

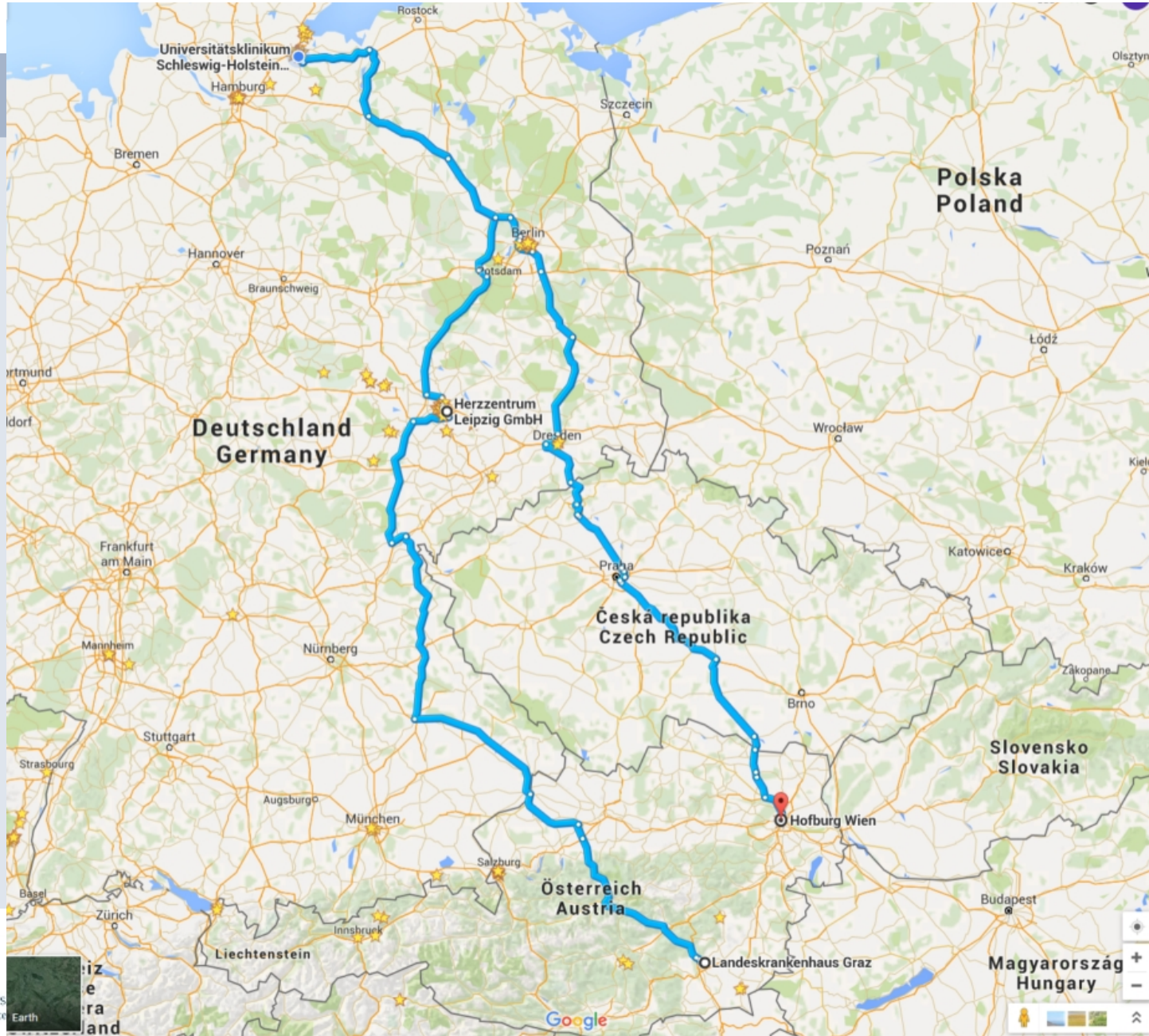
Post resuscitation care and role of urgent angiography after cardiac arrest

Georg Fuernau
Luebeck

DECLARATION OF INTEREST

- I have nothing to declare

The journey...



CPR and guidelines

European Resuscitation Council		
American Heart Association		

CPR and guidelines

European
Resuscitation
Council

15.10.2015



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Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation



European Resuscitation Council Guidelines for Resuscitation 2015 Section 1. Executive summary



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on behalf of the ERC Guidelines 2015 Writing Group¹

American Heart
Association

03.11.2015

Part 1: Executive Summary

2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

Robert W. Neumar, Chair; Michael Shuster; Clifton W. Callaway; Lana M. Gent; Dianne L. Atkins;
Farhan Bhanji; Steven C. Brooks; Allan R. de Caen; Michael W. Donnino; Jose Maria E. Ferrer;
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Eunice M. Singletary; Elizabeth H. Sinz; Andrew H. Travers; Myra H. Wyckoff; Mary Fran Hazinski

Questions in Post-Resuscitation-Care

European Resuscitation Council and European Society of Intensive Care Medicine Guidelines for Post-resuscitation Care 2015
Section 5 of the European Resuscitation Council Guidelines for Resuscitation 2015[☆]



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Véronique R.M. Moulaert^f, Charles D. Deakin^g, Bernd W. Bottiger^h, Hans Fribergⁱ,
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Part 8: Post-Cardiac Arrest Care

2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

Clifton W. Callaway, Chair; Michael W. Donnino; Ericka L. Fink; Romergryko G. Geocadin;
Eyal Golan; Karl B. Kern; Marion Leary; William J. Meurer; Mary Ann Peberdy;
Trevonne M. Thompson; Janice L. Zimmerman

Questions in Post-Resuscitation-Care

- Airway and breathing
 - Control of oxygenation
 - Control of ventilation
- Optimising neurological recovery
 - Sedation
 - Seizures
 - Glucose control
 - Temperature control
- Circulation
 - Coronary reperfusion
 - PCI in ROSC with STEMI
 - PCI in ROSC without STEMI
 - Indication and timing of CT scanning
 - Hemodynamic management
- Prognostication

Questions in Post-Resuscitation-Care

- Airway and breathing
 - Control of oxygenation
 - Control of ventilation
- Optimising neurological recovery
 - Sedation
 - Seizures
 - Glucose control
 - ~~Temperature control~~ → own talk
- Circulation
 - Coronary reperfusion
 - PCI in ROSC with STEMI
 - PCI in ROSC without STEMI
 - ~~Indication and timing of CT scanning~~
 - ~~Hemodynamic management~~ → own talk
- ~~Prognostication~~

Airway and breathing

- Avoid hypo- and hyperoxemia, keep SaO_2 at 94-98%
- PaCO_2 within a normal physiological range (35-45 mmHg)
- Any patient with impaired neurological function should be kept intubated and ventilated

Sedation and Control of seizures

- No data to indicate whether or not the choice of sedation influences outcome
- short-acting drugs will enable more reliable and earlier neurological assessment and prognostication
- Routine seizure prophylaxis in post-cardiac arrest patients is not recommended

Sedation and Control of seizures

- No data to indicate whether or not the choice of sedation influences outcome
- short-acting drugs will enable more reliable and earlier neurological assessment and prognostication
- Routine seizure prophylaxis in post-cardiac arrest patients is not recommended
- Maintain the blood glucose at ≤ 10 mmol/l (180 mg/dl) and avoid hypoglycaemia.

Coronary angiography

IMMEDIATE CORONARY ANGIOGRAPHY IN SURVIVORS OF OUT-OF-HOSPITAL CARDIAC ARREST

CHRISTIAN M. SPAULDING, M.D., LUC-MARIE JOLY, M.D., ALAIN ROSENBERG, M.D., MEHRAN MONCHI, M.D.,
SIMON N. WEBER, M.D., JEAN-FRANÇOIS A. DHAINAUT, M.D., PH.D., AND PIERRE CARLI, M.D.

Coronary angiography

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- 1994-1996: Prospective study performed in Paris France
- All survivors of OHCA with no obvious non cardiac cause of arrest regardless of clinical and ECG data
- Aged between 30 and 75 years of age
- Coronary angiography at admission followed if necessary by PCI

Coronary angiography

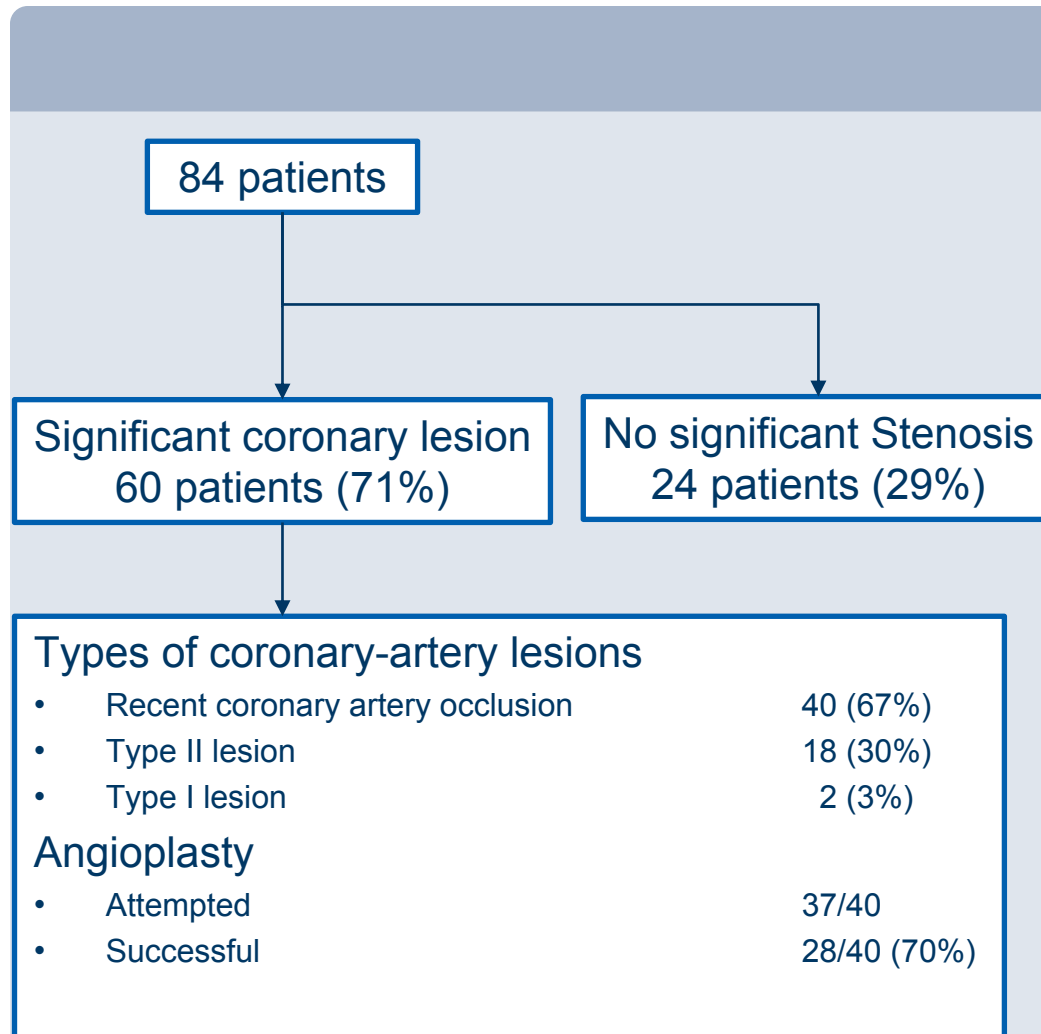


TABLE 4. RELATION BETWEEN ST-SEGMENT ELEVATION, CHEST PAIN BEFORE CARDIAC ARREST, AND RECENT CORONARY-ARTERY OCCLUSION IN THE 84 PATIENTS WHO UNDERWENT CORONARY ANGIOGRAPHY.*

VARIABLE	NO. OF PATIENTS	NO. WITH RECENT CORONARY-ARTERY OCCLUSION (%)
ST-segment elevation and chest pain		
Present	15	13 (87)
Absent	69	27 (39)
ST-segment elevation or chest pain		
Present	49	31 (63)
Absent	35	9 (26)

*ST-segment elevation was defined as an elevation of more than 1 mm in two contiguous leads.

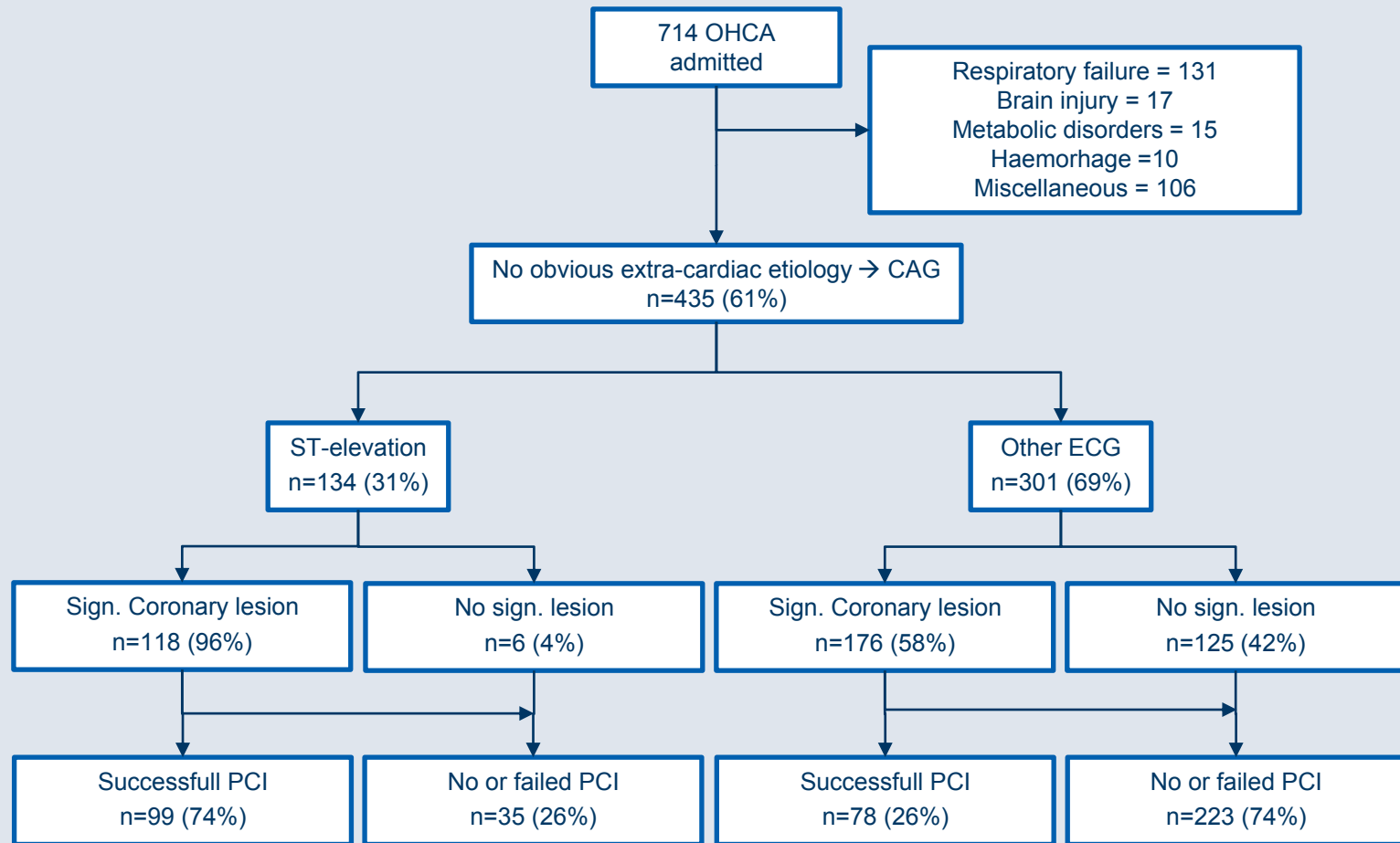
Predictors of survival

	OR	95%CI	P-value
<i>Absence of the need for inotropic drugs during transportation to the hospital</i>	3.6	1.10-11.8	0.03
<i>Delay between onset of cardiac arrest and ROSC (per 1 min)</i>	1.1	1.02-1.12	0.003
<i>Successful coronary angioplasty</i>	5.2	1.10-24.5	0.04

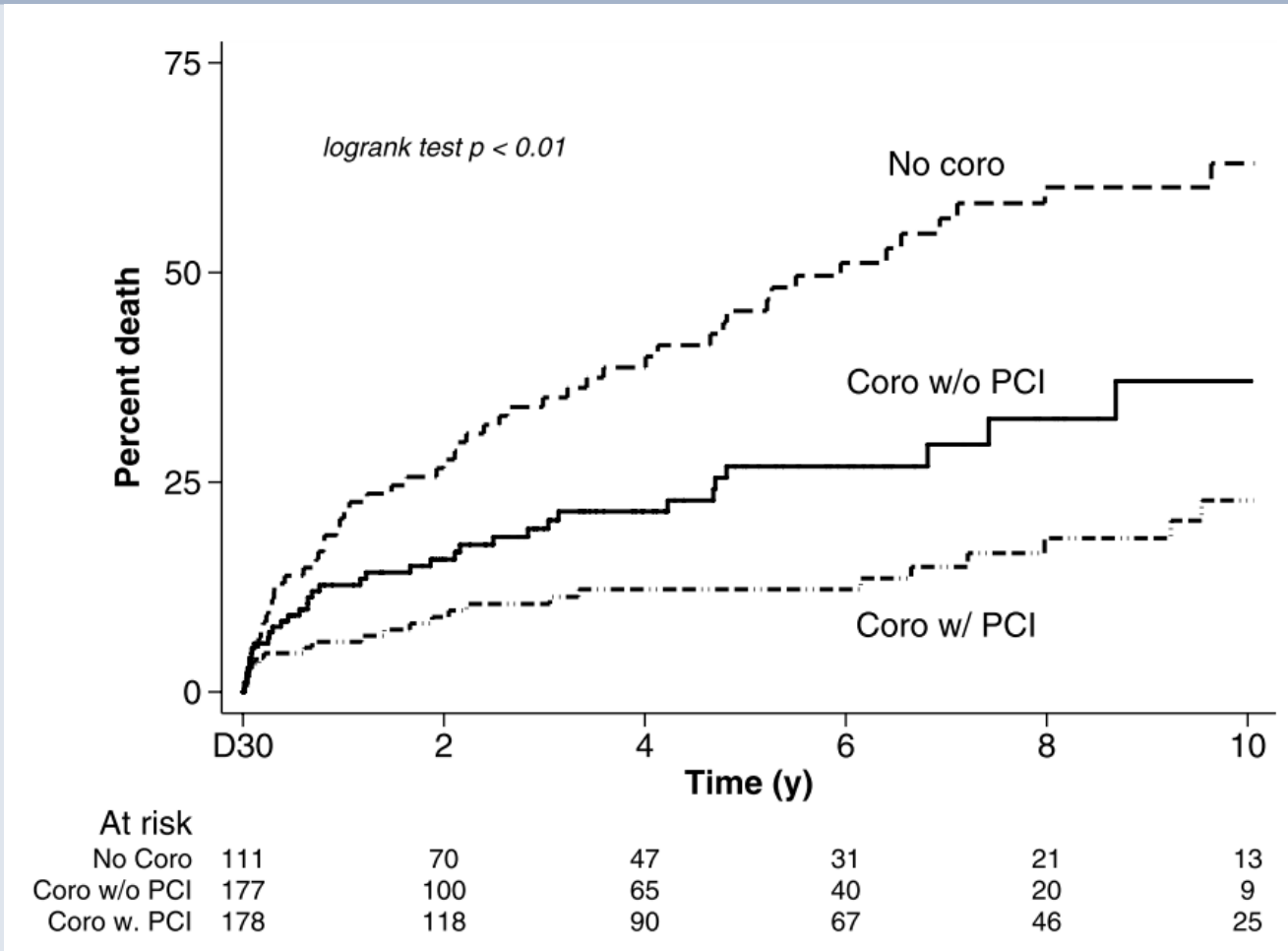
Impact of early angiography on outcome

		OR	95%CI	P-value
Spaulding et al., 1997		PCI: 5.2	1.10-24.5	0.04
Werling et al., 2006		CAG: 9.1	3.6-21.5	<0.001*
Merchant et al., 2008	With STE	CAG: 3.8	1.35-10.9	<0.05
	Without STE	CAG: 3.01	0.84-10.8	0.09
Reynolds et al., 2009		CAG: 2.16	1.12-4.19	<0.02
Anyfantakis et al., 2009		PCI no predictor of survival in multivariable analysis		
Dumas et al., 2010		PCI: 2.06	1.16-3.66	0.013
Nanjayya et al., 2011		CAG: 1.32	0.26-7.37	0.78
Tømte et al., 2011		CAG: 11.21	2.96-42.49	<0.001
Stub et al., 2011		CAG: 7.6	3.2-17.5	0.01*
Strote et al., 2011		Tertile with high vs. low CAG	73 vs 3%	0.001
Zanuttini et al., 2012		PCI success: 2.32	1.23-4.38	0.009
Cronier et al., 2011		CAG: 3.33	1.27-9.09	0.01
Bro-Jeppesen et al., 2012		CAG, no STE: 0.69	0.4-1.2	0.18
Søholm et al., 2013		Univariate significant	Multivariable no significance	
Hollenbeck et al., 2014		CAG: 2.86	1.42-5.56	0.003
Callaway et al., 2014		CAG: 1.69	1.06-2.70	<0.005

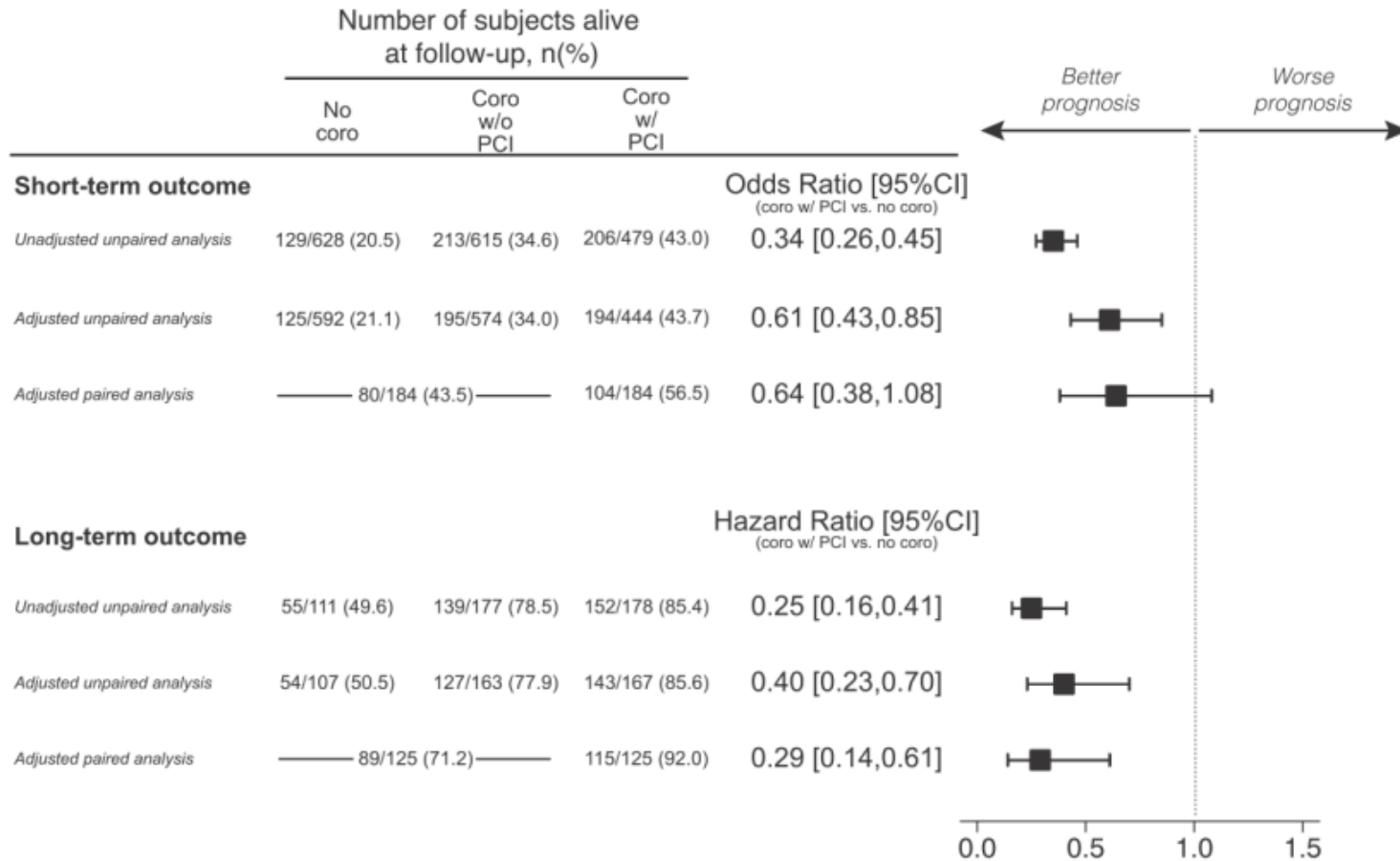
Findings in patients after OHCA



NSTEMI and PCI after OHCA



NSTEMI and PCI after OHCA



Variable	All Patients, n=1722	No Coronary Angiography, n=628	Coronary Angiography Without PCI, n=615	Coronary Angiography With PCI, n=479	P Value*	P Value†
ST-segment-elevation on post-ROSC ECG	318 (18.5)	23 (3.7)	70 (11.4)	225 (47.0)	<0.01	<0.01

Early ECG after ROSC

	ECG	Stenosis >90%	TIMI flow 0-1	PCI performed
Group 1	STEMI or new LBBB	26% STEMI 24% LBBB	49% STEMI 21% LBBB	64% STEMI 24% LBBB
Group 2	No STEMI but suspicious of coronary ischemia	27%	20%	41%
Group 3	No ECG findings indicating coronary ischemia	19%	11%	24%

Prediction of significant coronary lesions

Table 4. Multivariable Model

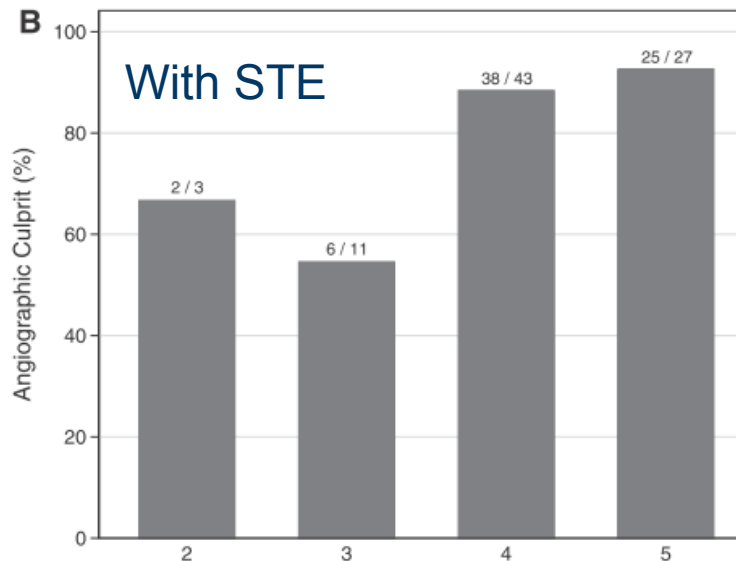
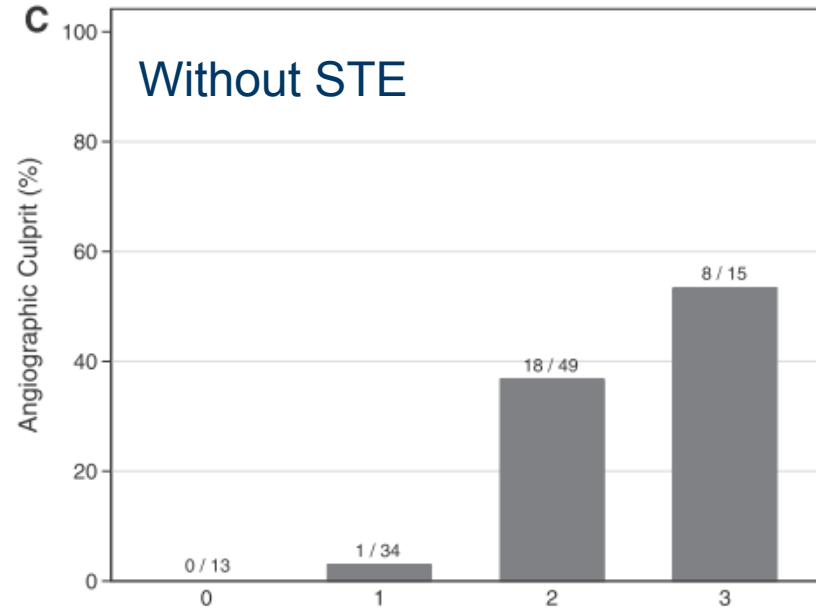
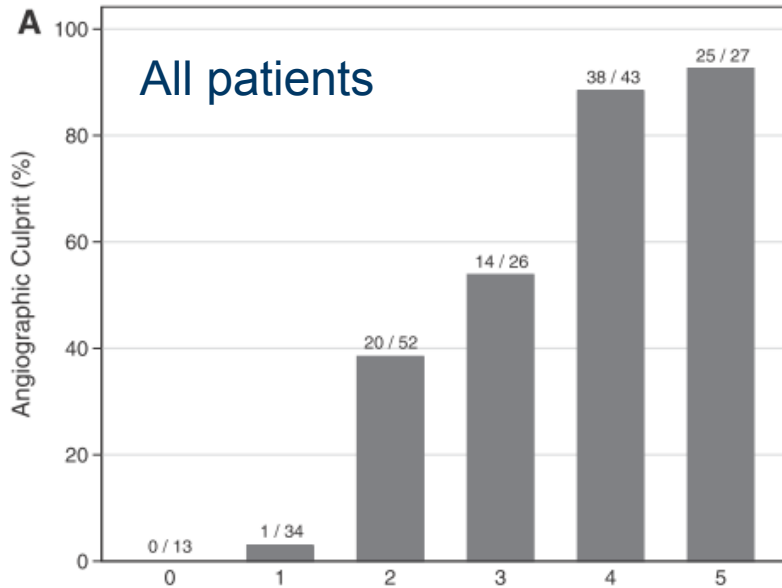
Variable	Oractiginal		Bias-Corrected	
	Coefficient	OR (95% CI)	Coefficient	OR (95% CI)
Intercept	−3.881	...	−3.393	...
Angina	1.429	4.17 (1.23–14.17)	1.249	3.49 (1.03–11.84)
Congestive heart failure	1.459	4.30 (1.04–17.87)	1.276	3.58 (0.86–14.88)
Shockable arrest rhythm	1.899	6.68 (1.61–27.79)	1.660	5.26 (1.26–21.89)
ST-elevation	2.593	13.37 (3.51–50.89)	2.267	9.65 (2.54–36.74)

Bias-corrected coefficients were determined via multiplication by the calibration slope (0.8743). CI indicates confidence interval; and OR, odds ratio.

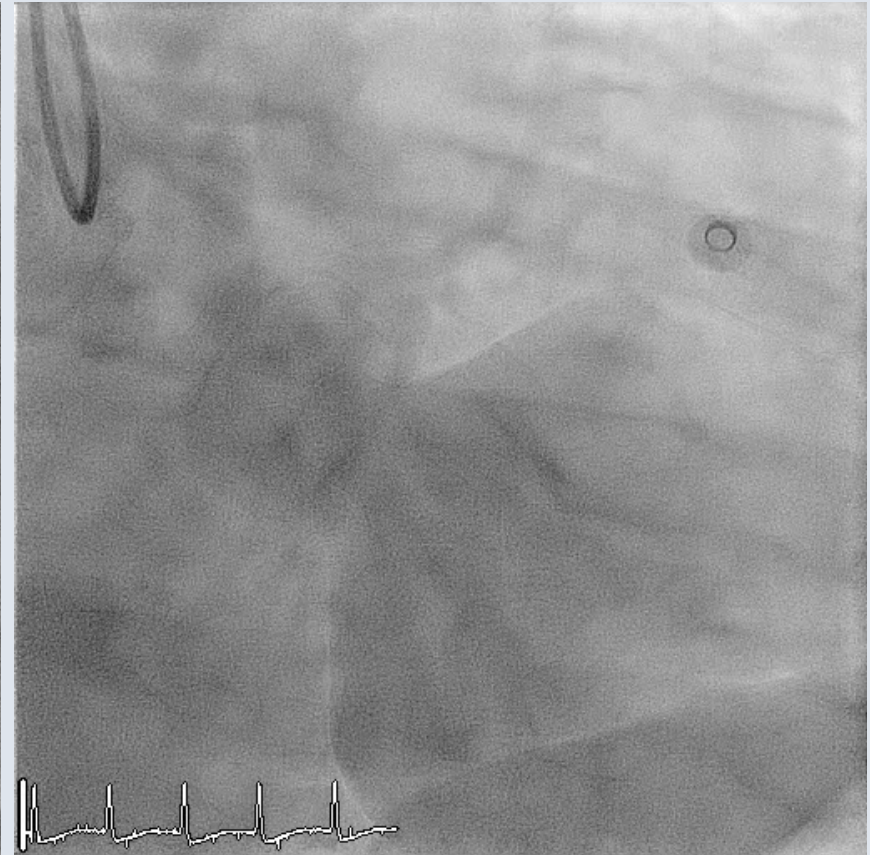
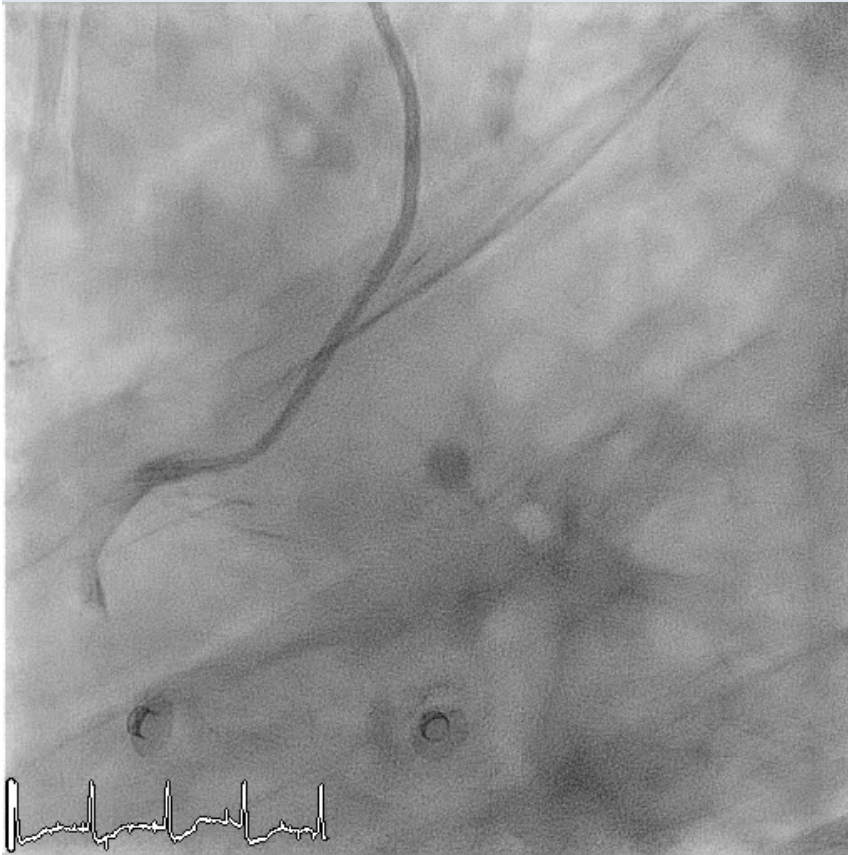
Table 5. Point Score (ACS²)

Variable	Point Value
Angina	1
Congestive heart failure symptoms	1
Shockable rhythm (ventricular fibrillation/ventricular tachycardia)	1
ST-elevation (2 contiguous leads)	2

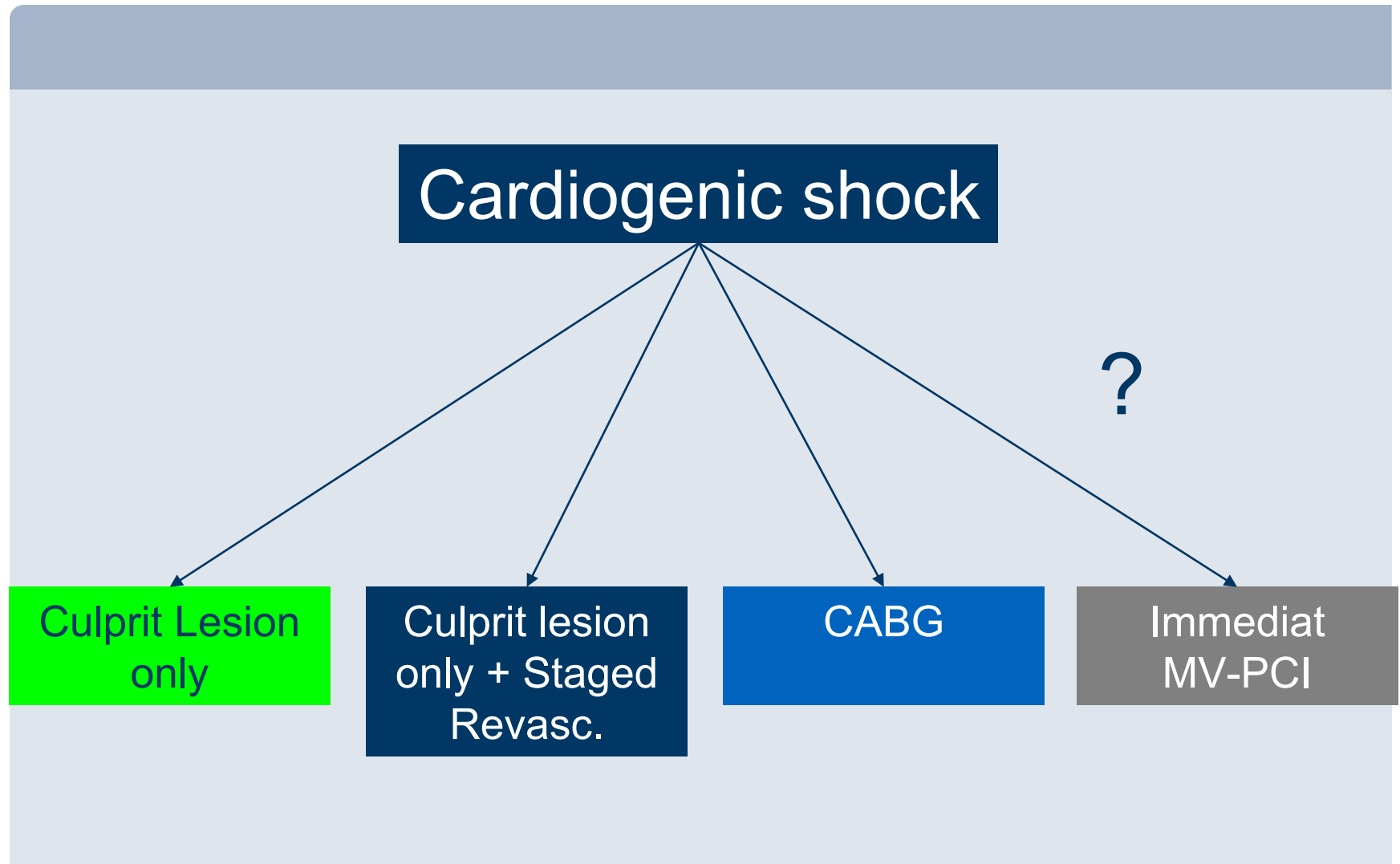
Prediction of signifacant coronary lesions



STEMI with OHCA and CS



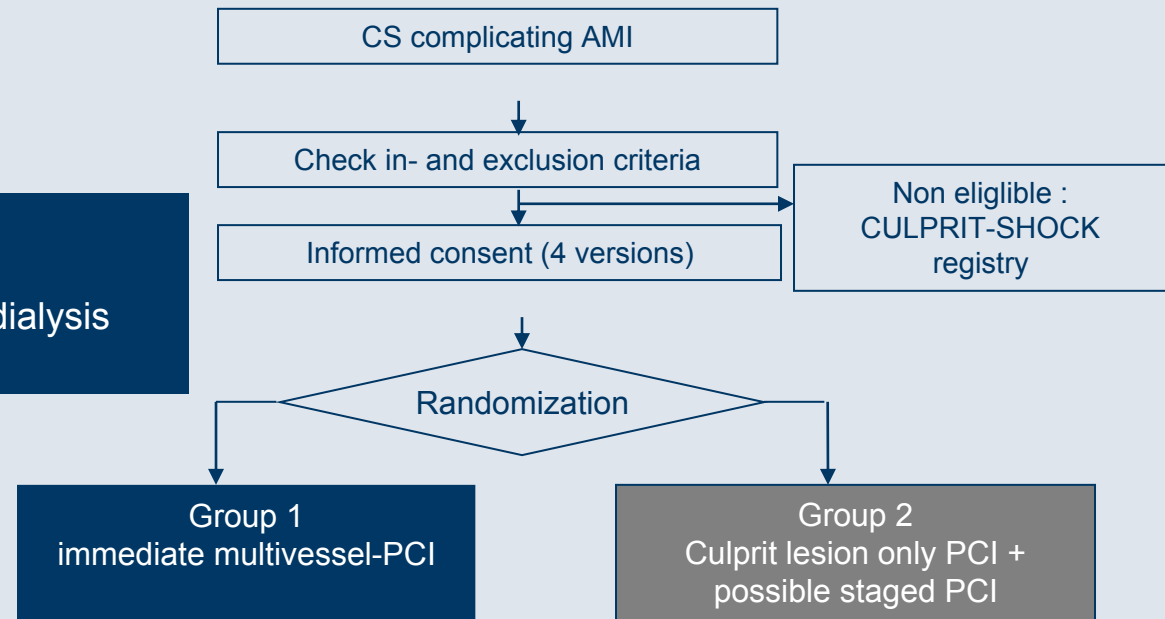
Potential revascularization strategies



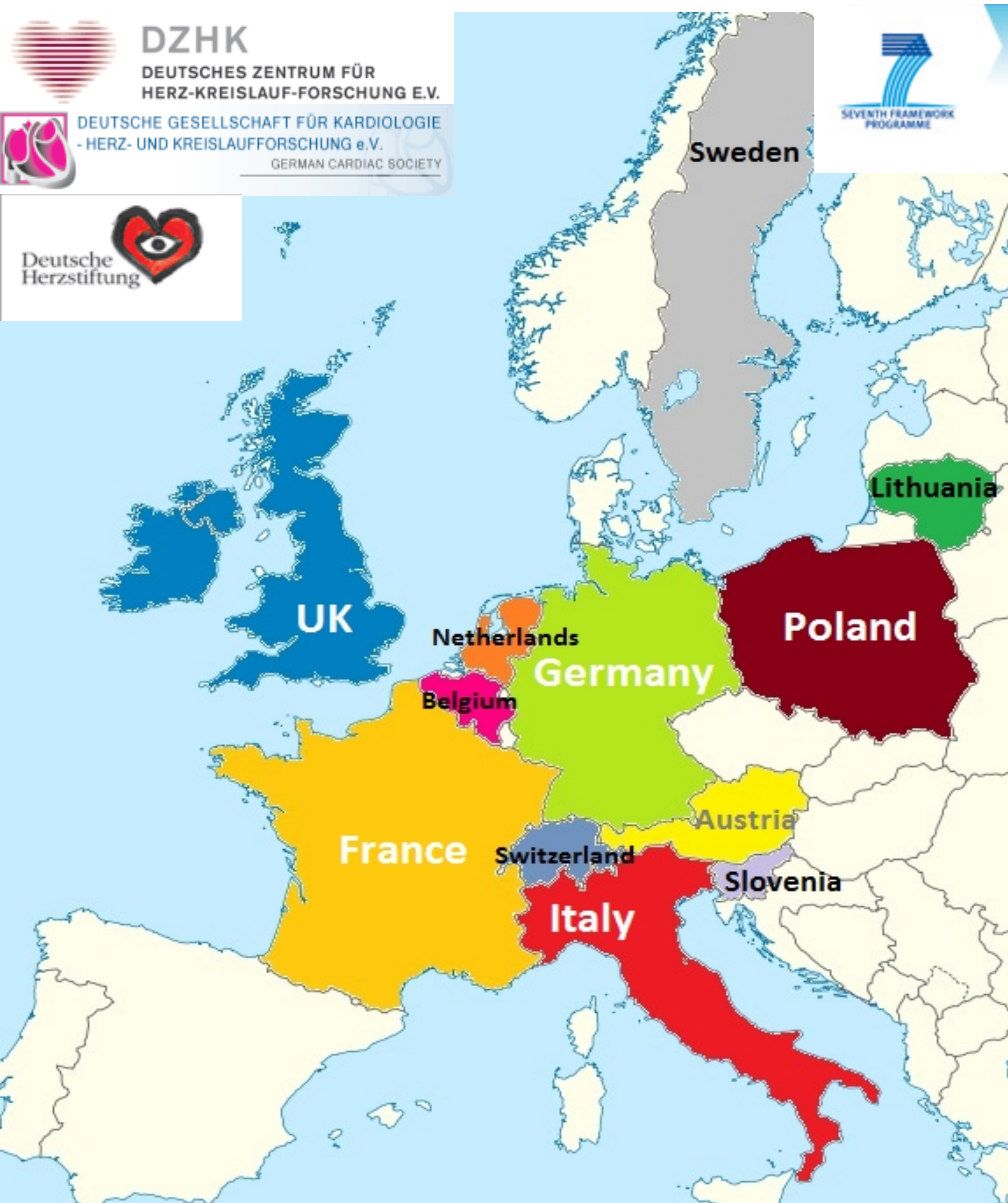
If you don't know: Randomize!

CULPRIT-SHOCK Trial

Primary Endpoint:
Mortality and/or
Acute renal failure requiring dialysis
30 days



CULPRIT-SHOCK Trial



PI + Coordinator:

Holger Thiele

Co-PI:

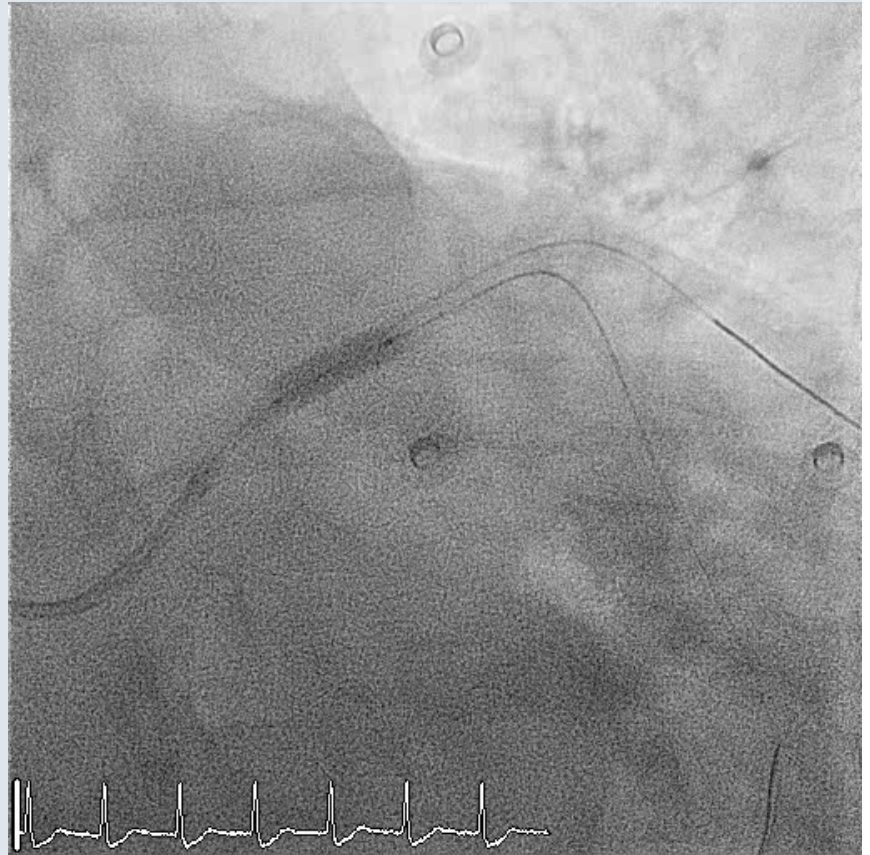
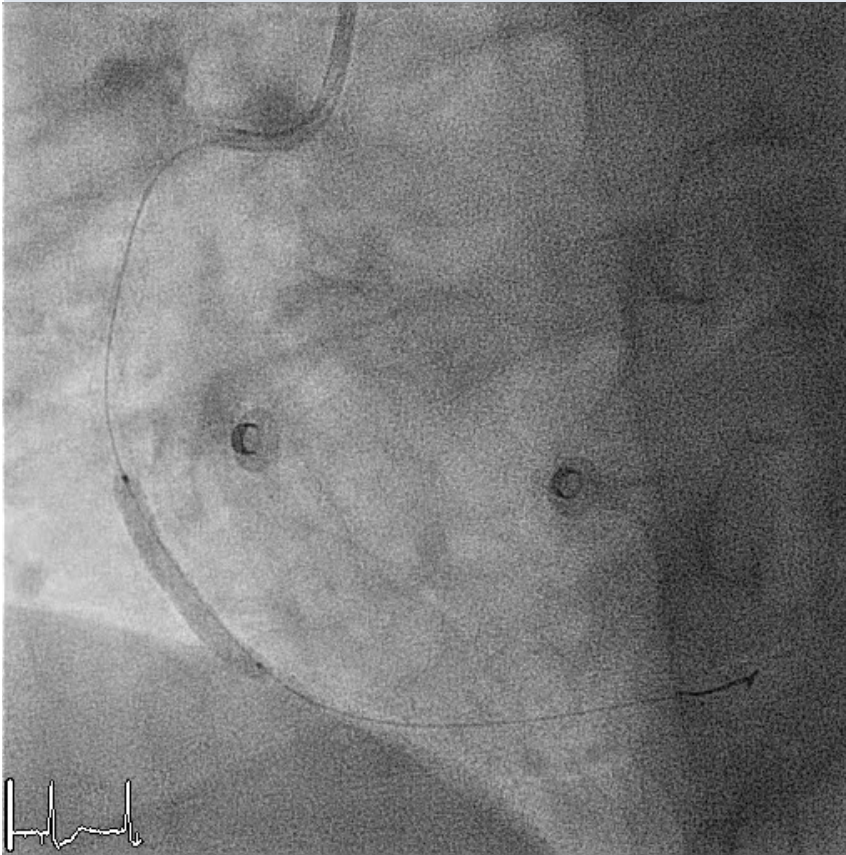
Steffen Desch

Uwe Zeymer

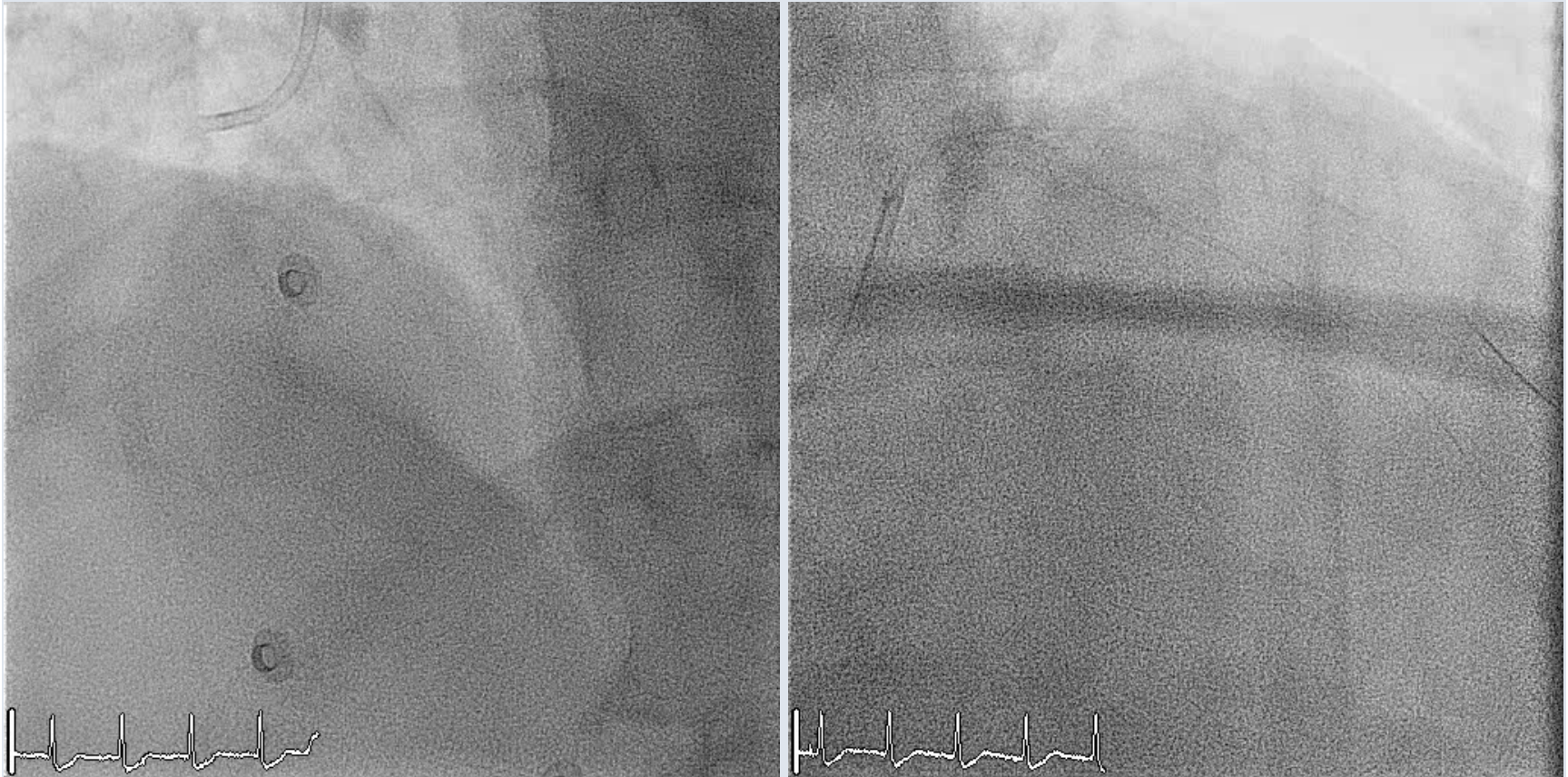
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- Gilles Montalescot
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- Pranas Serpytis
- Janina Stepinska
- Christiaan Vrints
- Marko Noc
- Keith Oldroyd
- Stefan Windecker
- Stefano Savonitto

STEMI with OHCA and CS

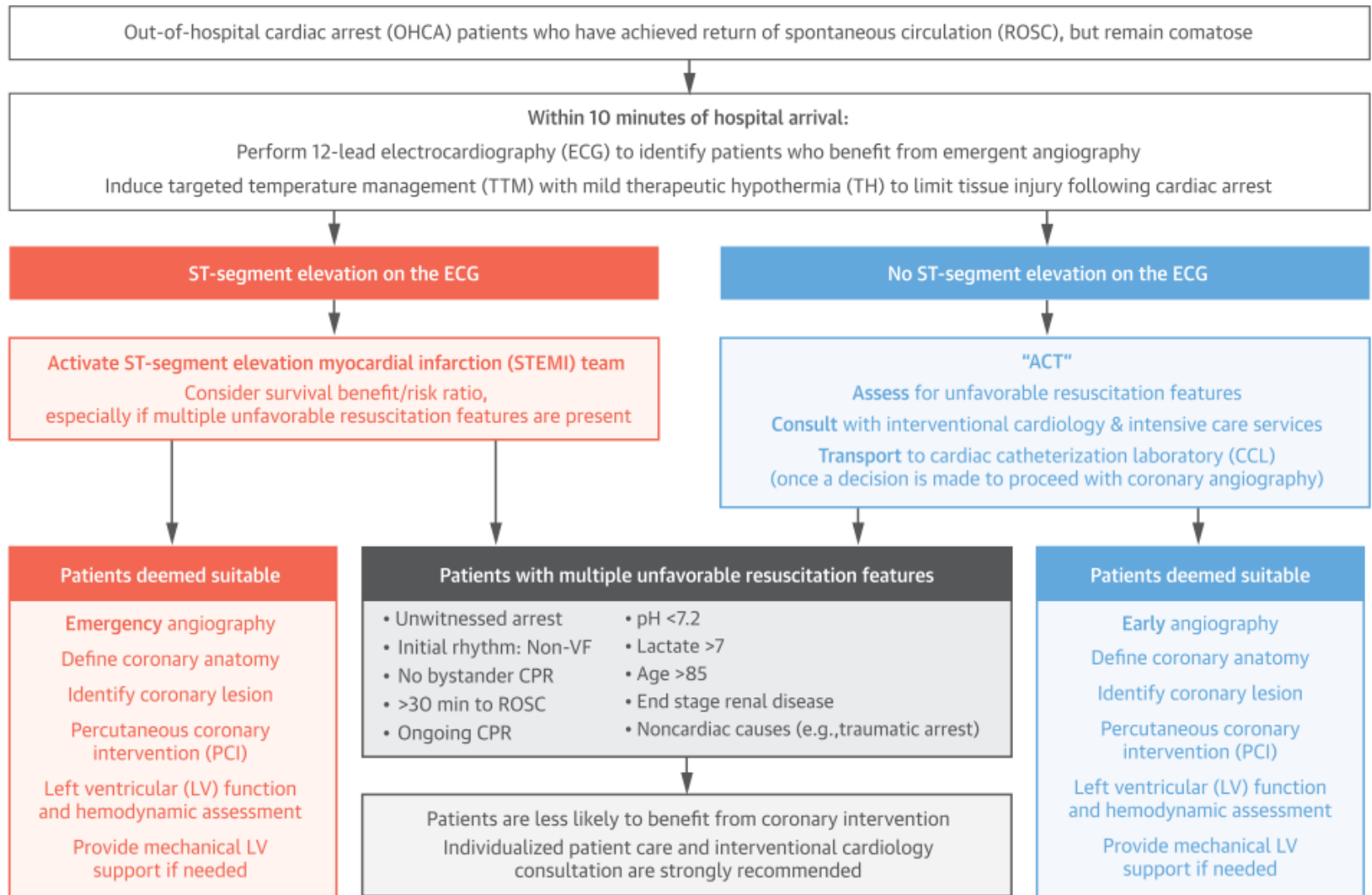


STEMI with OHCA and CS



Algorithm in OHCA

CENTRAL ILLUSTRATION Algorithm for Risk Stratification of Comatose Cardiac Arrest Patients



Angiographic findings in NSTEMI after CA?

TABLE 2 Angiographic Findings in Patients With Cardiac Arrest and No ST-Segment Elevation on ECG

First Author, Year (Ref. #)	Acute Occlusion	Culprit Lesion*	Significant CAD†
Merchant et al., 2008 (55)	6/17 (35)	—	10/17 (55)
Reynolds et al., 2009 (14)	—	—	31/54 (57)
Anyfantakis et al., 2009 (56)	—	—	27/44 (61)
Radsel et al., 2011 (31)	4/54 (7)	13/54 (24)	32/54 (59)
Bro-Jeppesen et al., 2012 (30)	—	—	43/82 (52)
Dumas et al., 2010 (3)	—	—	176/301 (58)
Hollenbeck et al., 2014 (25)	44/163 (27)	—	—
Kern et al., 2015 (52)	23	33	—
Total (%)	23	29	58

Values are n/N (%) or %. *Defined as acute occlusion or irregular plaque morphology with or without thrombus. †Defined according to the definition used in each study.

CAD = coronary artery disease; ECG = electrocardiogram.

NSTEMI and PCI after OHCA

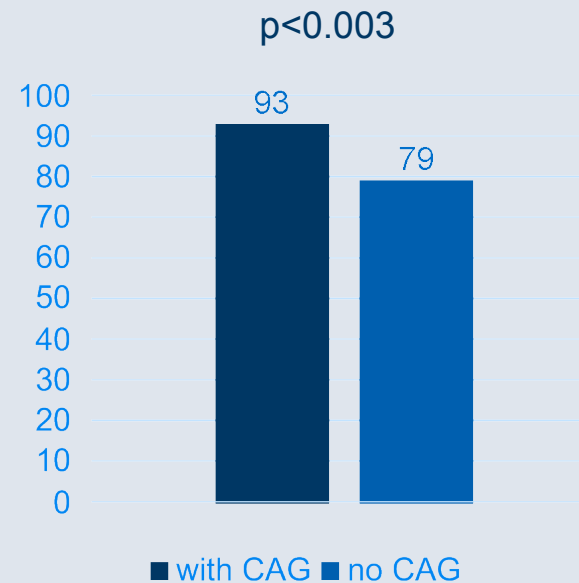
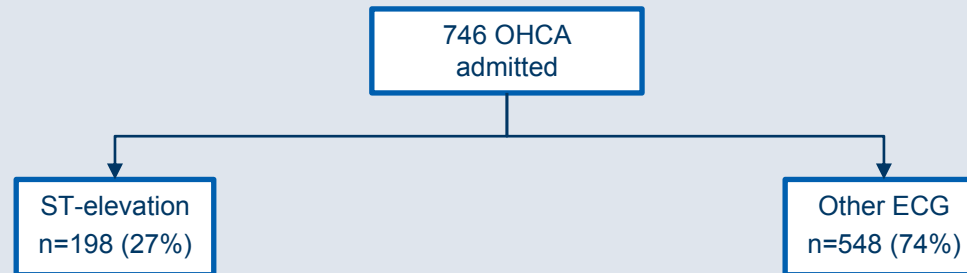
TTM modified intention
to treat population
(n=939)*

Table 2 Unadjusted and adjusted hazard ratios for death in patients with no acute ST elevation on the admission ECG

	Univariate HR (95 % CI)	Multivariate HR (95 % CI)	Multivariate p value
Early CAG	0.82 (0.64–1.03)	1.03 (0.80–1.32)	0.82
Age (per year)	1.04 (1.03–1.05)	1.03 (1.02–1.04)	<0.001*
Sex (male)	0.83 (0.63–1.09)	0.89 (0.67–1.19)	0.43
Previous AMI	1.27 (0.98–1.65)	0.95 (0.68–1.34)	0.77
Previous arrhythmia	1.38 (1.06–1.79)	1.09 (0.82–1.46)	0.56
Ischemic heart disease	1.51 (1.19–1.92)	1.15 (0.83–1.59)	0.39
Heart failure, NYHA 3–4	1.58 (1.09–2.29)	1.30 (0.86–1.96)	0.22
Witnessed arrest	0.74 (0.52–1.06)	0.91 (0.63–1.33)	0.64
Bystander CPR	0.58 (0.45–0.73)	0.83 (0.64–1.08)	0.18
Shockable initial rhythm	0.28 (0.22–0.35)	0.32 (0.25–0.42)	<0.001*
Minutes to ROSC	1.02 (1.02–1.02)	1.02 (1.02–1.02)	<0.001*
Shock on admission	2.85 (2.15–3.78)	1.97 (1.45–2.67)	<0.001*
Site ^a	0.66 (0.47–0.92)	0.91 (0.64–1.29)	0.59
Target temperature 33 °C	1.19 (0.94–1.50)	1.21 (0.95–1.54)	0.13



NSTEMI and PCI after OHCA



STEMI or NSTEMI and PCI after OHCA

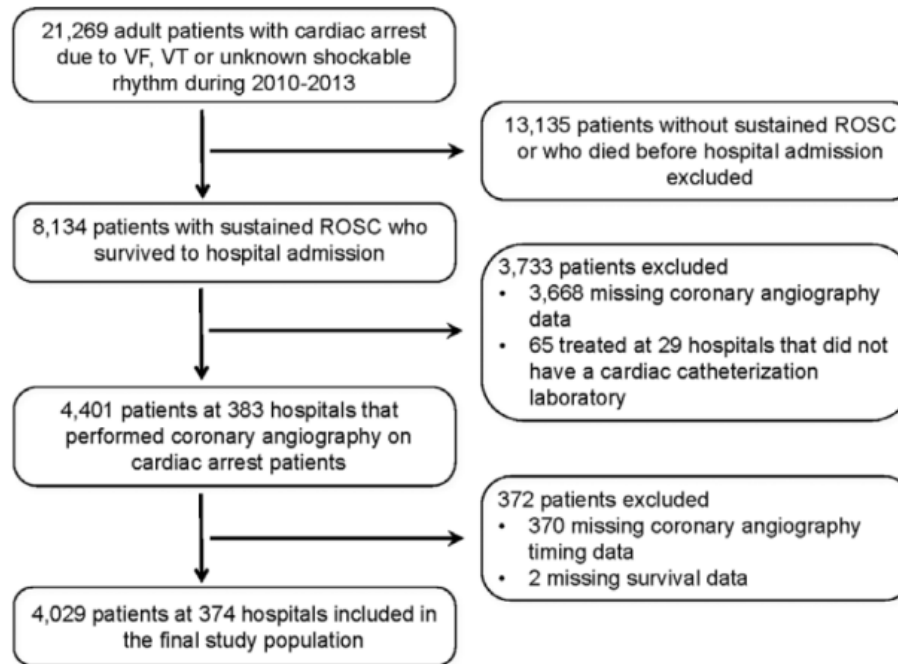


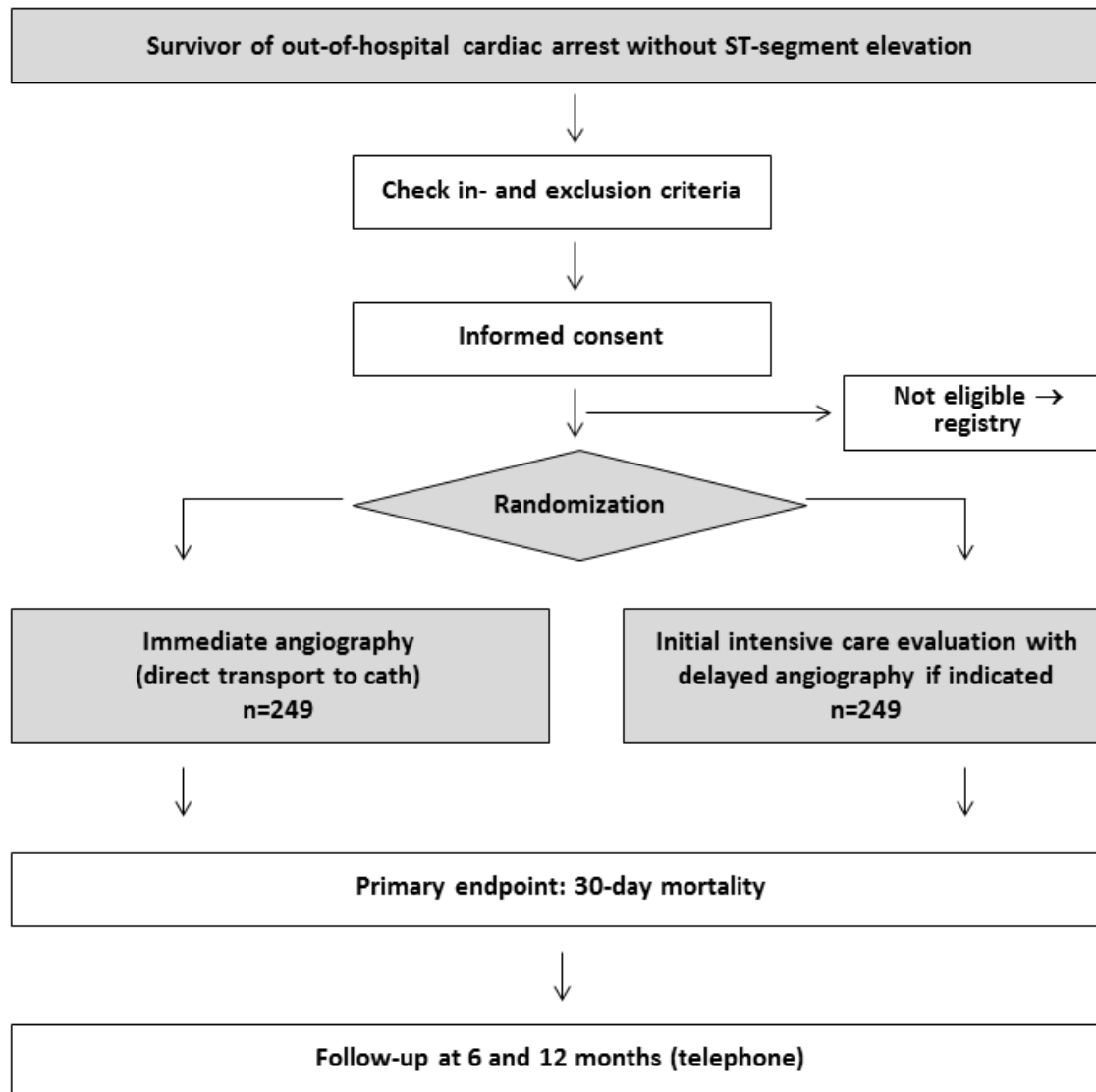
Table 3. Unadjusted and Adjusted Association of Early Coronary Angiography With Survival to Discharge and Favorable Neurological Outcome

Cohort	Survival to Discharge		Favorable Neurological Outcome	
	OR	95% CI	OR	95% CI
Unadjusted (before matching), (N=4029)*	2.16	1.89–2.47	2.18	1.92–2.47
Propensity matched, (N=2624)—all patients†	1.52	1.28–1.80	1.47	1.25–1.71
Propensity matched for patients identified as not having a STEMI, (N=620)†	1.29	0.87–1.90	1.60	1.14–2.26

If you don't know: Randomize!



TOMAHAWK flow





Anteriorer STEMI

Inclusion criteria

- Documented resuscitated OHCA of possible cardiac origin and return of spontaneous circulation
- Age ≥ 18 years
- Informed consent

Exclusion criteria

- ST-segment elevation or new left bundle branch block
- No return of spontaneous circulation upon hospital admission
- Severe hemodynamic or electrical instability requiring immediate coronary angiography/intervention (delay clinically not acceptable)
- Obvious extra-cardiac etiology such as traumatic brain injury, primary metabolic or electrolyte disorders, intoxication, overt hemorrhage, respiratory failure due to known lung disease, suffocation, drowning
- In-hospital cardiac arrest
- Pregnancy
- Participation in another clinical trial



TOMAHAWK centers (preliminary)



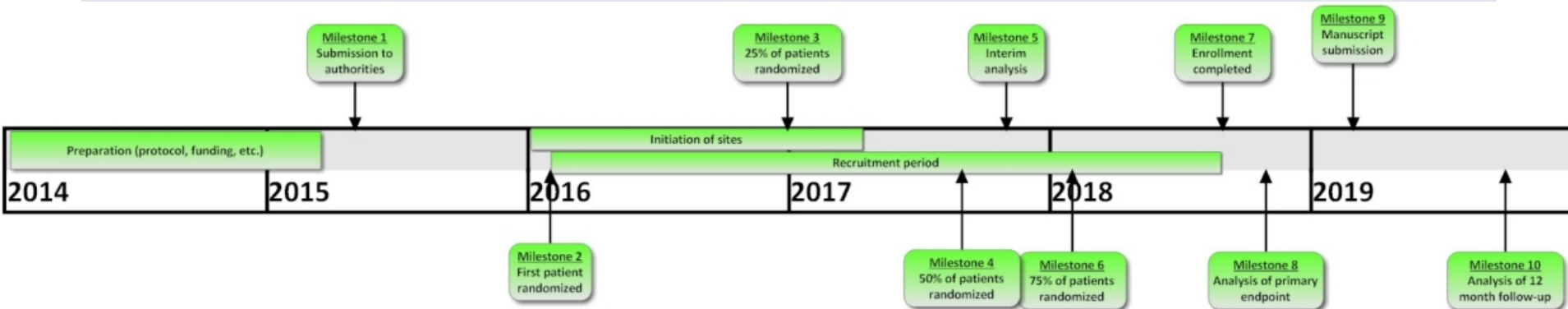
Principal investigator
Steffen Desch

TOMAHAWK subprojects

- Angiographic analysis (corelab)
- Predictive prognostic model and risk score
- Biomarkers (central biobank)
- ECG
- Microcirculation



TOMAHAWK timeline



Thank you for your attention



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