

CORONARY REPERFUSION AFTER ROSC

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Plan of This Presentation

- What are the guidelines' built on?
- Sudden cardiac arrest
- Possible MI
- What are the new published data say?
- Trauma
- Terminal cancer (DNR)
- Pediatric population
- What does guideline say for coronary reperfusion?

CORONARY REPERFUSION

1) PERCUTANEOUS CORONARY INTERVENTION (PCI)



2) THROMBOLYTICS



In adults in cardiac arrest, does the administration of thrombolytics increase the rate of survival to hospital discharge or return of spontaneous circulation compared to CPR and defibrillation alone?

TISSUE PLASMINOGEN ACTIVATOR IN CARDIAC ARREST WITH PULSELESS ELECTRICAL ACTIVITY

RIYAD B. ABU-LABAN, M.D., M.H.Sc., JAMES M. CHRISTENSON, M.D., GRANT D. INNES, M.D.,
CATHERINA A. VAN BEEK, R.N., B.S.N., KAREN P. WANGER, M.D., R. DOUGLAS MCKNIGHT, M.D.,
IAIN A. MACPHAIL, M.D., M.H.Sc., JOE PUSKARIC, E.M.A.-3, RICHARD P. SADOWSKI, E.M.A.-3, JOEL SINGER, PH.D.,
MARTIN T. SCHECHTER, M.D., PH.D., AND VICTOR M. WOOD, M.D.

N Engl J Med, Vol. 346, No. 20 • May 16, 2002 • www.nejm.org

- Randomized double-blind trial of placebo versus t-PA in 233 undifferentiated cardiac arrest patients with **pulseless electrical activity**
- The proportion of patients with ROSC was 21.4% in the t-PA group and 23.3% in the placebo group ($P=0.85$)
- No evidence of a beneficial effect of fibrinolysis in patients with cardiac arrest and pulseless electrical activity of unknown origin

Abu-Laban RB, Christenson JM, Innes GD, van Beek CA, Wagner KP, McKnight RD. Tissue plasminogen activator in cardiac arrest with PEA.

A 2006 meta- analysis of CPR with and without thrombolytic agents concluded that thrombolysis can improve neurological function and survival to discharge;

However, the conclusions of this meta-analysis are questionable as it involved low-quality heterogeneous studies and excluded a negative, double-blind, placebo- controlled trial

Li X, Fu QL, Jing XL, Li YJ, Zhan H, Ma ZF, Liao XX. A meta-analysis of cardiopulmonary resuscitation with and without the administration of thrombolytic agents. Resuscitation 2006;70:31–6.

ORIGINAL ARTICLE

Thrombolysis during Resuscitation for Out-of-Hospital Cardiac Arrest

Bernd W. Böttiger, M.D., Hans-Richard Arntz, M.D.,
Douglas A. Chamberlain, M.D., Erich Bluhmki, Ph.D., Ann Belmans, M.Sc.,
Thierry Danays, M.D., Pierre A. Carli, M.D., Jennifer A. Adgey, M.D.,
Christoph Bode, M.D., and Volker Wenzel, M.D., M.Sc.,
for the TROICA Trial Investigators and the European Resuscitation
Council Study Group*

TROICA

N Engl J Med 2008; 359: 2651-62

TROICA

N Engl J Med 2008;359:2651-62

- A double-blind, multicenter trial of 443 patients
- Randomly assigned adult patients with witnessed out-of-hospital cardiac arrest to receive tenecteplase or placebo during CPR
- The inclusion criteria were restricted to patients with **ventricular fibrillation** refractory to three external electric shocks
- Adjunctive heparin or aspirin was not used

TROICA

- **No differences** between tenecteplase and placebo in the primary end point of **30-day survival** (14.7% vs. 17.0%; $P=0.36$; RR, 0.87; 95% CI: 0.65-1.15)
- or in the secondary end points of **hospital admission** (53.5% vs. 55.0%, $P=0.67$),
- Return of spontaneous circulation (55.0% vs. 54.6%, $P = 0.96$), **24-hour survival** (30.6% vs 33.3%, $P = 0.39$),
- survival to **hospital discharge** (15.1% vs. 17.5%),
- **neurologic outcome** ($P=0.69$)
- There were more intracranial hemorrhages in the tenecteplase group

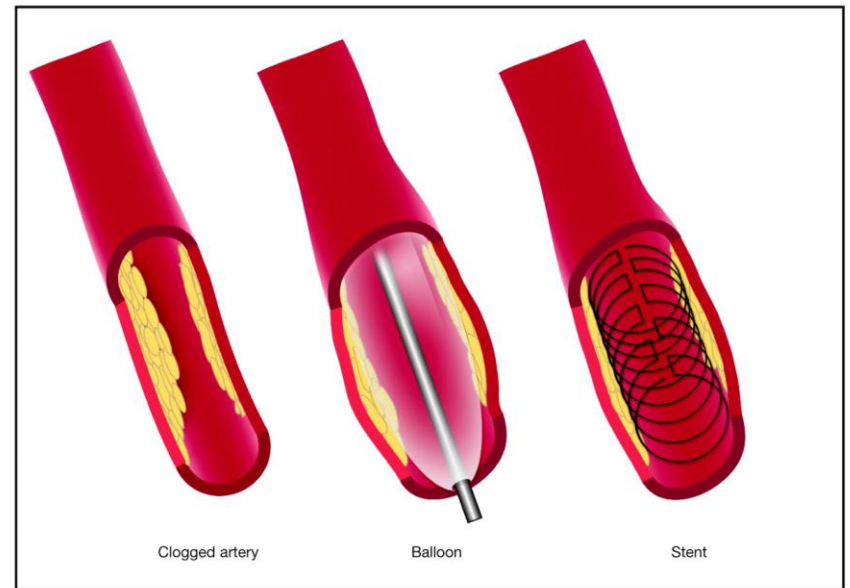
Impact of fibrinolysis on immediate prognosis of patients with out-of-hospital cardiac arrest

**Aurélien Renard · Catherine Verret · Daniel Jost · Jean-Baptiste Meynard ·
Julie Tricehreau · Olivier Hersan · David Fontaine ·
Frédérique Briche · Patrick Benner · Olivier de Stabenrath ·
Christophe Bartou · Nicolas Segal · Laurent Domanski**

- Retrospective; 107 fibrinolytics + 1,154 controls
- The primary endpoint was survival to hospital admission

- After adjusting for covariates, survival to hospital admission was more frequent in patients who received **fibrinolytic** (ORa: 1.7, CI 95%: 1.09–2.68)
- For **asystole/PEA patients**, **fibrinolytic** was associated with a higher survival to hospital admission (ORa: 3.61, CI 95%:1.88–6.96)
- For **VT/VF patients**, survival to hospital admission was not affected by fibrinolytic administration (OR: 1.08, CI 95%: 0.61–1.92)

Trombolytics vs PCI





Clinical paper

Primary percutaneous coronary intervention and thrombolysis improve survival in patients with ST-elevation myocardial infarction and pre-hospital resuscitation^{☆,☆☆}

Oliver Koeth^{a,c}, Ralf Zahn^{a,c}, Timm Bauer^{a,c}, Claus Juenger^{b,c}, Anselm Kai Gitt^{a,b,c}, Jochen Senges^{b,c}, Uwe Zeymer^{a,b,*,c}

^a Herzzentrum Ludwigshafen, Department of Cardiology, Ludwigshafen, Germany

^b Institut für Herzinfarktforschung Ludwigshafen an der Universität Heidelberg, Ludwigshafen, Germany

Primary PCI as well as **thrombolysis** in survivors of pre-hospital resuscitation with STEMI were associated with a significant reduction of **hospital mortality** (OR: 0.29, 95% CI 0.17–0.50; and 0.74, 95% CI 0.54–0.99, respectively), while primary **PCI was superior compared to thrombolysis** (OR 0.50, 95% CI 0.30–0.84).

RESEARCH

Open Access

Postresuscitation care with mild therapeutic hypothermia and coronary intervention after out-of-hospital cardiopulmonary resuscitation: a prospective registry analysis

Jan Thorsten Gräsner^{1*†}, Patrick Meybohm^{1†}, Amke Caliebe², Bernd W Böttiger³, Jan Wnent¹, Martin Messelken⁴, Tanja Jantzen⁵, Thorsten Zeng⁶, Bernd Strickmann⁷, Andreas Bohn⁸, Hans Fischer⁹, Jens Scholz¹, Matthias Fischer⁴, for the German Resuscitation Registry Study Group

- In normothermic patients (n=405), **PCI** was independently associated with **increased 24-hour survival** (4.46 (2.26 to 8.81), $P < 0.001$) and **CPC 1 or CPC 2** (10.81 (5.86 to 19.93), $P < 0.001$).
- Analysis of all patients (n=584) revealed that 24-hour survival was increased by MTH (7.50 (4.12 to 13.65), $P < 0.001$) and PCI (3.88 (2.11 to 7.13), $P < 0.001$),
- while the **proportion** of patients with **CPC 1 or CPC 2** was significantly **increased** by **PCI** (5.66 (3.54 to 9.03), $P < 0.001$) but not by **MTH** (1.27 (0.79 to 2.03), $P = 0.33$)

Comparing percutaneous coronary intervention and thrombolysis in patients with return of spontaneous circulation after cardiac arrest

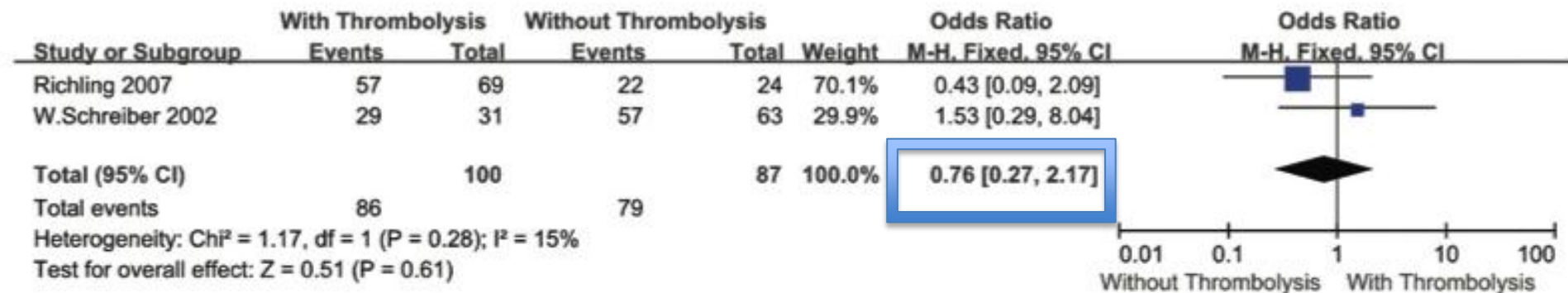
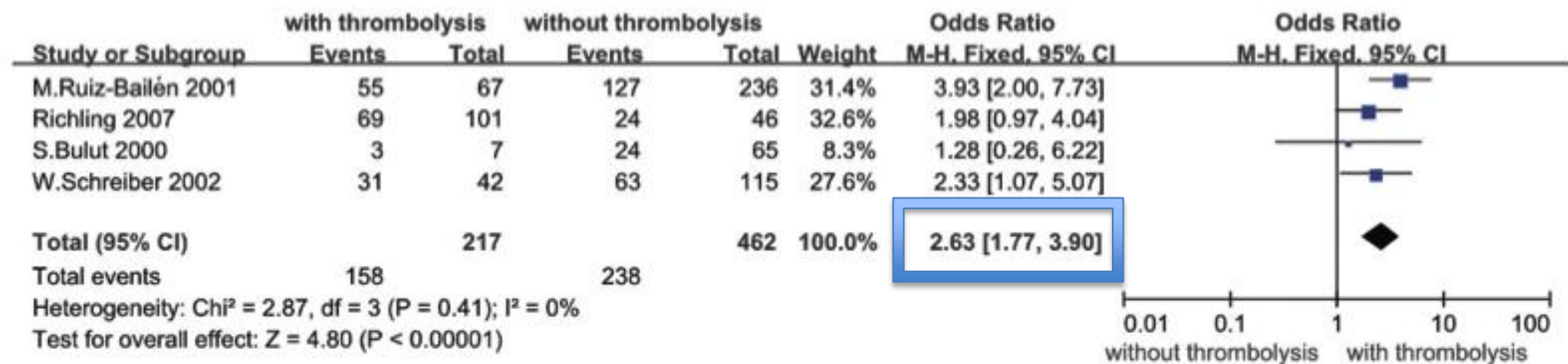
Ying-Qing Li,^I Shu-Jie Sun,^{II} Na Liu,^{III} Chun-Lin Hu,^I Hong-Yan Wei,^I Hui Li,^I Xiao-Xing Liao,^I Xin Li^{I*}

^IThe First Affiliated Hospital of Sun Yat-sen University, Emergency Department, Guangzhou, People's Republic of China. ^{II}East Hospital of Tongji University, Emergency Department, Shanghai, People's Republic of China. ^{III}University Cancer Center, Sun Yat-sen, Guangzhou, People's Republic of China.

Clinics. 2013; 68(4): 523-529

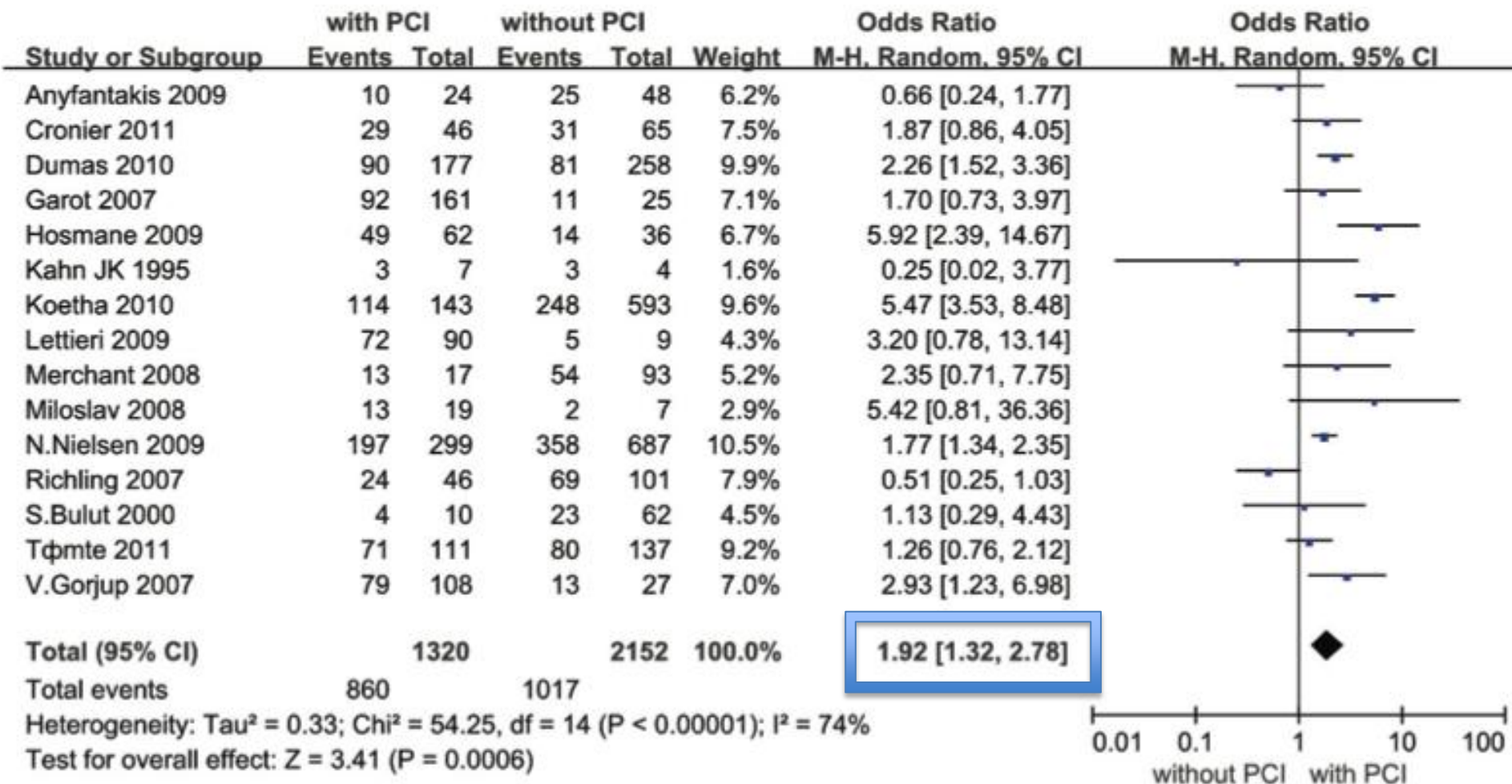
Meta-analysis

The **hospital discharge** rates between the with- and without-**thrombolysis** patients for the meta-analysis



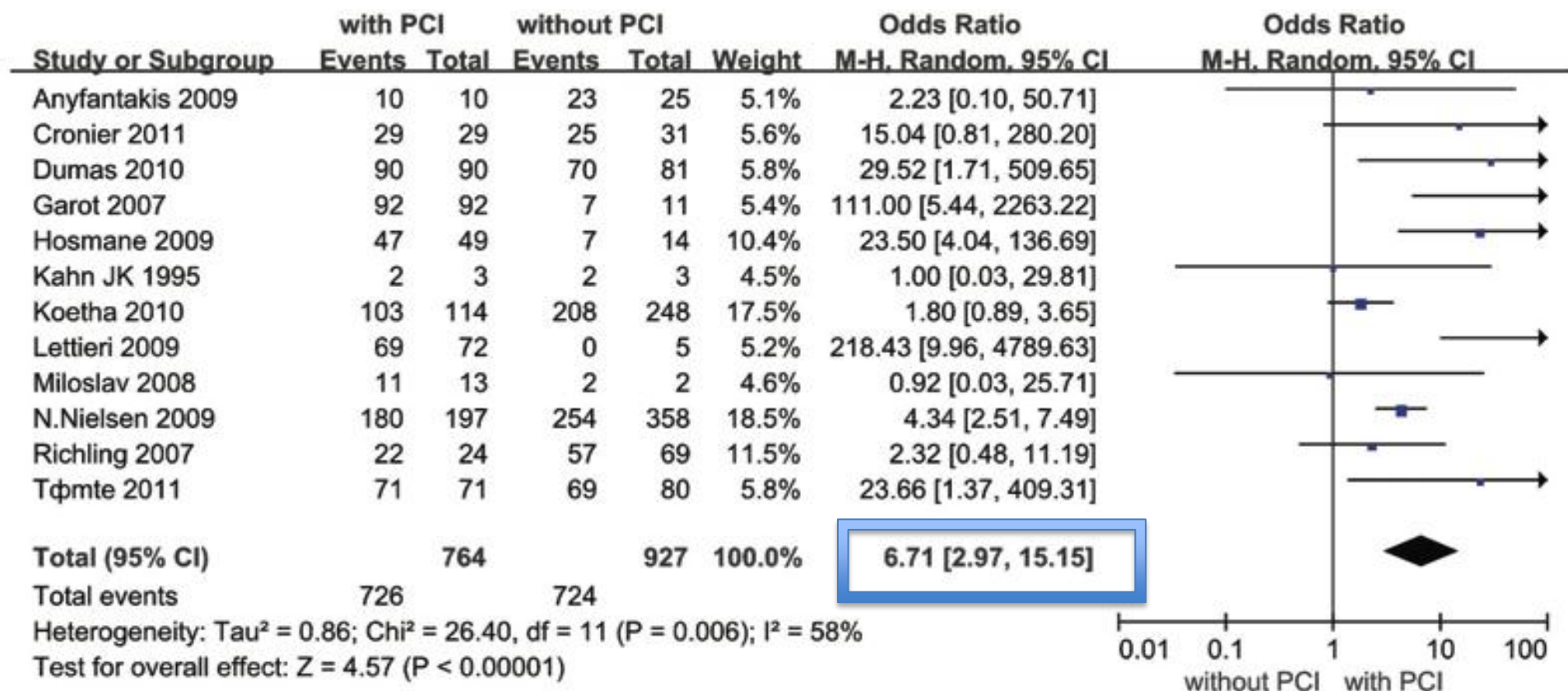
The **neurological recovery** rates between the with- and without-**thrombolysis** patients for the meta-analysis

Better hospital discharge rates with- compared to without-**PCI** patients

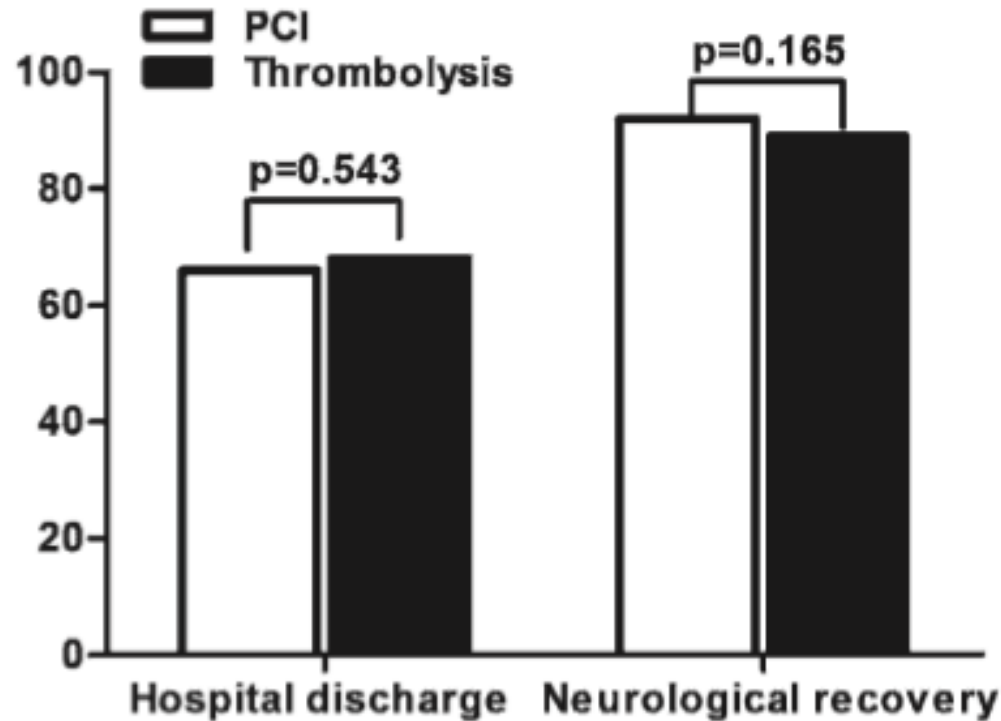


Li YQ, Sun SJ, Liu N, Hu CL, Wei HY, Li H, et al. Comparing percutaneous coronary intervention and thrombolysis in patients with return of spontaneous circulation after cardiac arrest. Clinics. 2013;68(4):523-529.

PCI treatment significantly improved the rate of neurological recovery at the time of hospital discharge in patients with ROSC after CA (OR: **6.71**; 95% CI: 2.97-15.15, p:0.001)

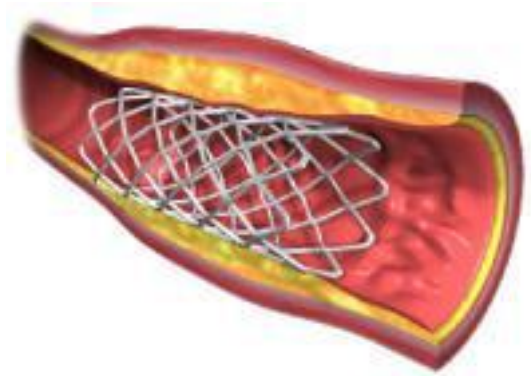


Li YQ, Sun SJ, Liu N, Hu CL, Wei HY, Li H, et al. Comparing percutaneous coronary intervention and thrombolysis in patients with return of spontaneous circulation after cardiac arrest. Clinics. 2013;68(4):523-529.



The meta- analysis indicated that both **PCI** and **thrombolysis** could **improve the hospital discharge rate** for patients with ROSC after CA, but only **PCI** could **improve the neurological recovery rate**

What about long time survival with **PCI**?

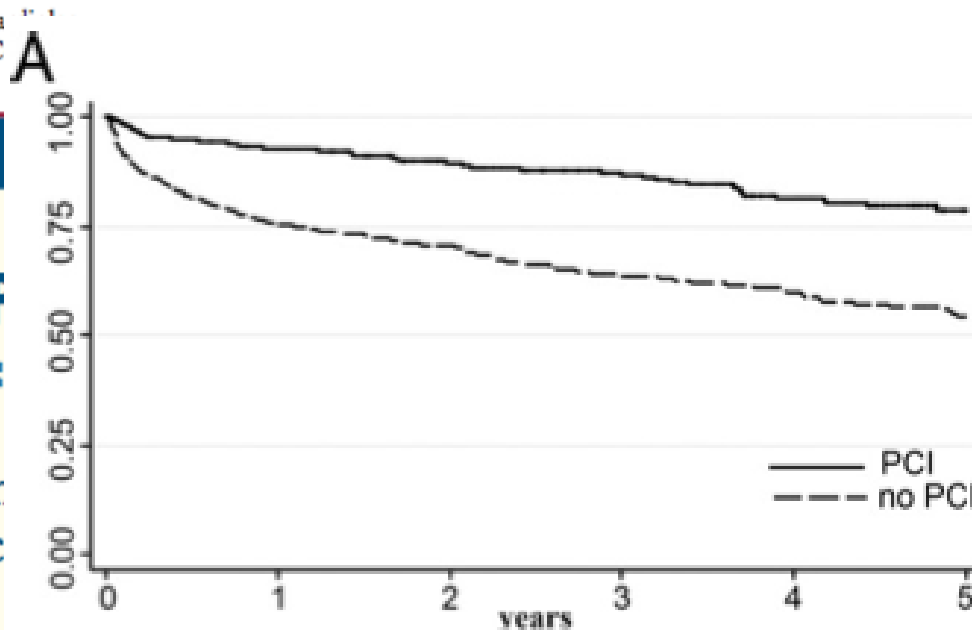


CLINICAL RESEARCH

Long-Term Follow-Up From Out of

Role of Percutaneous Coronary Intervention and Therapeutic

Florence Dumas, MD
Alain Cariou, MD,†
Seattle, Washington; et al.

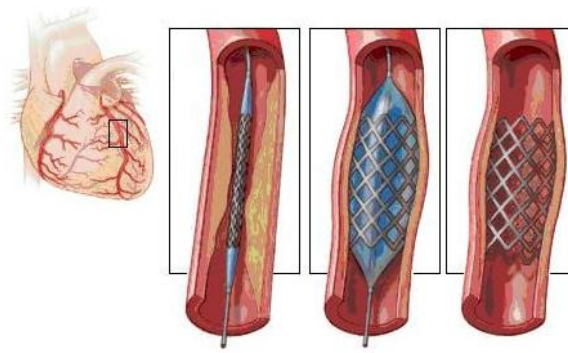


		years	deaths	Person-year	Survival rate (%)
PCI+	1 year		28	365.1	92.7 (89.6-94.9)
	5 years		71	1429.6	78.7 (73.7-82.8)
PCI-	1 year		152	512.5	75.4 (71.8-78.6)
	5 years		242	1633.1	54.4 (49.7-58.8)

H,*

Cardiac Arrest

Five-year survival analysis: After adjustment for confounders, **PCI** was associated with a **lower risk of death** (hazard ratio [HR]: 0.46 [95% confidence interval [CI]: 0.34 to 0.61]; $p < 0.001$)



Are pre-arrest symptoms and post-resuscitation ECG findings helpful in determining which post-resuscitated patients need emergent **PCI**?



Contents lists available at ScienceDirect

Resuscitation

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

Clinical paper

Value of post-resuscitation electrocardiogram in the diagnosis of acute myocardial infarction in out-of-hospital cardiac arrest patients[☆]

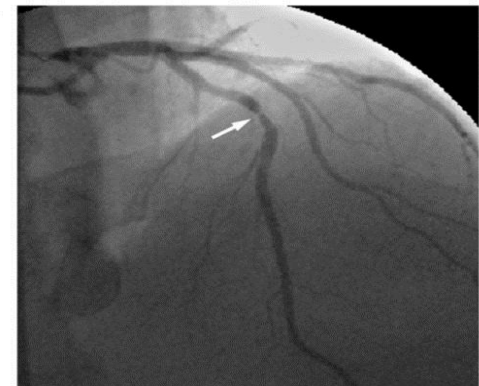
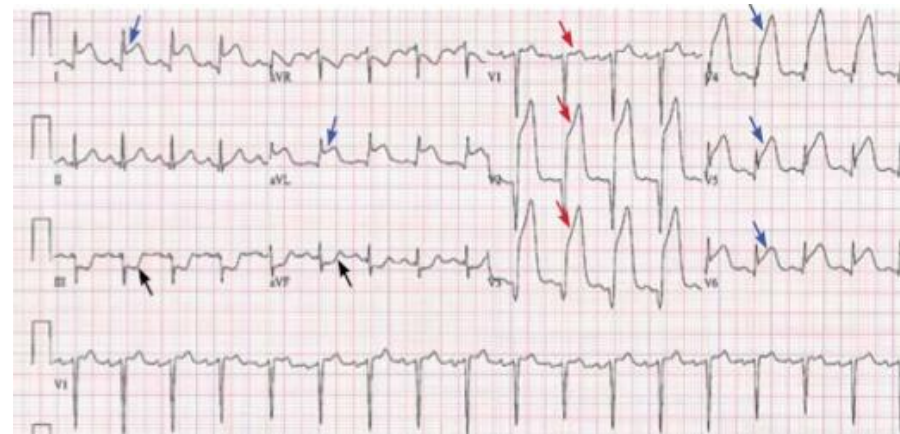
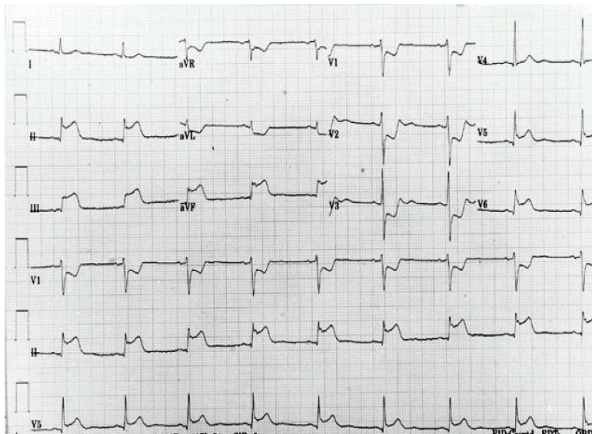
Characteristics of the combination of different ECG criteria for the selection of OHCA patients with AMI.

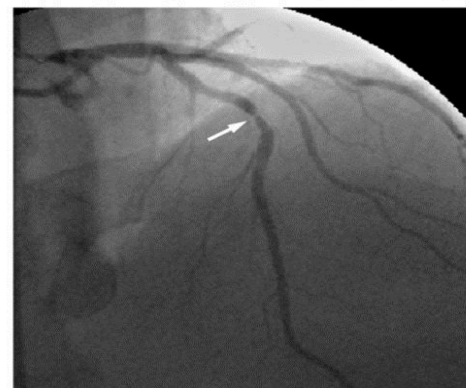
	Sensitivity (%) (CI)	Specificity (%) (CI)	PPV (%) (CI)	NPV (%) (CI)	Accuracy (%) (CI)
ST-elevation (n = 70)	88 (77–95)	84 (75–90)	76 (64–85)	92 (85–97)	85 (79–90)
ST-elevation and/or depression (n = 96)	95 (86–99)	62 (52–72)	59 (49–69)	96 (87–99)	74 (67–81)
Combined criterion ^a (n = 116)	100 (94–100)	46 (36–56)	52 (42–61)	100 (92–100)	66 (58–73)
Extended criterion ^b (n = 124)	100 (94–100)	39 (30–49)	48 (39–58)	100 (91–100)	61 (52–69)

PPV = positive predictive value; NPV = negative predictive value; CI = confidence interval.

^a The combined criterion includes ST-elevation and/or depression, and/or left bundle branch block and/or non-specific wide QRS complex.^b The extended criterion includes ST-elevation and/or depression, and/or left bundle branch block and/or non-specific wide QRS complex and/or right bundle branch block.

Multivariate logistic regression and the independent correlates of **AMI** found were **ST-elevation—OR = 29.6**, CI = 10.8–81.08 ($p < 0.001$) and the presence of **VF as initial rhythm—OR = 5.7**, CI = 2.1–15.8 ($p < 0.001$)





-Among resuscitated patients without ST-segment elevation, 11% had an acutely occluded coronary artery¹

-In 418 patients angiographically diagnosed with AMI, the sensitivity of ST-elevation was 85% if LAD and RCA were occluded, and 46% for Cx occlusion²

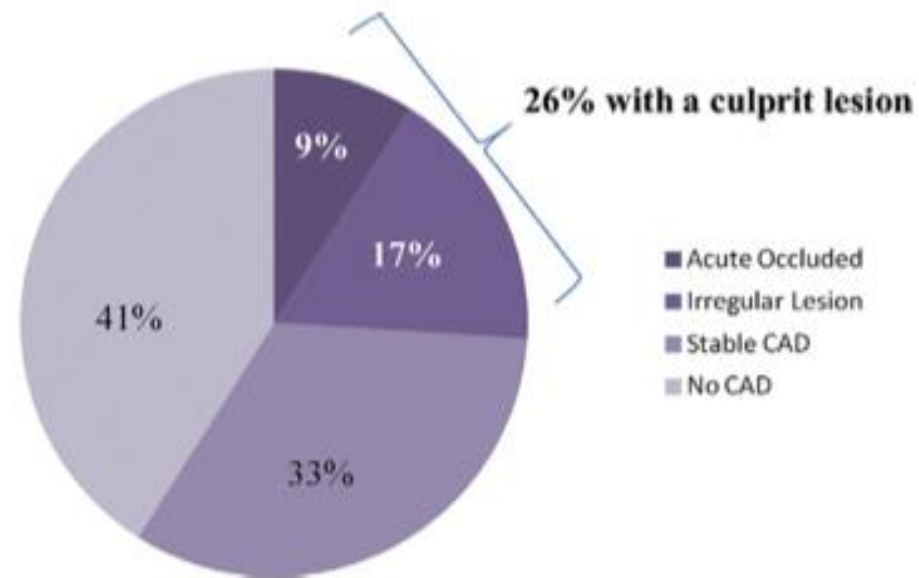
¹Spaulding CM, Joly L-M, Rosenberg A, et al. Immediate coronary angiography in survivors of out-of-hospital cardiac arrest. N Engl J Med 1997;336:1629–33.

²Schmitt C, Lehmann G, Schmieder S, Karch M, Neumann FJ, Schomig A. Diagnosis of acute myocardial infarction in angiographically documented occluded infarct vessel: limitations of ST-segment elevation in standard and extended ECG leads. Chest 2001;120:1540–6.

In 3 studies, **PCI** was performed immediately after resuscitation, and the diagnostic characteristics of the ST-elevation were evaluated: PPV ranged from 63% to 83% and NPV from 74% to 84%

- Spaulding CM, Joly LM, Rosenberg A, et al. Immediate coronary angiography in survivors of out-of-hospital cardiac arrest. N Engl J Med 1997;336:1629–33.
- Dumas F, Cariou A, Manzo-Silberman S, et al. Immediate percutaneous coronary intervention is associated with better survival after out-of-hospital cardiac arrest: insights from the PROCAT (Parisian Region Out of hospital Cardiac Arrest) registry. Circ Cardiovasc Interv 2010;3:200–7.
- Anyfantakis ZA, Baron G, Aubry P, et al. Acute coronary angiographic findings in survivors of out-of-hospital cardiac arrest. Am Heart J 2009;157:312–8.

Even in the absence of ST-segment elevation, an acute culprit lesion is present in 25% of patients



Radsel P, Knafelj R, Kocjancic S, Noc M. Angiographic characteristics of coronary disease and postresuscitation electrocardiograms in patients with aborted cardiac arrest outside a hospital. Am J Cardiol 2011;108: 634–8.

Whether patients **without** evidence of **ST elevation** following resuscitation can benefit from **PCI** and should undergo early and routine coronary catheterization ?

Urgent PCI is reasonable and successful regardless of the post-resuscitation ECG findings

-Dumas et al. Long-Term Prognosis Following Resuscitation From Out of Hospital Cardiac Arrest J Am Coll Cardiol 2012;60:21–7

-Impact of Emergency Coronary Angiography on In-Hospital Outcome of Unconscious Survivors After Out-of-Hospital Cardiac Arrest. Am J Cardiol 2012;110:1723–1728

Is whether the patient is conscious or comatose a deciding factor in performing emergent coronary angiography ?

Excellent long-term neurologically favorable outcomes can be achieved even in those comatose at the time of cardiac catheterization

When Should Post-Resuscitation **Coronary Angiography** Be Performed?

- We do not know
- Meet the same goal of a 90-min door-to-reperfusion time for all post-resuscitation patients as it is for the STEMI patients

**What if PCI
now?**

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graph TD; A([What if PCI now?]) --> B[Arrest CPR]; B --> C[ROSC];
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Arrest CPR

ROSC

Circulation. 2012;126:1605-1613.

Should We Emergently Revascularize Occluded Coronaries for Cardiac Arrest?

Rapid-Response Extracorporeal Membrane Oxygenation and Intra-Arrest Percutaneous Coronary Intervention

Eisuke Kagawa, MD; Keigo Dote, MD, PhD; Masaya Kato, MD, PhD; Shota Sasaki, MD, PhD; Yoshinori Nakano, MD; Masato Kajikawa, MD; Akifumi Higashi, MD; Kiho Itakura, MD; Akihiko Sera, MD, PhD; Ichiro Inoue, MD, PhD; Takuji Kawagoe, MD, PhD; Masaharu Ishihara, MD, PhD; Yuji Shimatani, MD; Satoshi Kurisu, MD, PhD

- multicenter cohort study, Hiroshima, 2004 – 2011
- Median age 63 y, OHCA
- rapid-response ECMO was performed in 86 patients with ACS who were unresponsive to conventional CPR

- Emergency coronary angiography was performed in 81 patients (94%), and intra-arrest PCI was performed in 61 patients (71%)
- The rates of ROSC 88%, 30-day survival 29%, and favorable neurological outcomes 24%
- All of the patients who received intra-arrest PCI achieved return of spontaneous heartbeat

Can Post-Resuscitation Echocardiography Be useful ?

- The global hypokinesis of post- resuscitation myocardial stunning can obscure the echocardiographic findings and conclusions
- Do not routinely do emergent echocardiography on post-resuscitation patients

Kern KB, Hilwig RW, Rhee KH, Berg RA. Myocardial dysfunction following resuscitation from cardiac arrest: an example of global myocardial stunning. J Am Coll Cardiol 1996;28:232–40.

Should **MTH** and emergent **coronary angiography** be done simultaneously or must 1 therapy wait on the other?

- **Simultaneous treatment is feasible**
- Therapeutic hypothermia is recommended in combination with primary PCI, and should be started as early as possible, preferably before initiation of PCI
- Angiography and/or PCI need not preclude or delay other therapeutic strategies including therapeutic hypothermia

2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science

“It is reasonable to perform early angiography and primary percutaneous coronary intervention in selected patients despite the absence of ST-segment elevation on the ECG or prior clinical findings, such as chest pain, if coronary ischemia is considered the likely cause on clinical grounds”

O'Connor RE, Bossaert L, Arntz H-R, et al., for the Acute Coronary Syndrome Chapter Collaborators. Part 9: acute coronary syndromes: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Circulation 2010;122 Suppl 2:S422– 65.

ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation

Table 7 Cardiac arrest

Recommendations	Class ^a	Level ^b
Immediate angiography with a view to primary PCI is recommended in patients with resuscitated cardiac arrest whose ECG shows STEMI.	I	B
Immediate angiography with a view to primary PCI should be considered in survivors of cardiac arrest without diagnostic ECG ST-segment elevation but with a high suspicion of ongoing infarction.	IIa	B

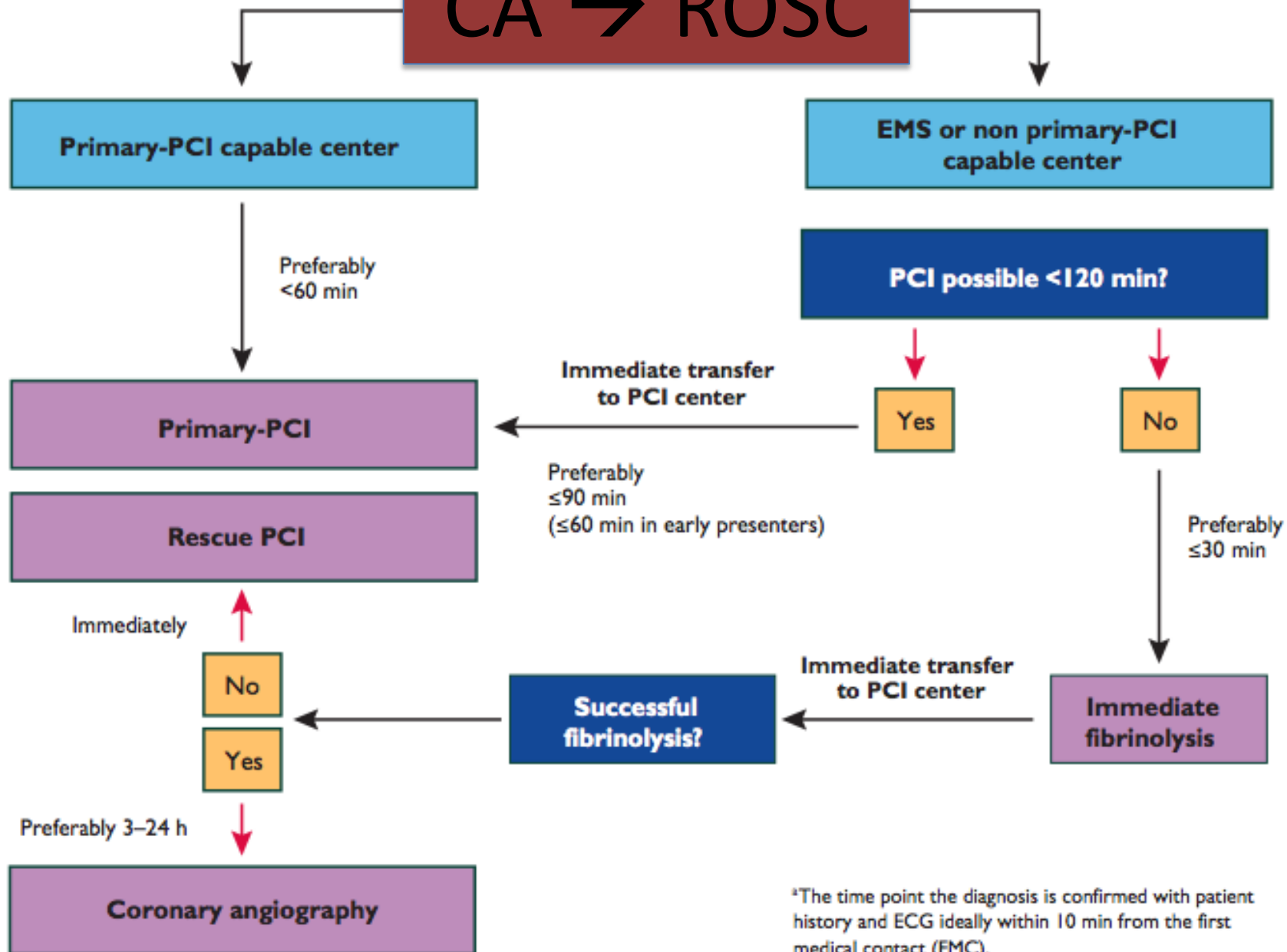
When **fibrinolysis** after ROSC ?

In centers where immediate PCI is not available, patients presenting with ECG changes following ROSC should have in-hospital fibrinolysis if it has not been administered in the pre-hospital setting



Richling N, Herkner H, Holzer M. Thrombolytic therapy vs primary percutaneous intervention after ventricular fibrillation cardiac arrest due to acute ST-segment elevation myocardial infarction and its effect on outcome. American Journal of Emergency Medicine 2007;25:545-50.

CA → ROSC



^aThe time point the diagnosis is confirmed with patient history and ECG ideally within 10 min from the first medical contact (FMC).
All delays are related to FMC (first medical contact).