical respiratory support is indicated according to blood gasses.	I	C
Urgent echocardiography/Doppler must be performed to detect mechanical complications, assess systolic function and loading conditions.	I	C
High-risk patients must be transferred early to tertiary centres.	I	C
Emergency revascularization with either PCI or CABG in suitable patients must be considered.	I	B
Fibrinolysis should be considered if revascularization is unavailable.	IIa	C
Intra-aortic balloon pumping may be considered.	IIb	B
LV assist devices may be considered for circulatory support in patients in refractory shock.	IIb	C
Haemodynamic assessment with balloon floating catheter may be considered.	IIb	B
Inotropic/vasopressor agents should be considered: • Dopamine	IIa	C
• Dobutamine	IIa	C
• Norepinephrine (preferred over dopamine when blood pressure is low).	IIb	B

Steg et al. Eur Heart J.2012;33:2569-2619

Cardiogenic Shock – CHF Guidelines

Recommendations	Class [a]	Level [b]	Ref [c]
In all patients with suspected cardiogenic shock, immediate ECG and echocardiography are recommended.	I	C	
All patients with cardiogenic shock should be rapidly transferred to a tertiary care center which has a 24/7 service of cardiac catheterization, and a dedicated ICU/CCU with availability of short-term mechanical circulatory support.	I	C	
In patients with cardiogenic shock complicating ACS an immediate coronary angiography is recommended (within 2 hours from hospital admission) with an intent to perform coronary revascularization.	I	C	
Continous ECG and blood pressure monitoring are recommended.	I	C	
Invasive monitoring with an arterial line is recommended.	I	C	
Fluid challenge (saline or Ringer's lactate, >200 ml/15–30 min) is recommended as the first-line treatment if there is no sign of overt fluid overload.	I	C	
Intravenous inotropic agents (dobutamine) may be considered to increase cardiac output.	IIb	C	
Vasopressors (norepinephrine preferable over dopamine) may be considered if there is a need to maintain SBP in the presence of persistent hypoperfusion.	IIb	B	558
IABP is not routinely recommended in cardiogenic shock.	III	B	585, 586
Short-term mechanical circulatory support may be considered in refractory cardiogenic shock depending on patient age, comorbidities and neurological function.	IIb	C	

Ponikowski et al. Eur Heart J. 2016;37:2129–2200

Austrian/German S3-Guideline Cardiogenic Shock

Leitlinien

Kardiologe 2011 · 5:166–224
DOI 10.1007/s12181-011-0349-8

K. Werdan · M. Ruß · M. Buerke · L. Engelmann · M. Ferrari · I. Friedrich · A. Geppert · J. Graf · G. Hindricks · U. Janssens · B.M. Pieske · R. Prondzinsky · S. Reith · H.-J. Trappe · M. Zehender · H.-R. Zerkowski · U. Zeymer · H.A. Adams · J. Briegel · G. Delle-Karth · F.A. Schöndube · B. Schwaab · C. Bode · A. Christoph · R. Erbel · J.T. Fuhrmann · R. Strasser · H.-R. Figulla · G. Görge · D. Schmitt · G. Schuler · R.-E. Silber · U. Tebbe · B. Zwißler

Deutsch-österreichische S3-Leitlinie „Infarktbedingter kardiogener Schock – Diagnose, Monitoring und Therapie“

Werdan et al. Dtsch Ärzteblatt Int 2012;109:343-351

AHA Scientific Statement

American Heart Association

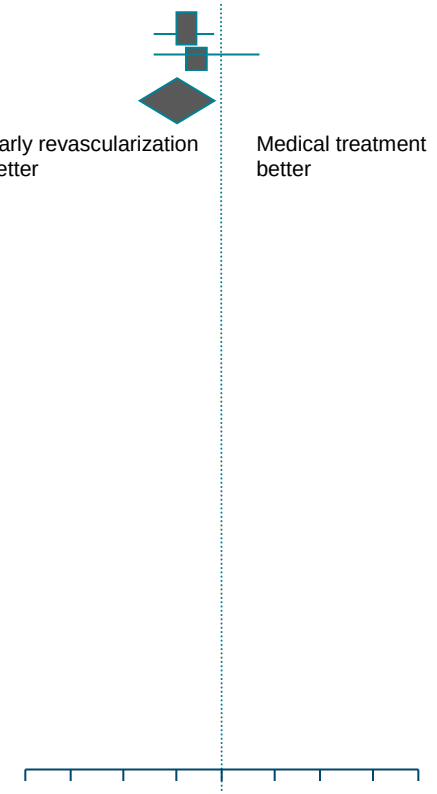
Contemporary Management of Cardiogenic Shock – A Scientific Statement

Sean van Diepen MD MSc[1]; Jason N. Katz, MD, MHS[2]; Nancy M. Albert PhD[3]; Timothy D. Henry MD[4]; Alice K Jacobs MD[5]; Navin K. Kapur MD[6]; Ahmet Kilic, MD[7]; Venu Menon MD[8]; E. Magnus Ohman, MD[9]; Nancy K. Sweitzer MD PhD[10]; Holger Thiele MD[11]; Jeffrey B. Washam PhamD[12]; Mauricio G. Cohen MD[13]

Diepen et al. Circulation 2017; in press

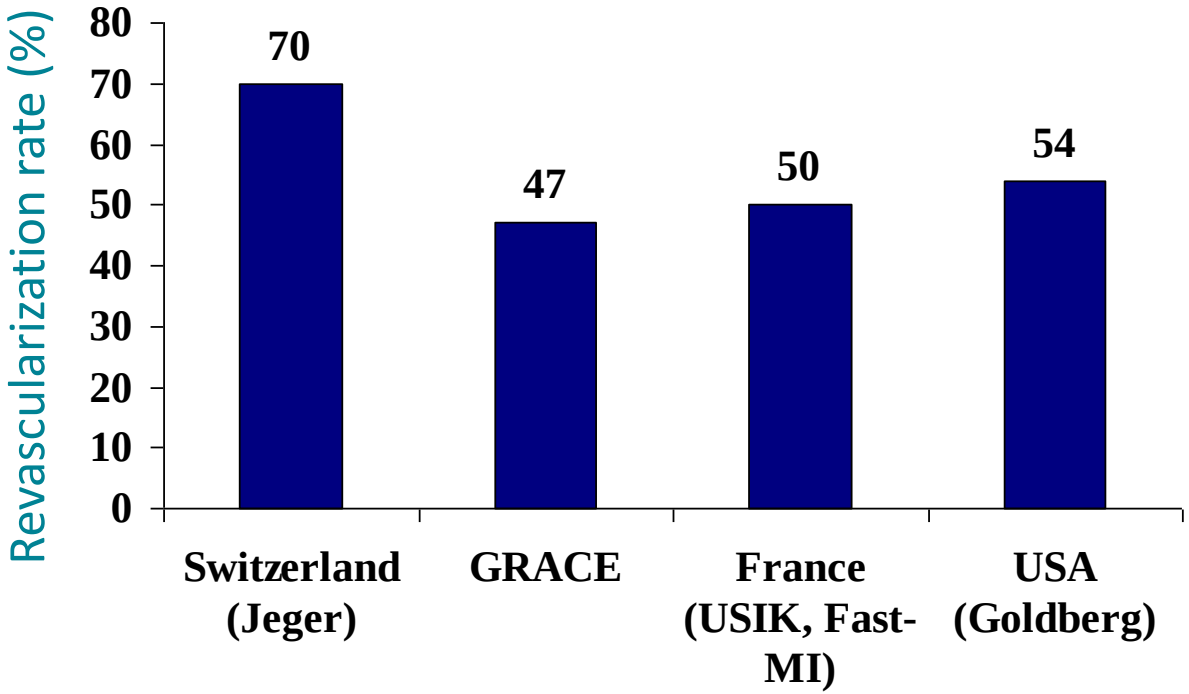
Randomized Trials in Cardiogenic Shock

Trial	Follow-up	n/N	n/N	Relative Risk 95% CI	Relative Risk 95% CI
Revascularization (PCI/CABG)					
SHOCK	1 year	81/152	100/150		0.72 (0.54;0.95)
SMASH	30 days	22/32	18/23		0.87 (0.66;1.29)
Total		**103/184**	**118/173**		**0.82 (0.69;0.97)**



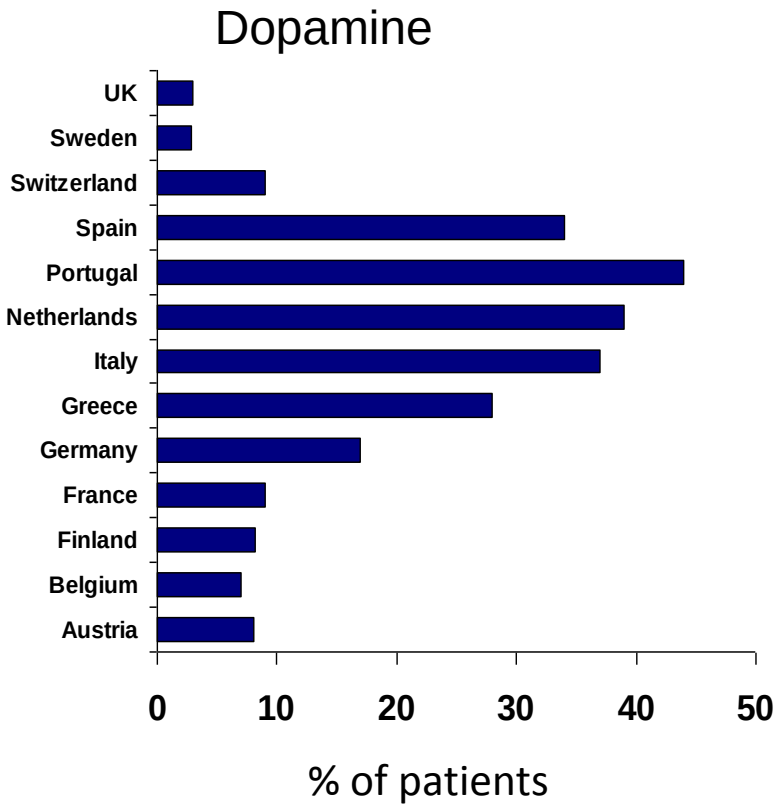
Thiele et al. Eur Heart J 2015;36:1223-1230

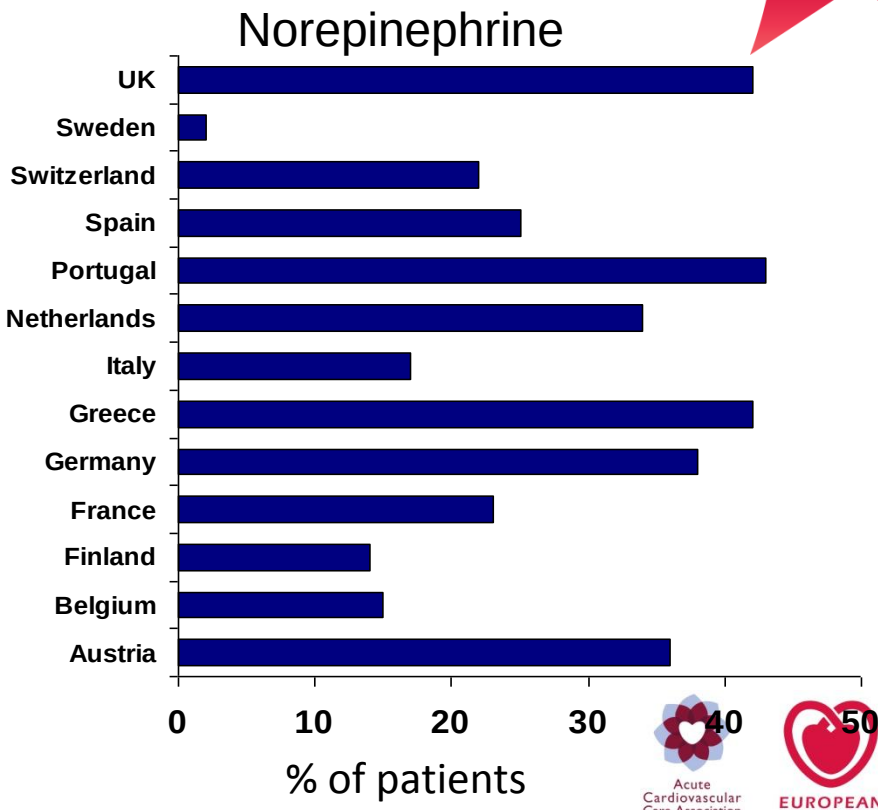
Revascularization Rate – Registry Data



Catecholamine Use in Europe

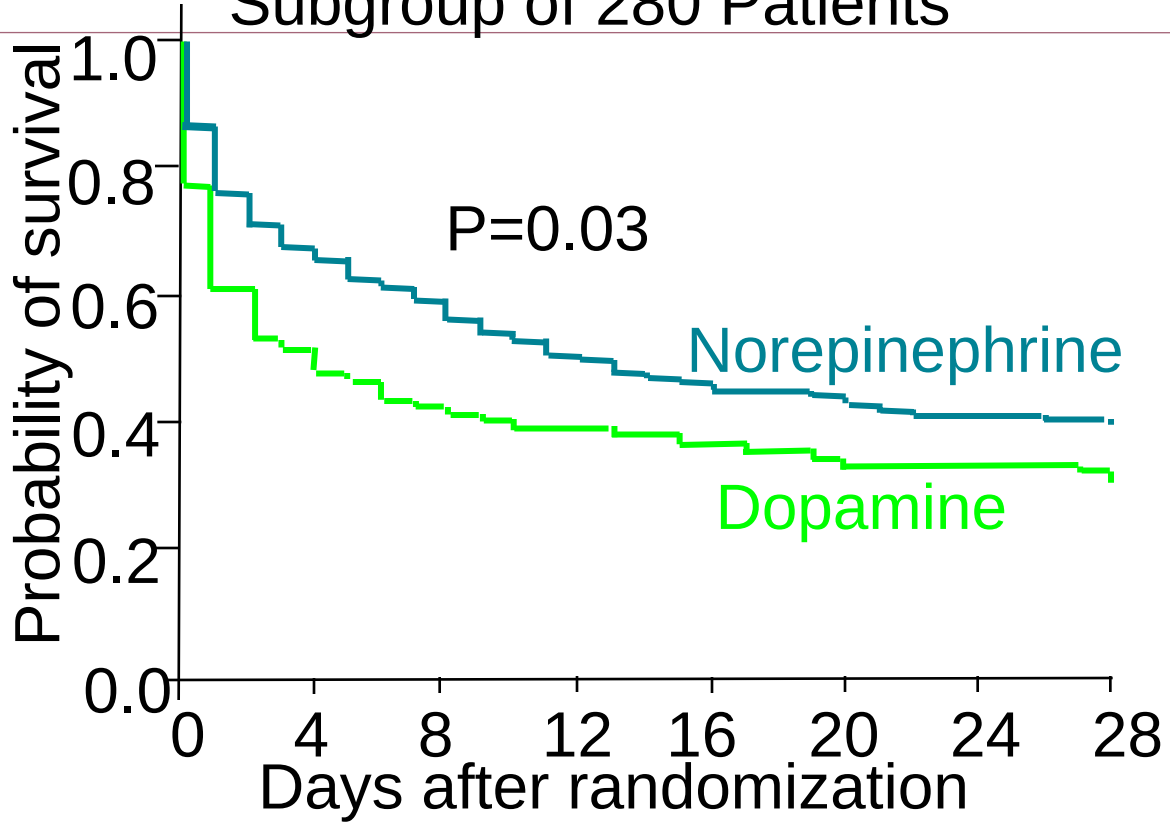
N=1058 with shock





Sakr et al. Crit Care Med.2006; 34:589–597

Catecholamines in Cardiogenic Shock



De Backer et al. NEJM 2010;362:779-789

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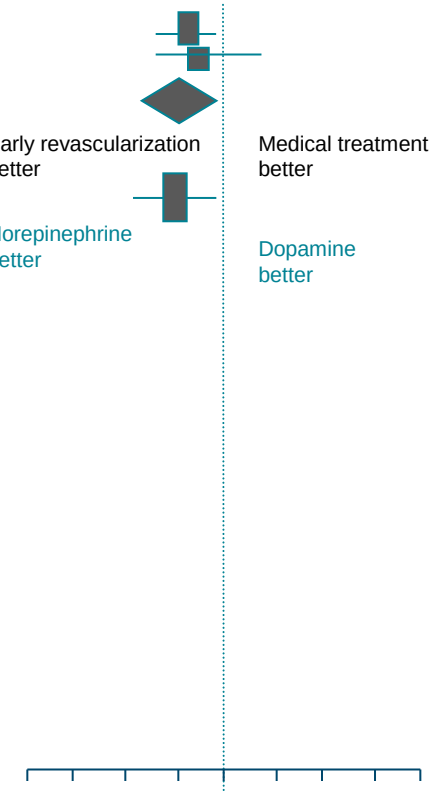
Total		**103/184**	**118/173**		**0.82 (0.69;0.97)**
Vasopressors					
SOAP-2 (CS Subgruppe)	28 days	64/145	50/135		0.75 (0.55;0.93)



Thiele et al. Eur Heart J 2015;36:1223-1230

German/Austrian S3-Guideline

Inotropes and vasoactive drugs

E.34 For inotropic support in infarct related CS *Dobutamine* should be used.	⇑
E.35 *Norepinephrine* should be used in particular in the initial phase of CS, when no extended hemodynamic monitoring is available, in combination with dobutamine to esnure adequate perfusion pressure.	⇑
E.36 Levosimendane and PDE-inhibitors may be used in catecholamine refractary.	⇔
E.39 *Dopamine* should not be used.	⇓⇓

Werdan et al. Dtsch Arztebl Int. 2012;109:343-351

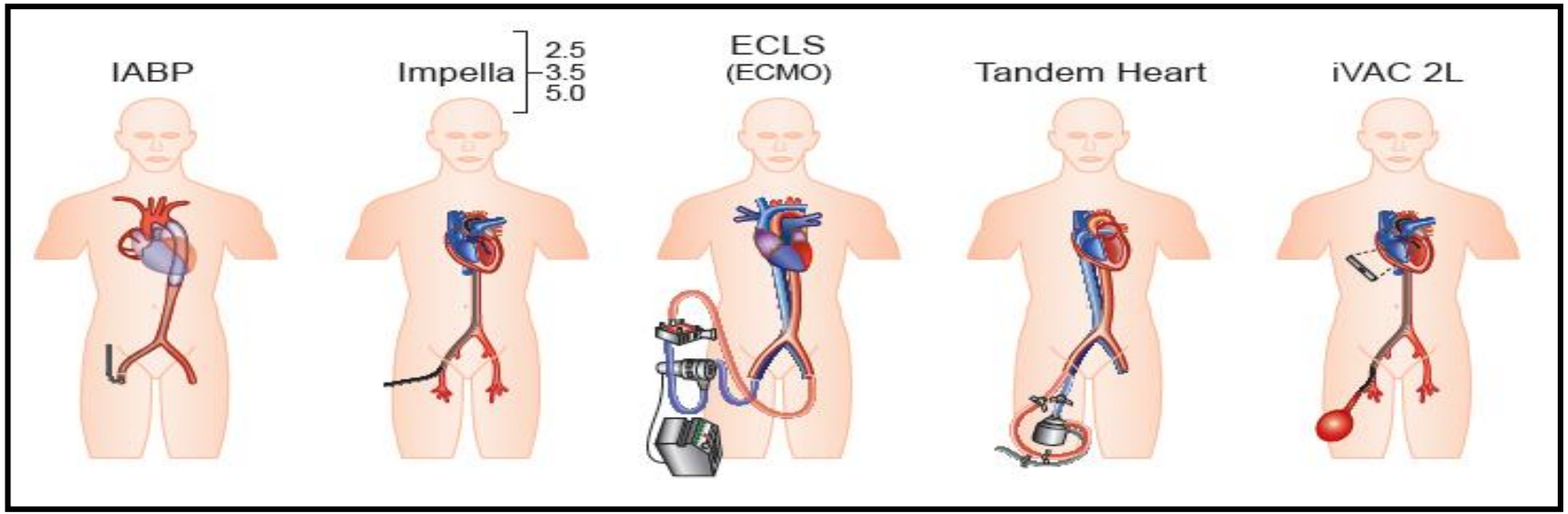
Catecholamines - Germany

	IABP	Control	P-Value
Catecholamine; n/total (%)			
Dopamine	15/298 (5.0)	11/297 (3.7)	0.43
Norepinephrine	220/298 (73.8)	222/297 (74.8)	0.80
Epinephrine	76/298 (25.5)	80/297 (26.9)	0.69
Dobutamine	160/298 (53.7)	156/297 (52.5)	0.78
Catecholamine dose (µg/kg/min); median (IQR)			
Dopamine	4.1 (2.9-7.7)	4.2 (3.6-8.3)	0.76
Norepinephrine	0.3 (0.1-1.2)	0.4 (0.1-1.1)	0.73
Epinephrine	0.3 (0.1-1.3)	0.3 (0.2-1.4)	0.59
Dobutamine	10.2 (4.9-20.6)	9.0 (4.8-17.6)	0.25

Thiele et al. NEJM 2012;367:1287-1296

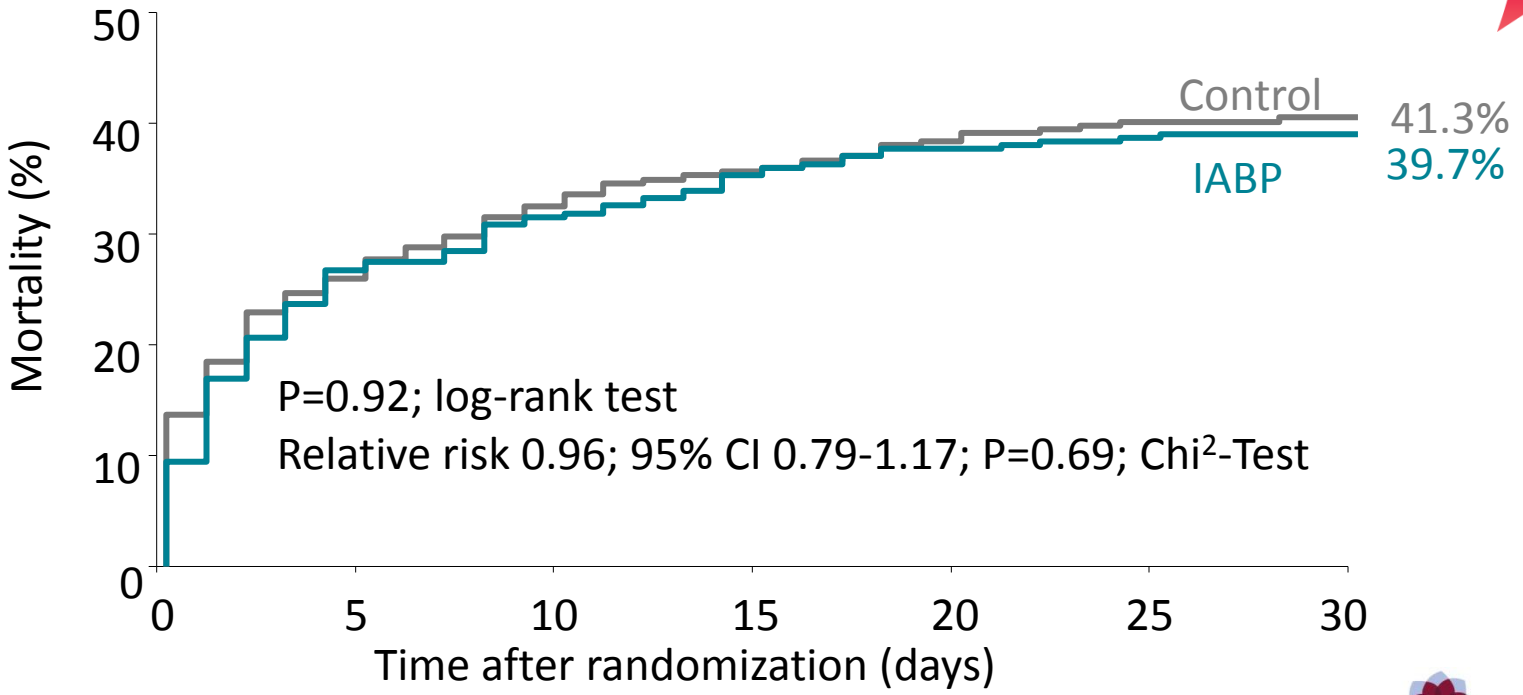
Currently Available Percutaneous Devices

HeartMate PHP



Thiele et al. Eur Heart J 2015;36:1223-1230
Blumenstein et al. EuroIntervention 2016;epub

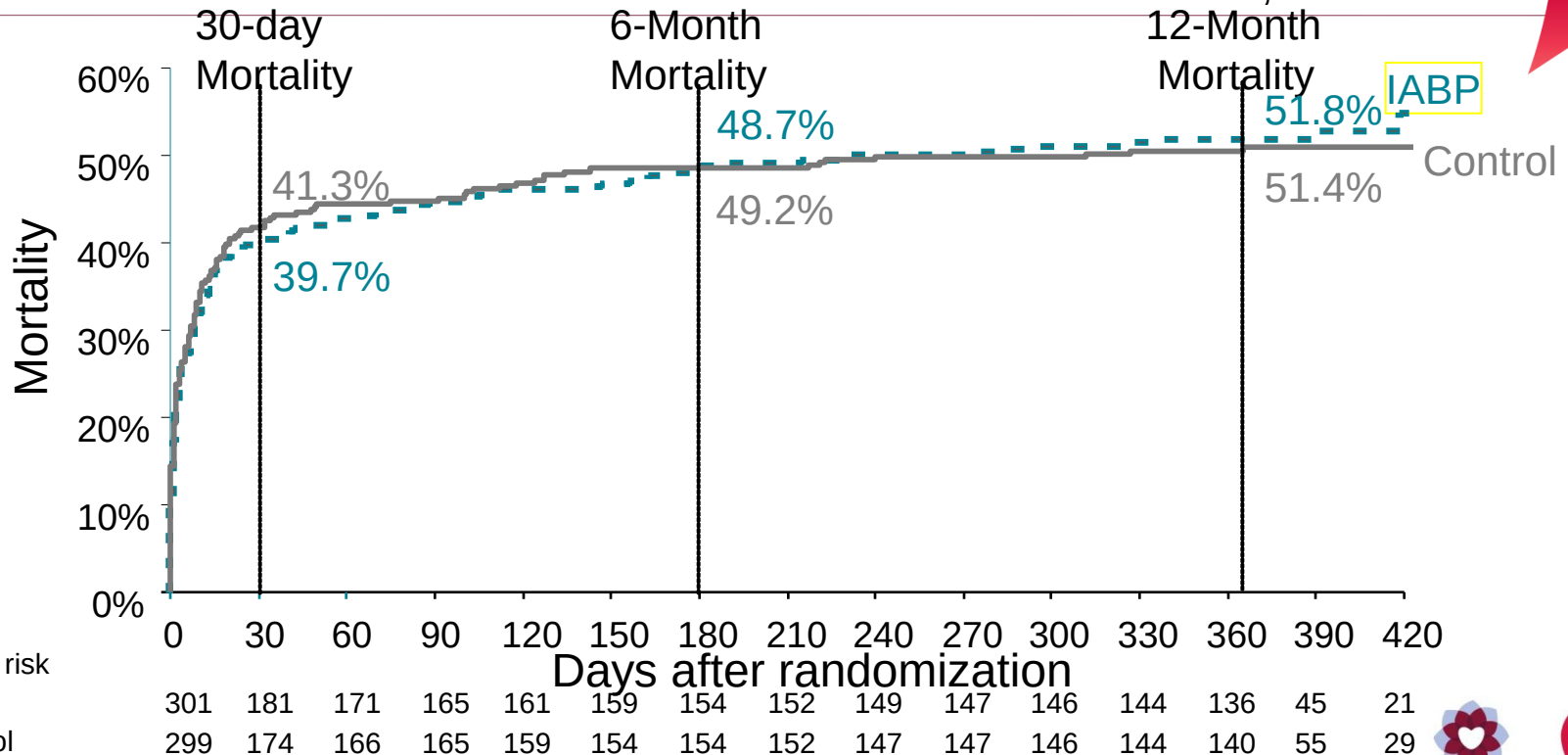
Primary Study Endpoint (30-Day Mortality)



Thiele et al. NEJM 2012;367:1287-1296

Mortality 12-Month Follow-up

P=0.94; log-rank test
Relative risk 1.02; 95% CI 0.88-1.19



www.escardio.org/ACCA

Thiele et al. Lancet 2013;382:1638-1645

ESC Guidelines 2012 - 2014 - 2016

IABP in cardiogenic shock

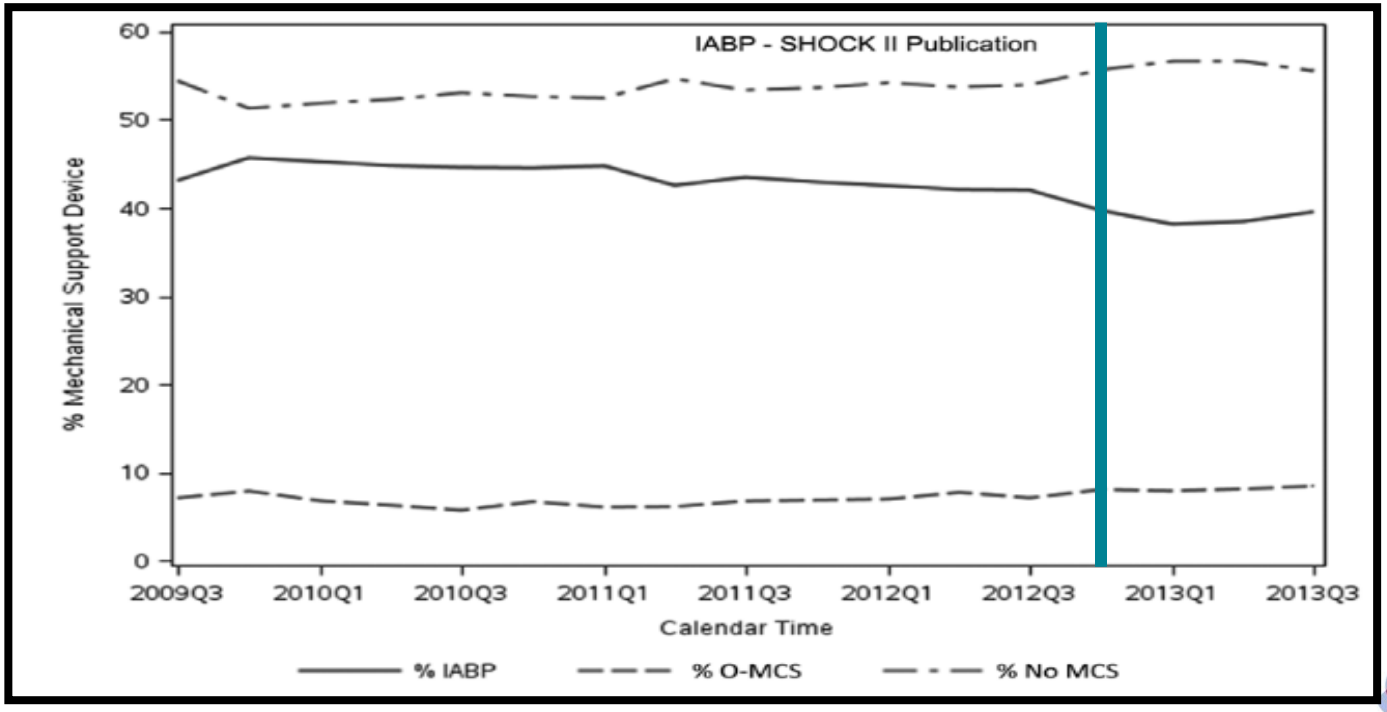
EUROPEAN SOCIETY OF CARDIOLOGY®

Class IC → IIb B → III

Ponikowski et al. Eur Heart J.2016;37:2129–2200
Roffi et al. Eur Heart J. 2016;37:267-315
Windecker et al. Eur Heart J. 2014;35:2541-2619

IABP + Other Devices Use

Cath PCI US Registry: 76474 patients with PCI and cardiogenic shock



No mechanical support

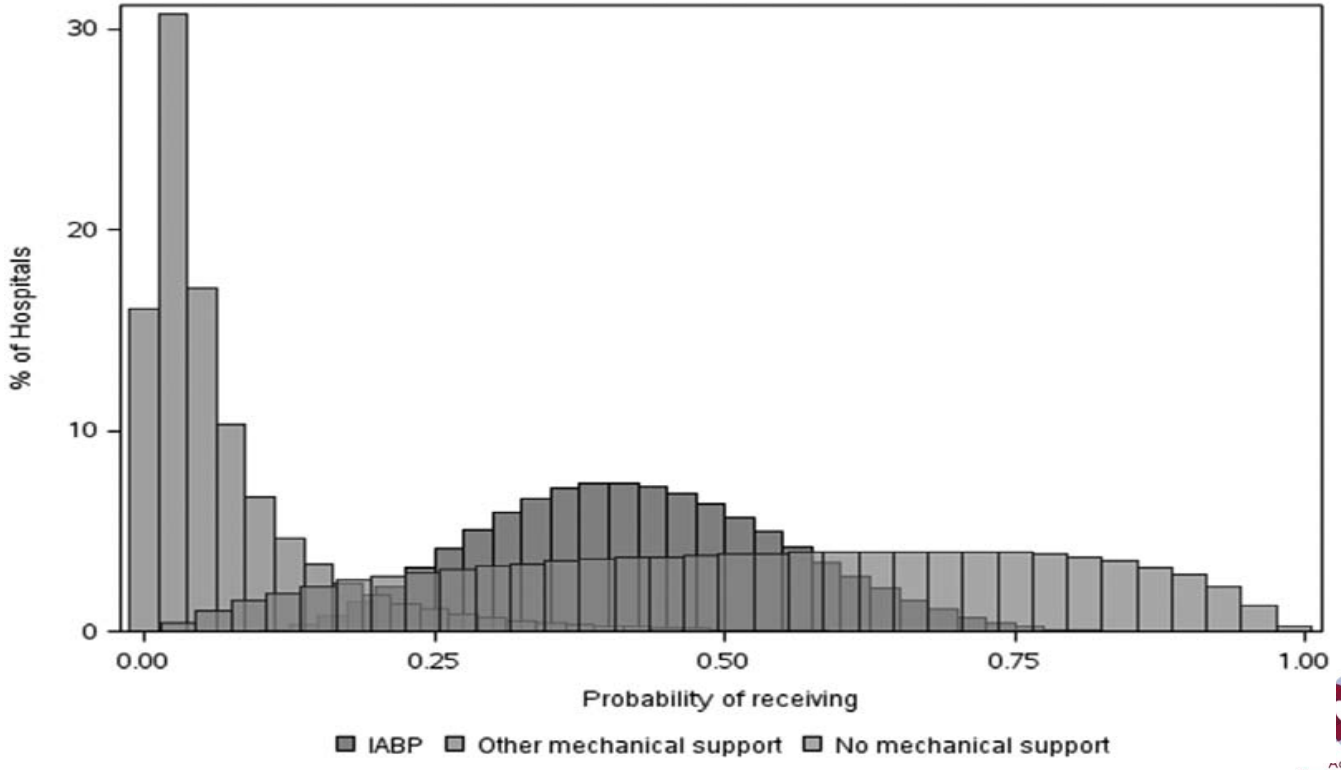
IABP

Mechanical support

Sandhu et al. Circulation 2015;132:1243-1251

Hospital Variation in IABP + MCS Use

Cath PCI US Registry: 76474 patients with PCI and cardiogenic shock



Sandhu et al. Circulation 2015;132:1243-1251

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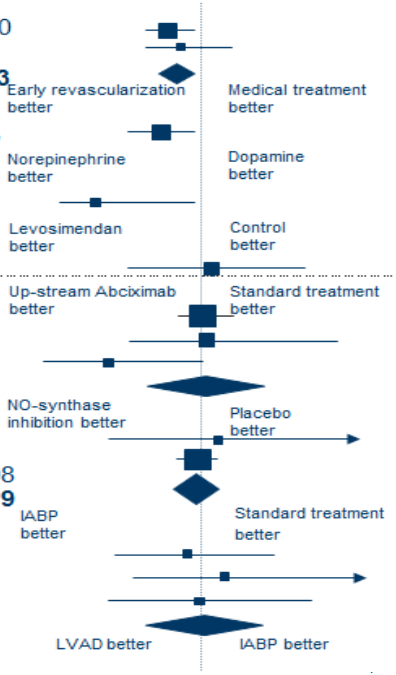
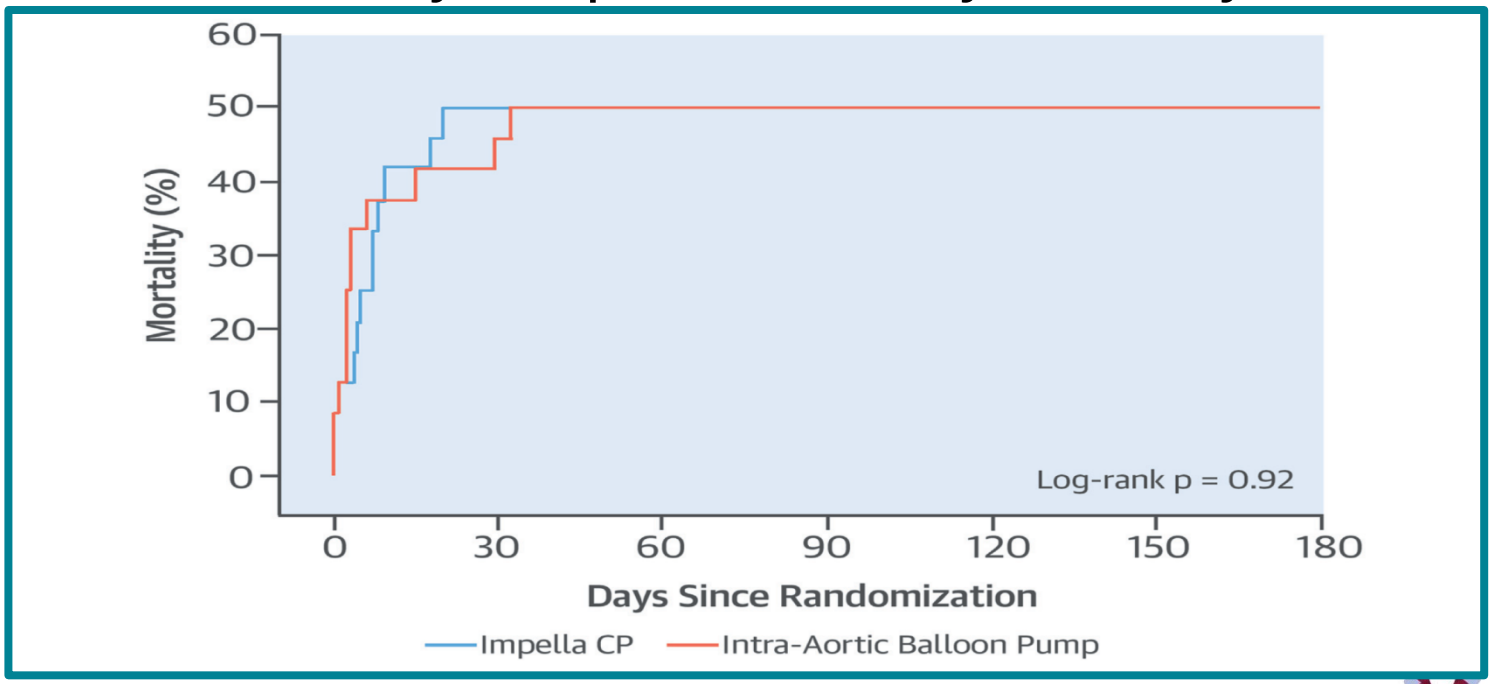
Vasopressors					
SOAP-2 (CS subgroup)	28 days	64/145	50/135		0.75 (0.55;0.93)
Inotropes					
Unverzagt et al.	30 days	5/16	10/16		0.33 (0.11;0.97)
Gp IIb/IIIa-Inhibitors					
PRAGUE-7	In-hospital	15/40	13/40		1.15 (0.59;2.27)
NO-Synthase-Inh.					
TRIUMPH	30 days	97/201	76/180		1.14 (0.91;1.45)
SHOCK II	30 days	24/59	7/20		1.16 (0.59;2.69)
Cotter et al.	30 days	4/15	10/15		0.40 (0.13;1.05)
Total		**125/275**	**93/215**		**1.05 (0.85;1.29)**
IABP					
IABP-SHOCK I	30 days	7/19	6/21		1.28 (0.45;3.72)
IABP-SHOCK II	30 days	119/300	123/298		0.96 (0.79-1.17)
Total		**126/319**	**129/319**		**0.98 (0.81;1.18)**
LVAD					
Thiele et al.	30 days	9/21	9/20		0.95 (0.48;1.90)
Burkhoff et al.	30 days	9/19	5/14		1.33 (0.57-3.10)
Seyfarth et al.	30 days	6/13	6/13		1.00 (0.44-2.29)
Total		**24/53**	**20/47**		**1.06 (0.68-1.66)**



Thiele et al. Eur Heart J 2015;36:1223-1230

Impella CP versus IABP

Primary endpoint – 30-day mortality



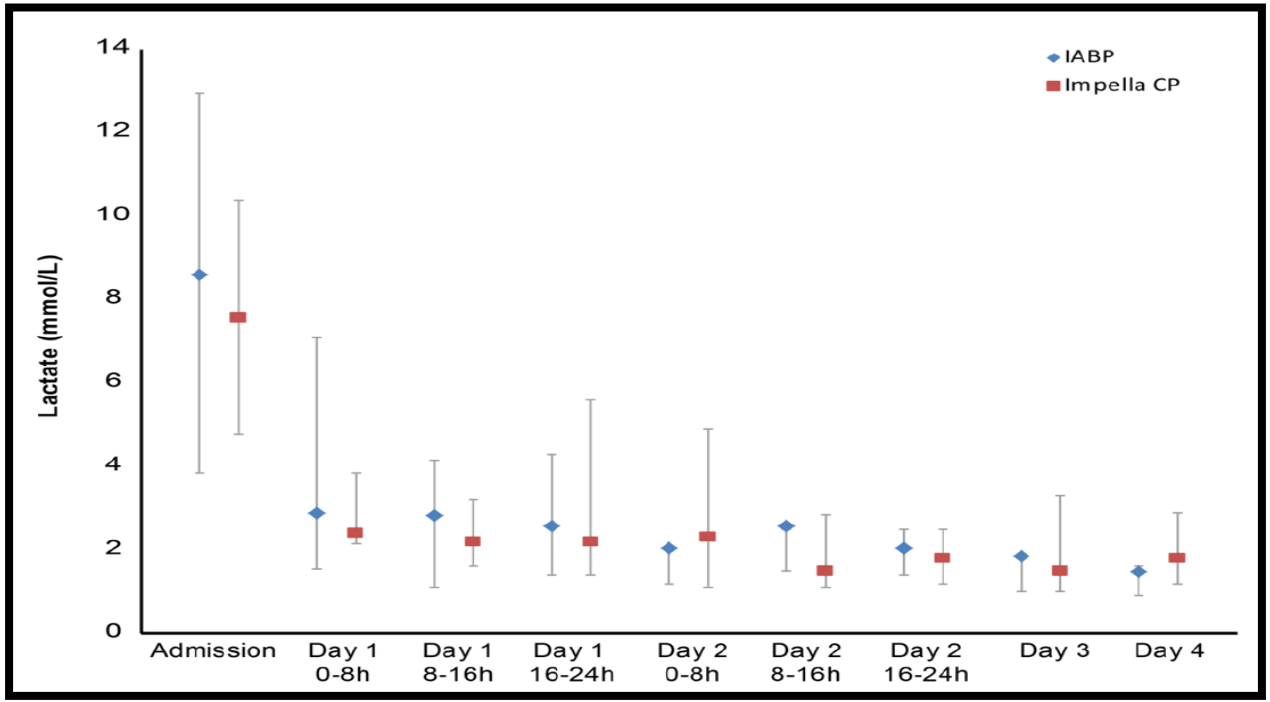
IMPRESS-IN-SEVERE-SHOCK

www.escardio.org/ACCA

Ouweneel et al. JACC 2017;69;278-287

Impella CP versus IABP

Arterial Lactate



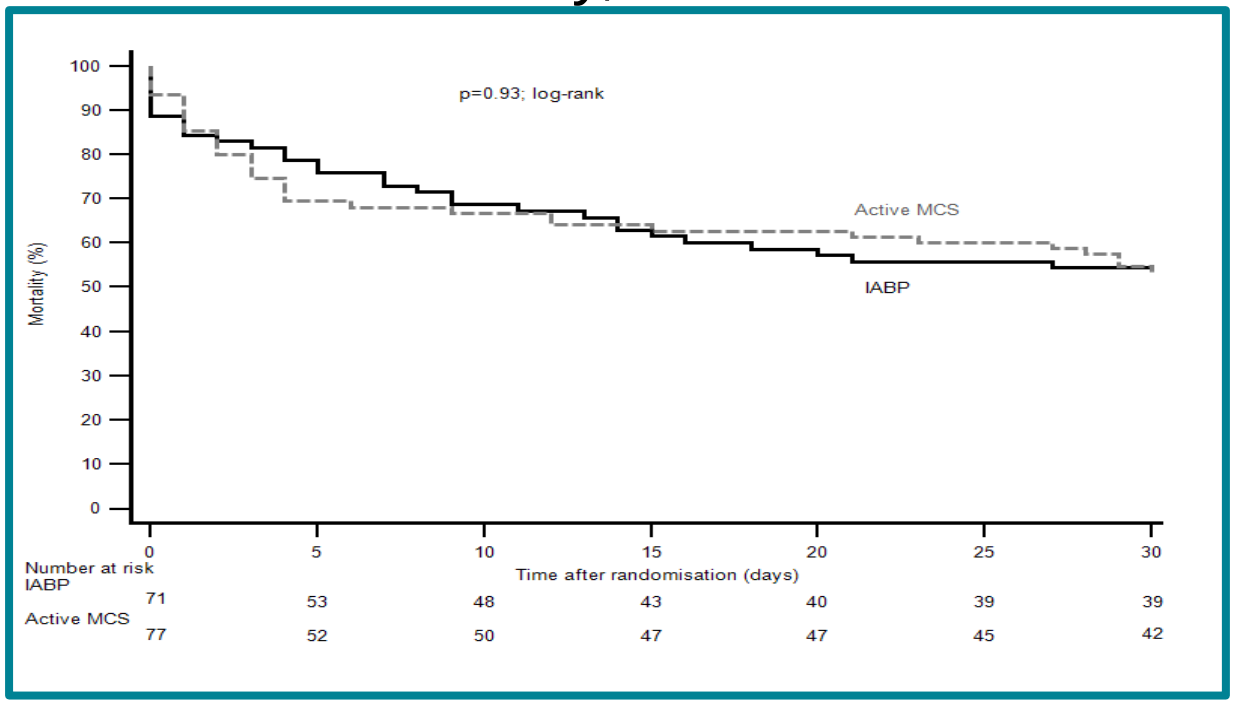
IMPRESS-IN-SEVERE-SHOCK

www.escardio.org/ACCA

Ouweneel et al. JACC 2017;69;278-287

Actual Metaanalysis

Mortality, N=148



Thiele et al. Submitted

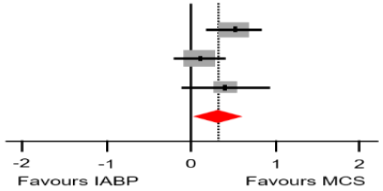
Actual Metaanalysis

Hemodynamic parameters + arterial lactate

	MCS Total	MCS Mean±SD	IABP Total	IABP Mean±SD	MD	95%CI	Weight
Thiele et al.	21	2.3±0.6	20	1.8±0.4	0.50	[0.19;0.81]	38.1%
Burkhoff et al.	19	2.3±0.6	14	2.1±0.2	0.10	[-0.19;0.39]	40.8%
ISAR-SHOCK	13	2.2±0.6	13	1.8±0.7	0.40	[-0.10;0.90]	21.2%
Overall	**53**		**47**		**0.32**	**[0.04;0.59]**	**100%**

Heterogeneity: τ^2=0.025, I^2=44.1%, p=0.17
Test for overall effect: p=0.02

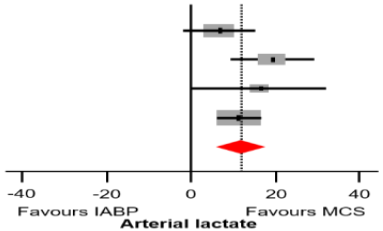
Cardiac index



	MCS Total	MCS Mean±SD	IABP Total	IABP Mean±SD	MD	95%CI	Weight
Thiele et al.	21	76±10	20	70±16	6.00	[-2.21;14.21]	25.4%
Burkhoff et al.	19	91±16	14	72±12	19.00	[9.45;28.55]	20.6%
ISAR-SHOCK	13	87±18	13	71±22	16.00	[0.55;31.45]	9.5%
IMPRESS-IN-SEVERE-SHOCK	24	80±10	24	69±7	11.00	[6.12;15.88]	44.5%
Overall	**77**		**71**		**11.85**	**[6.76;16.94]**	**100%**

Heterogeneity: τ^2=8.923, I^2=32.7%, p=0.22
Test for overall effect: p<0.001

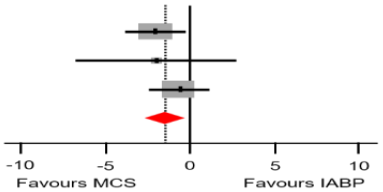
Mean arterial pressure



	MCS Total	MCS Mean±SD	IABP Total	IABP Mean±SD	MD	95%CI	Weight
Thiele et al.	21	3.0±1.3	20	5.0±3.6	-2.00	[-3.67;-0.33]	48.2%
ISAR-SHOCK	12	6.1±4.0	13	8.0±7.5	-1.90	[-6.56;2.76]	6.2%
IMPRESS-IN-SEVERE-SHOCK	24	2.7±1.3	24	3.3±4.1	-0.60	[-2.32;1.12]	45.6%
Overall	**57**		**57**		**-1.36**	**[-2.52;-0.19]**	**100%**

Heterogeneity: τ^2=0, I^2=0%, p=0.51
Test for overall effect: p=0.02

Arterial lactate



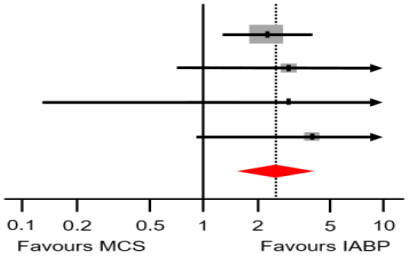
Thiele et al. Submitted

Actual Metaanalysis

Complications

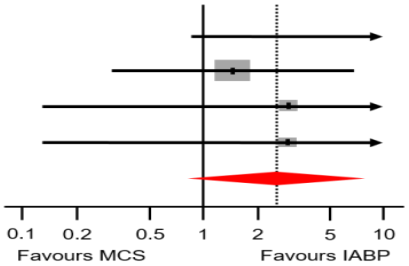
	MCS		IABP		Bleeding	RR	95%CI	Weight
	Events	Total	Events	Total				
Thiele et al.	19	21	8	20		2.26	[1.30;3.94]	74.7%
Burkhoff et al.	8	19	2	14		2.95	[0.74;11.80]	11.9%
ISAR-SHOCK	1	13	0	13		3.00	[0.13;67.29]	2.4%
IMPRESS-IN-SEVERE-SHOCK	8	24	2	24		4.00	[0.95;16.92]	11.0%
Overall	**36**	**77**	**12**	**71**		**2.50**	**[1.55;4.04]**	**100%**

Heterogeneity: τ^2=0, I^2=0%, p=0.88
Test for overall effect: p<0.001



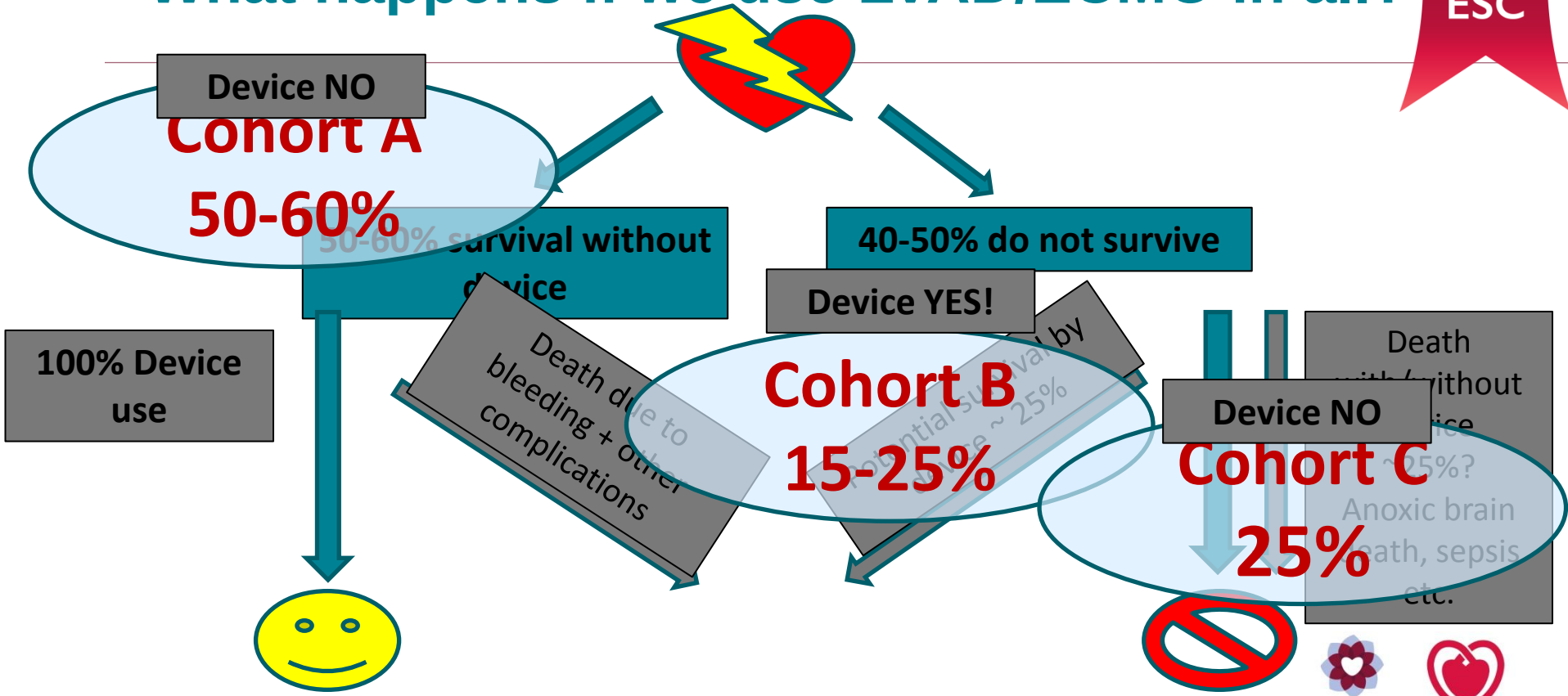
	MCS		IABP		Leg ischaemia	RR	95%CI	Weight
	Events	Total	Events	Total				
Thiele et al.	7	21	0	20		14.30	[0.87;234.74]	17.1%
Burkhoff et al.	4	19	2	14		1.47	[0.31;6.95]	55.6%
ISAR-SHOCK	1	13	0	13		3.00	[0.13;67.29]	13.8%
IMPRESS-IN-SEVERE-SHOCK	1	24	0	24		3.00	[0.13;70.09]	13.5%
Overall	**13**	**77**	**2**	**71**		**2.64**	**[0.83;8.39]**	**100%**

Heterogeneity: τ^2=0, I^2=0%, p=0.53
Test for overall effect: p=0.10



Thiele et al. Submitted

What happens if we use LVAD/ECMO in all?



ECMO Complications

Variable	All patients (n=83)
Overall transfusions, n (%)	67 (81.0%)
RPB	9.5 ± 10.6
Death from device	3 (5.3%)
Use of antibiotics, n (%)	73 (88.0%)
Pneumonia, n (%)	32 (40.0%)
Septic constellation, n (%)	13 (16.2%)
Access site complication	25 (31.3%)

Leipzig/Lübeck ECMO Registry

de Waha et al. EuroIntervention 2016;111:1363-1371

IABP-SHOCK II Score – Mortality Prediction

Score

Variable	Points
Age >73 years	1
History of stroke	2
Glucose >10.6 mmol/l *	1
Creatinine >132.6 µmol/l *	1
Serum lactate >5 mmol/l *	2
TIMI flow after PCI <3	2
Maximum	9

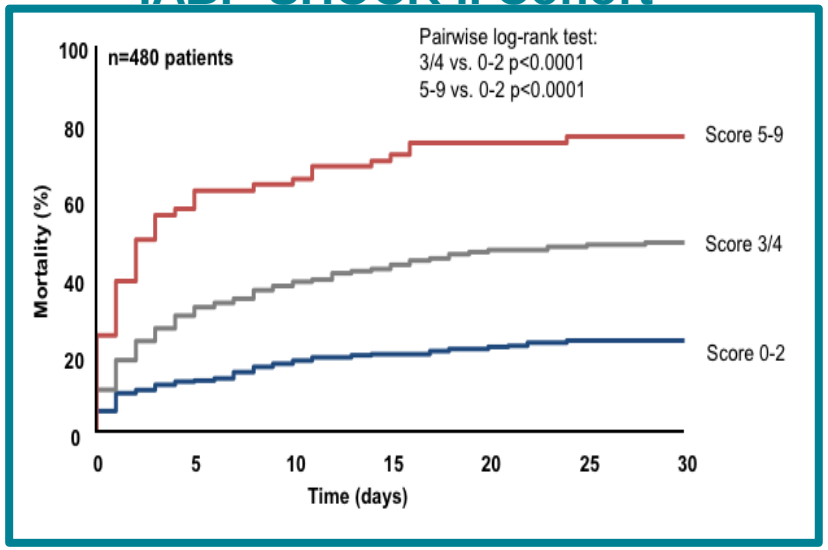
Risk categories

Category	Points
Low	0-2
Intermediate	3/4
High	5-9

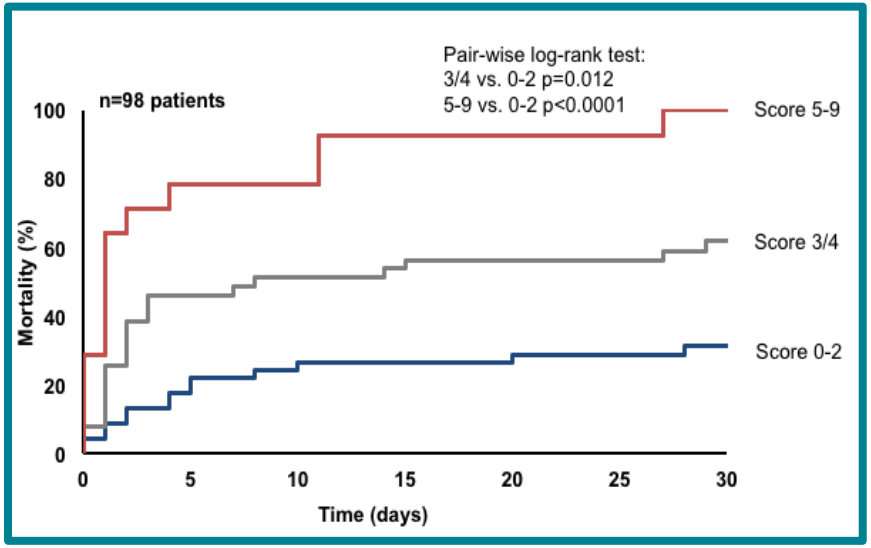
Poess et al. JACC 2017; in press

IABP-SHOCK II Score – Mortality Prediction

IABP-SHOCK II Cohort



CardSHOCK Validation Cohort



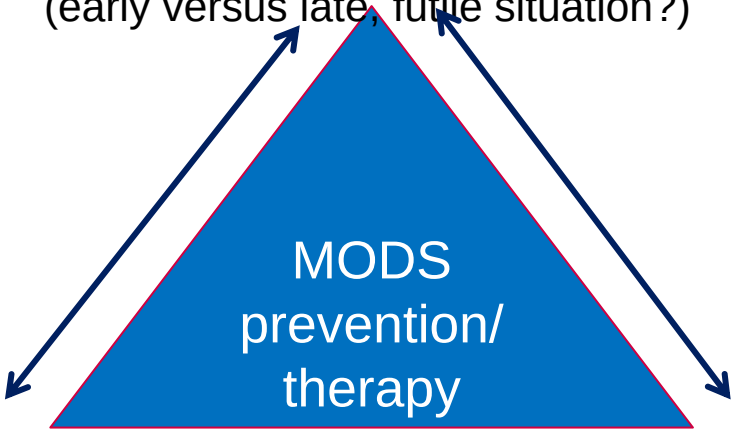
Poess et al. JACC 2017; in press

How to Prevent MODS?

Mechanical support device?

Optimal timing

(early versus late, futile situation?)



Optimal Support

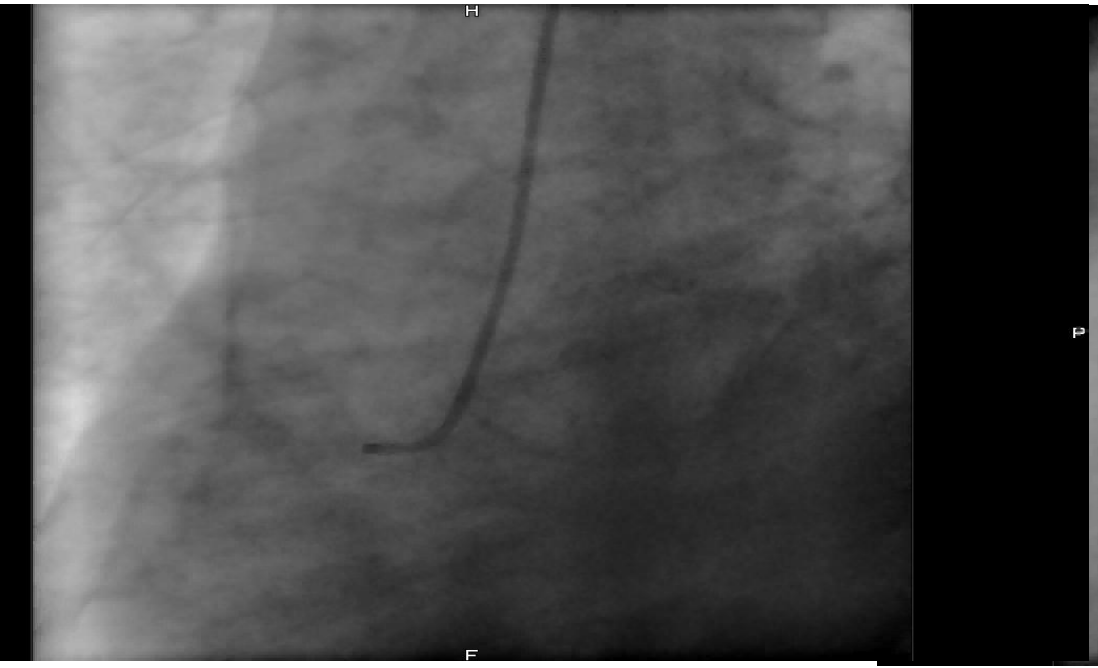
(Flow 2-7 l/min)

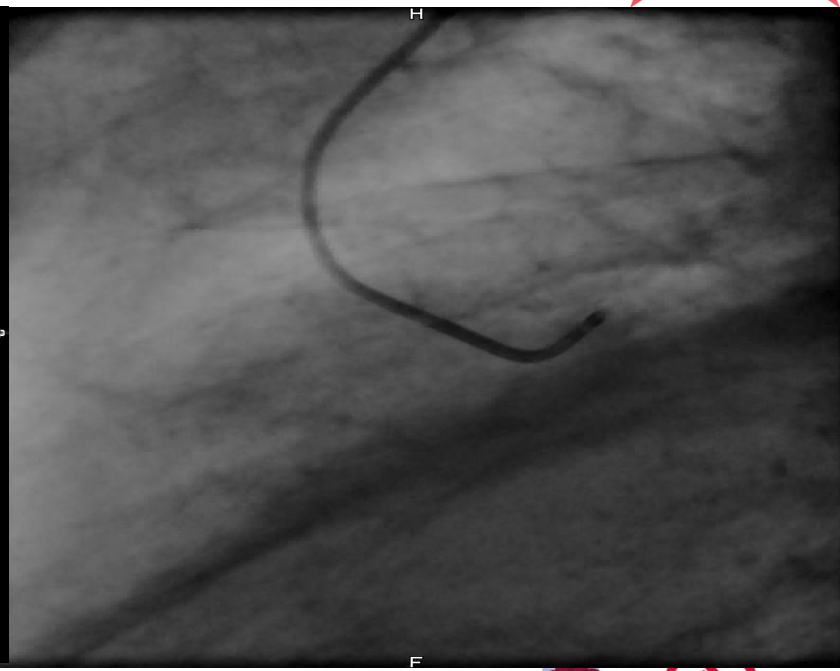
Prevention of device-complications

(device malfunction, limb ischemia, hemolysis, bleeding, infection/inflammation)

Zeymer and Thiele. JACC 2017; 69:288-290

Anterior STEMI + Cardiogenic Shock

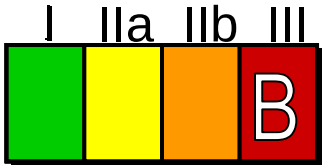




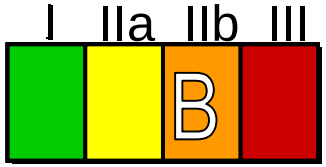
Multivessel PCI in ACS?

STEMI, no Shock

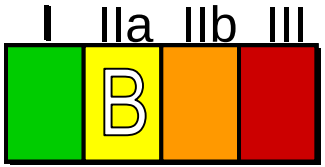
2012

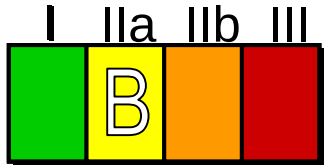


2014



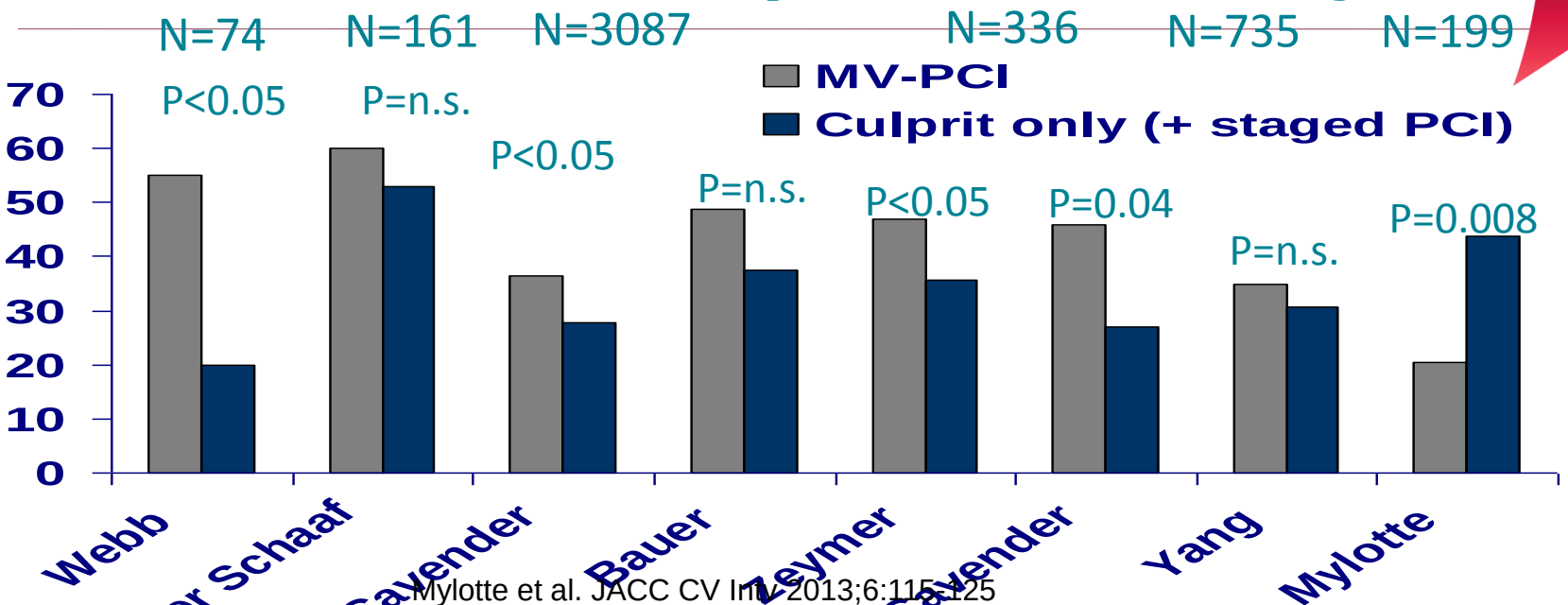
STEMI, Shock





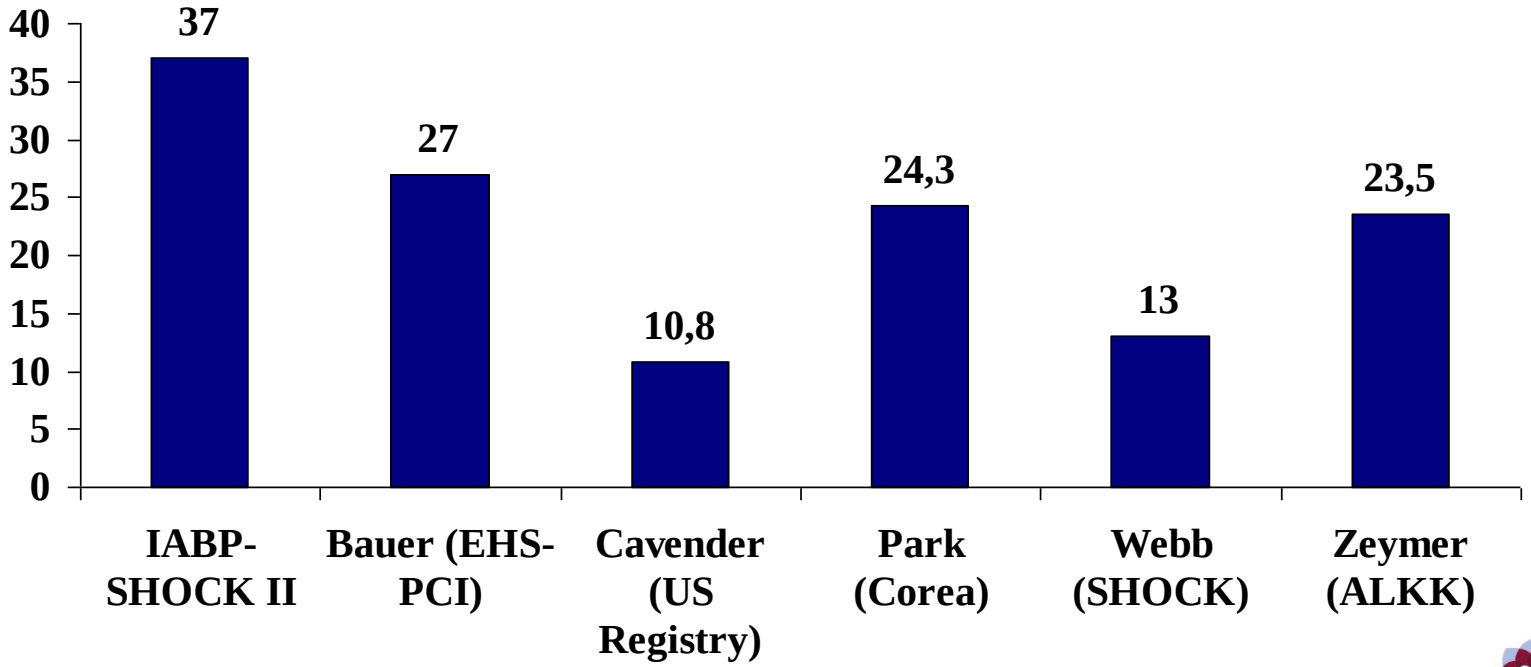
Steg et al. Eur Heart J. 2012;33:2569-2619
Windecker et al. Eur Heart J. 2014;35:2541-2619

Multivessel PCI or Culprit Lesion Only PCI

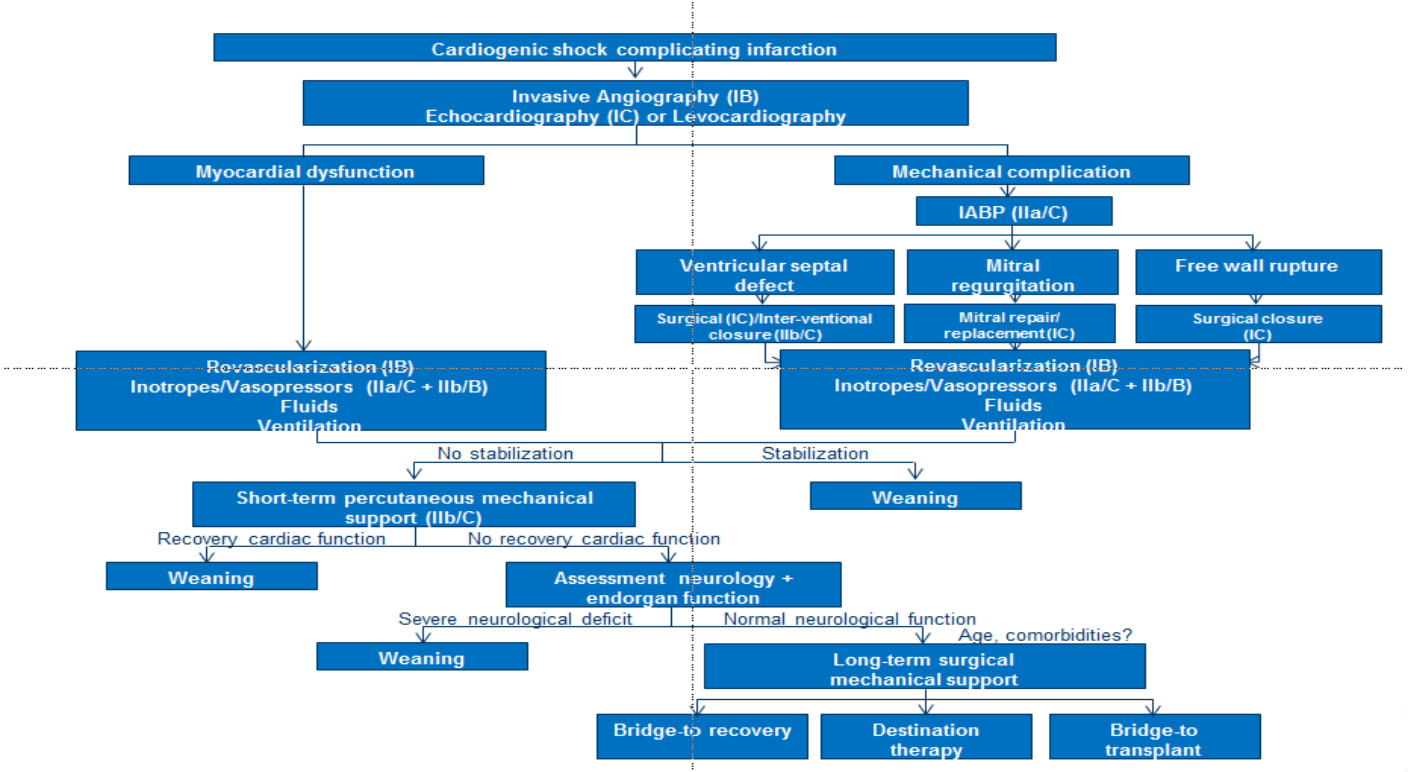


Mylotte et al. JACC CV Intv 2013;6:115-125
Yang et al. Crit Care Med. 2014;47:17-25
Webb et al. J Am Coll Cardiol 2003;42:1380-1386.
van der Schaaf et al. Am J Cardiol 2010;105:955-959
Cavender et al. Am J Cardiol 2009;104:507-513
Bauer et al. Am J Cardiol 2012;109:941-946
Zeymer et al. EuroIntervention 2014;epub
Cavender et al. J Invasive Cardiol 2013;25:218-224

Multivessel PCI Use in Clinical Practice



Treatment Algorithm Cardiogenic Shock

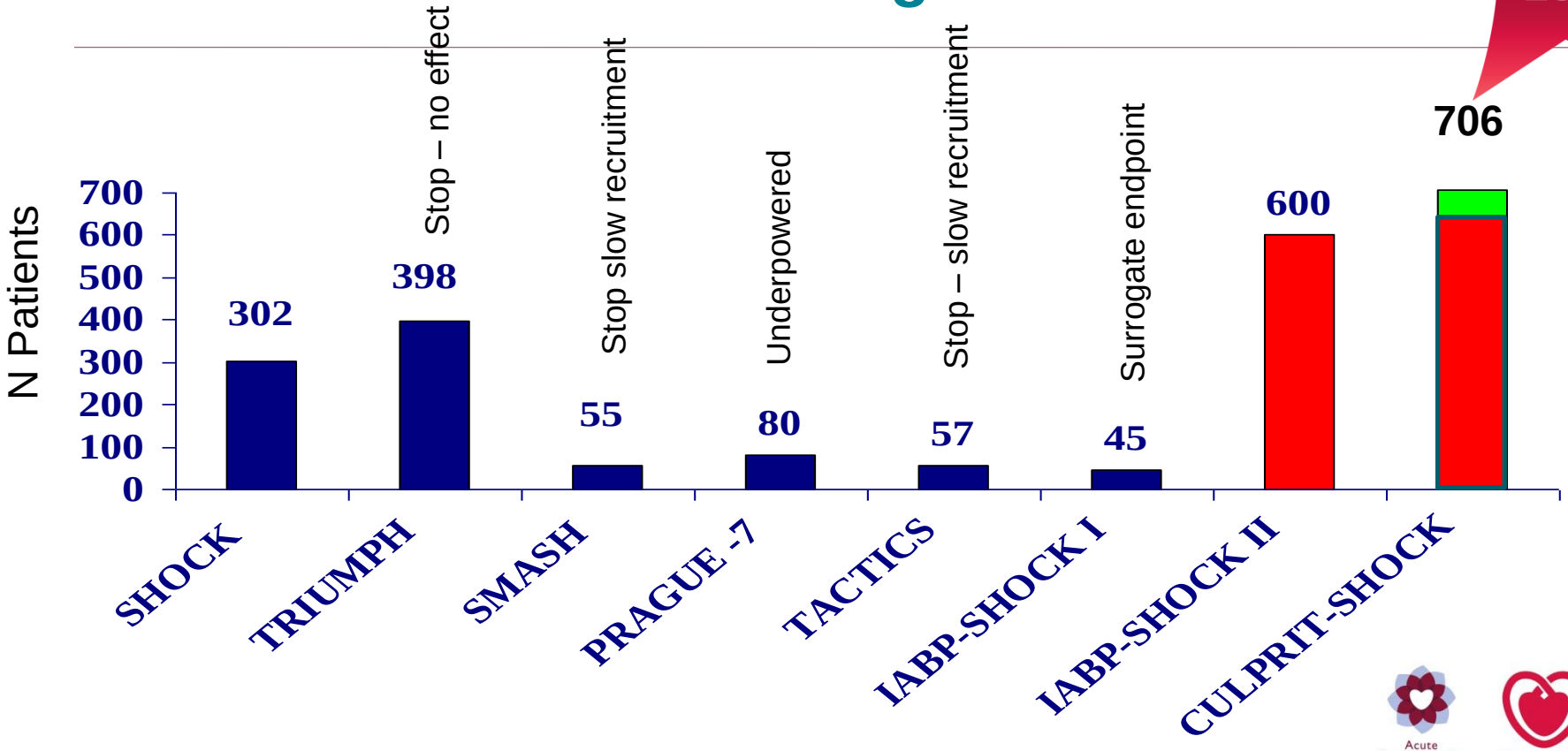


Thiele et al. Eur Heart J 2015;36:1223-1230

Open Issues in Cardiogenic Shock

- Revascularization strategy (PCI vs CABG, PCI culprit only vs MV-PCI?)
- Access site (radial vs femoral?)
- Antiplatelet therapy (ASA, Clopi, Prasugrel, Ticagrelor, Cangrelor, GpIIb/IIIa-Inh.?)
- Ventilation strategy
- Optimal blood glucose
- Transfusion strategy (liberal vs. restrictive use)
- Mechanical complications (when to do surgery/intervention?)
- Optimal inotrope
- Levosimendan
- MCS (when, which, how, weaning time point?)
- Etc., etc., etc.

Patient Inclusion in Cardiogenic Shock Trials



Universitäres Herzzentrum Lübeck

Thank you for your attention

WE ARE THE ESC

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A Registered Branch of the ESC

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