

# **Reperfusion therapy in acute myocardial infarction and acute ischaemic stroke: similarities and differences**

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**Charles University Prague**  
**Czech Republic**

**STEMI**  
**Prague**  
**1982**

Dec. 20, 1982

Čas lék čes 1983; 122: 694-6.

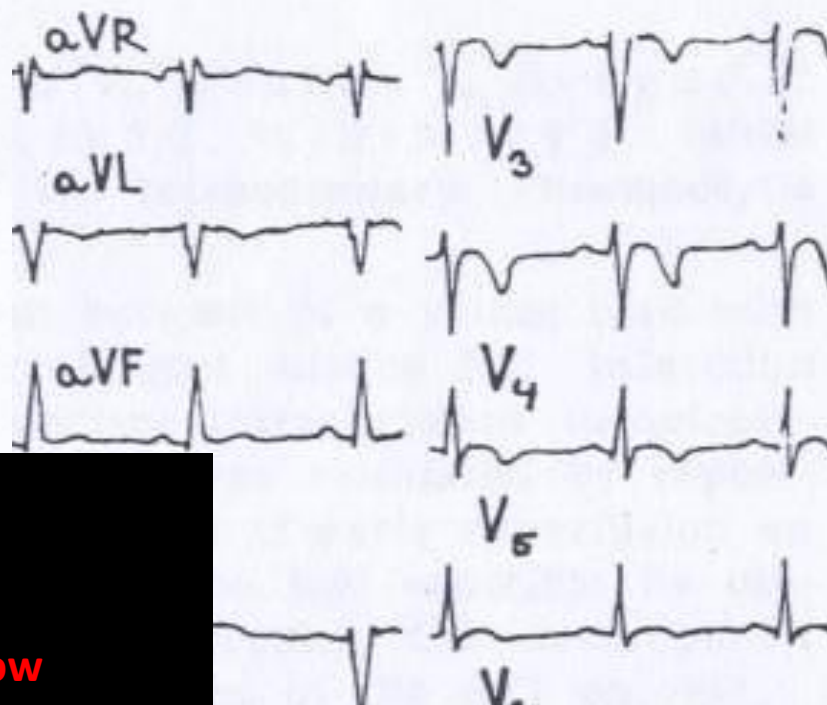
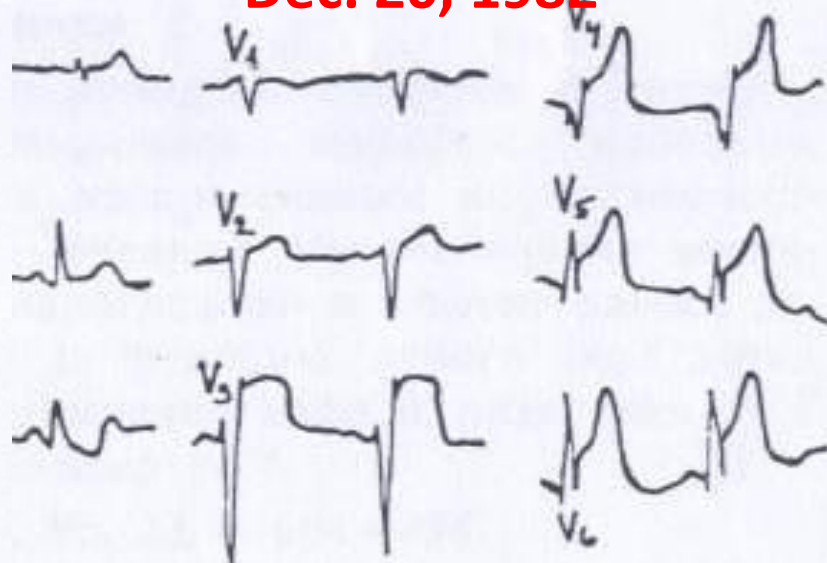
## PRVNÍ ZKUŠENOSTI SE SELEKTIVNÍ INTRAKORONÁRNÍ TROMBOLYTICKOU LÉČBOU

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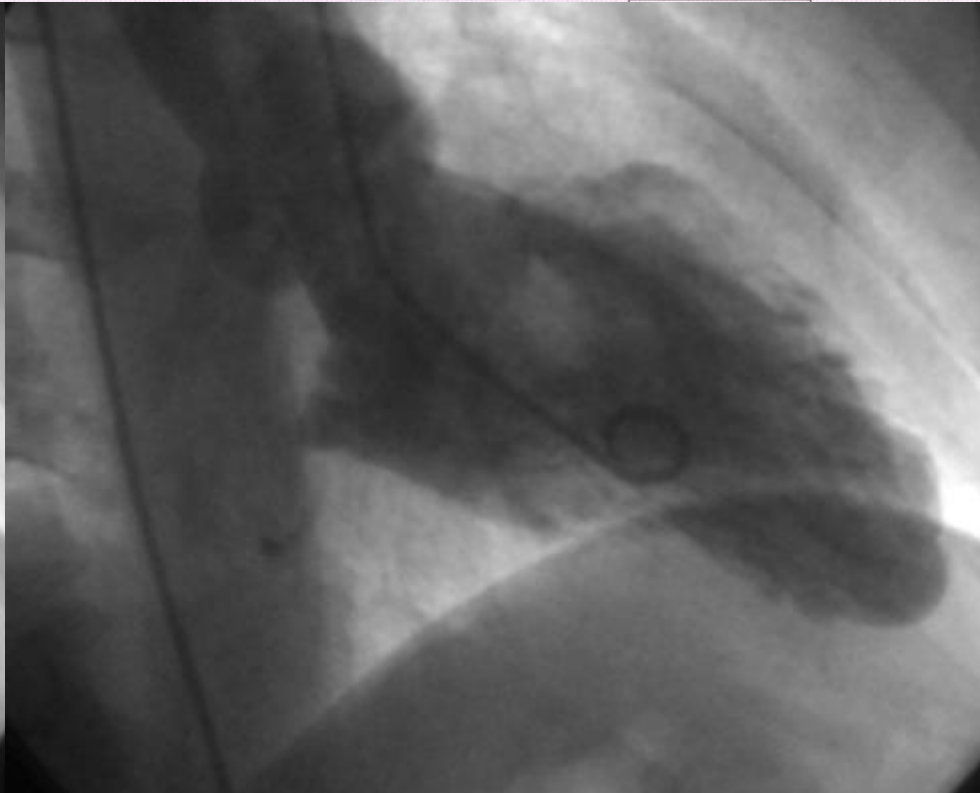
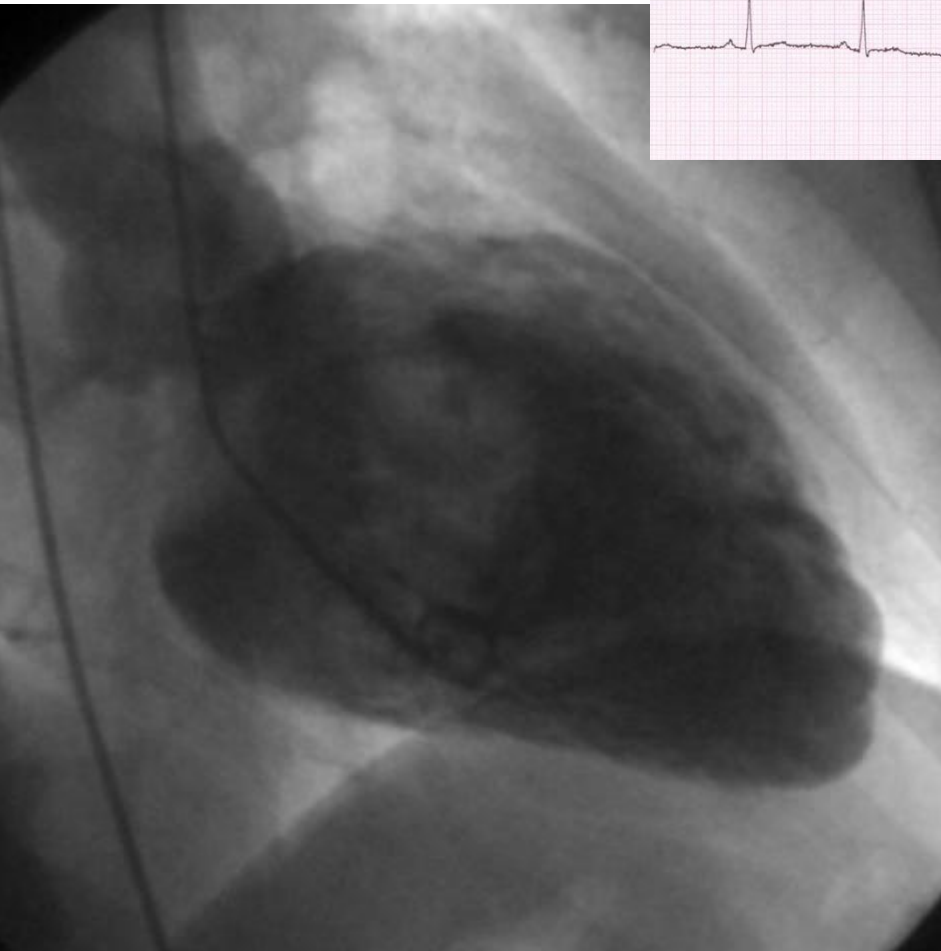
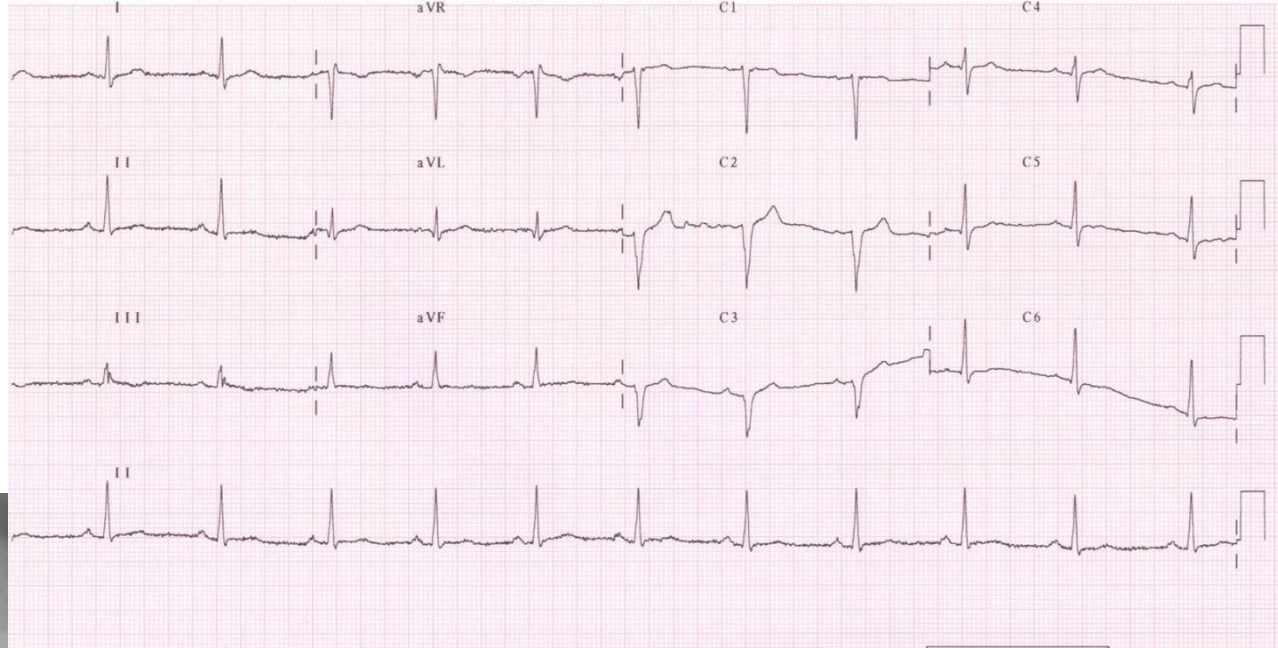
### Souhrn

Referováno o případu mladého muže s transmurálním anteroseptolaterálním infarktem myokardu, který byl ošetřen selektivní intrakoronární trombolytickou léčbou. Rekanalizace byla hodnocena opakovanou koronarografií a efekt včasné reperfúze na kinetiku a funkci levé komory jedné i dvounormální echokardiografií, vývoje

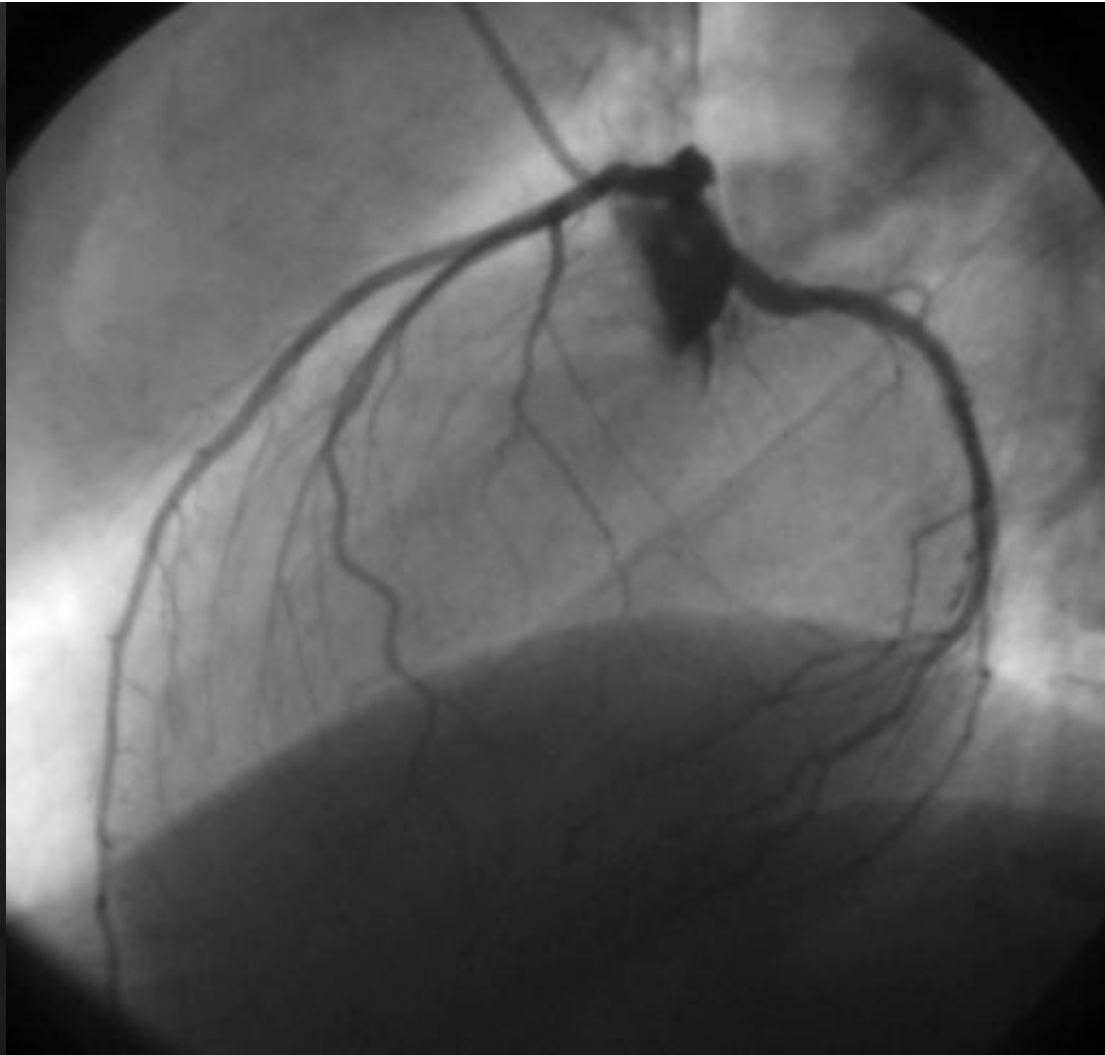
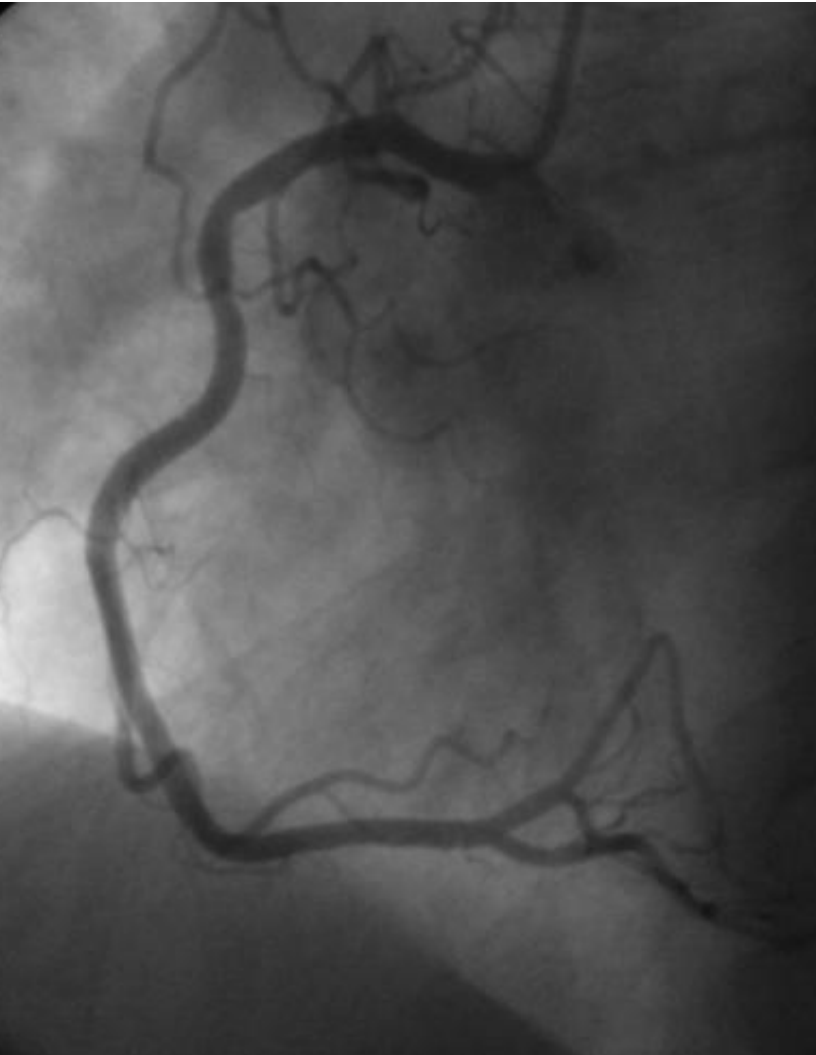


**37-years old smoker,  
acute LAD occlusion (TIMI 0 flow)  
Single-vessel disease  
Intracoronary streptokinase infusion – TIMI 3 flow**

**24 years later:**  
**Healthy non-smoker**  
**No medication !**



# CAG 24 years after successful reperfusion therapy



**STEMI**  
**Zwolle**  
**1993**

## A COMPARISON OF IMMEDIATE CORONARY ANGIOPLASTY WITH INTRAVENOUS STREPTOKINASE IN ACUTE MYOCARDIAL INFARCTION

FELIX ZIJLSTRA, M.D., PH.D., MENKO JAN DE BOER, M.D., JAN C.A. HOORNTJE, M.D., PH.D.,  
STOFFER REIFFERS, PH.D., JOHAN H.C. REIBER, PH.D., AND HARRY SURYAPRANATA, M.D., PH.D.

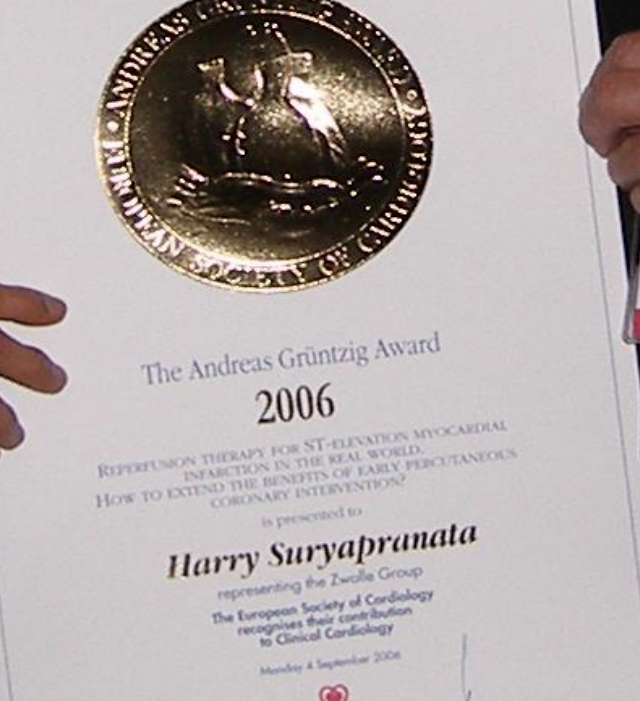
**Abstract** *Background.* Despite the widespread use of intravenous thrombolytic therapy and of immediate percutaneous transluminal coronary angioplasty for the treatment of acute myocardial infarction, randomized comparisons of the two approaches to reperfusion are lacking. We report the results of a prospective, randomized trial comparing immediate coronary angioplasty (without previous thrombolytic therapy) with intravenous streptokinase treatment.

*Methods.* A total of 142 patients with acute myocardial infarction were randomly assigned to receive one of the two treatments. The left ventricular ejection fraction was measured by radionuclide scanning before hospital discharge. Quantitative coronary angiography was performed to assess the degree of residual stenosis in the infarct-related arteries.

*Results.* A total of 72 patients were assigned to receive streptokinase and 70 patients to undergo immediate angioplasty. Angioplasty was technically successful in 64 of the 65 patients who underwent the procedure. Infarction

recurred in nine patients assigned to receive streptokinase, but in none of those assigned to receive angioplasty ( $P = 0.003$ ). Fourteen patients in the streptokinase group had unstable angina after their infarction, but only four in the angioplasty group ( $P = 0.02$ ). The mean ( $\pm$ SD) left ventricular ejection fraction as measured before discharge was  $45 \pm 12$  percent in the streptokinase group and  $51 \pm 11$  percent in the angioplasty group ( $P = 0.004$ ). The infarct-related artery was patent in 68 percent of the patients in the streptokinase group and 91 percent of those in the angioplasty group ( $P = 0.001$ ). Quantitative coronary angiography revealed stenosis of  $36 \pm 20$  percent of the luminal diameter in the angioplasty group, as compared with  $76 \pm 19$  percent in the streptokinase group ( $P < 0.001$ ).

*Conclusions.* Immediate angioplasty after acute myocardial infarction was associated with a higher rate of patency of the infarct-related artery, a less severe residual stenotic lesion, better left ventricular function, and less recurrent myocardial ischemia and infarction than was intravenous streptokinase. (N Engl J Med 1993;328:680-4.)

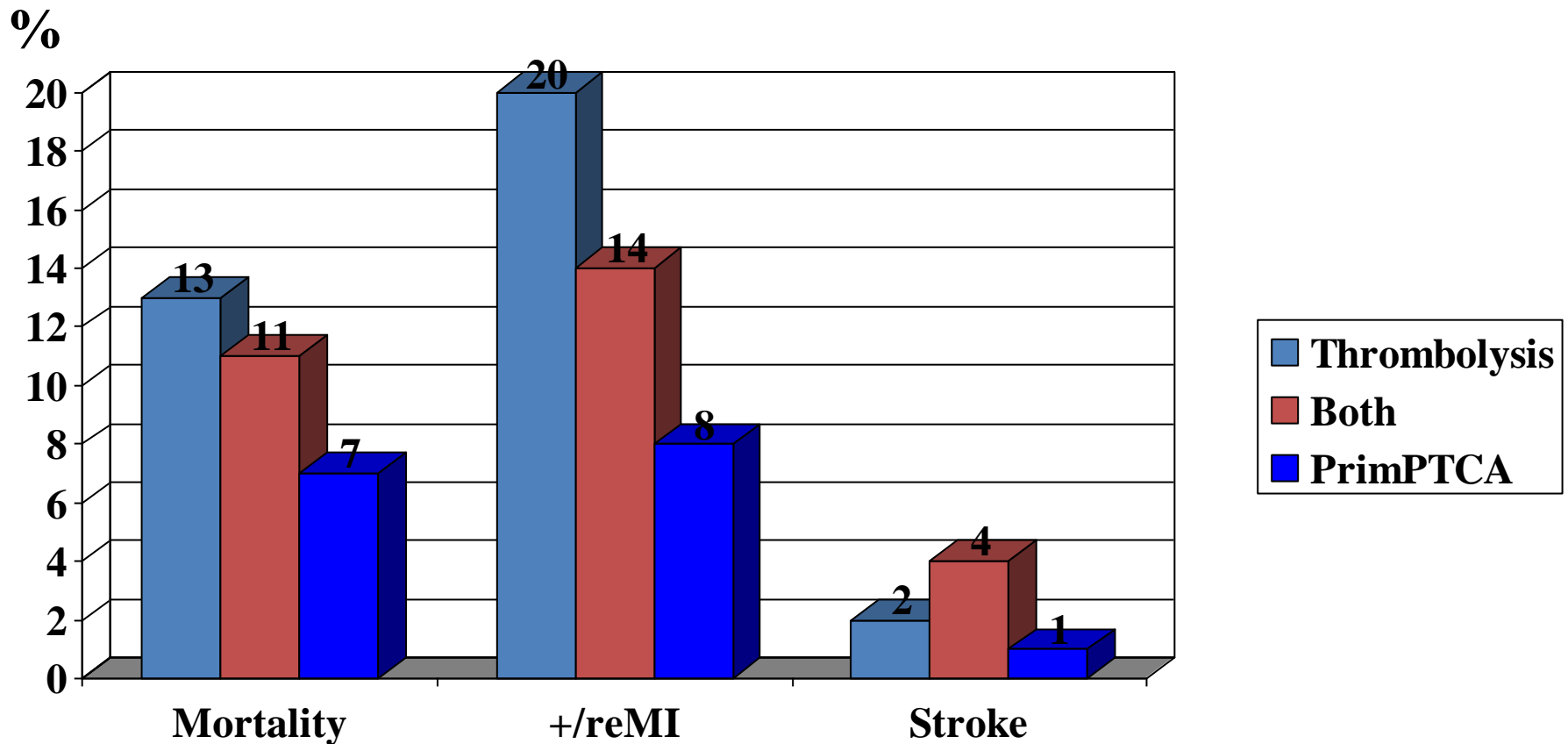




**STEMI**  
**Czech Republic**  
**1997-2002**

# PRAGUE-1 (n=300) and LIM1 (n=224)

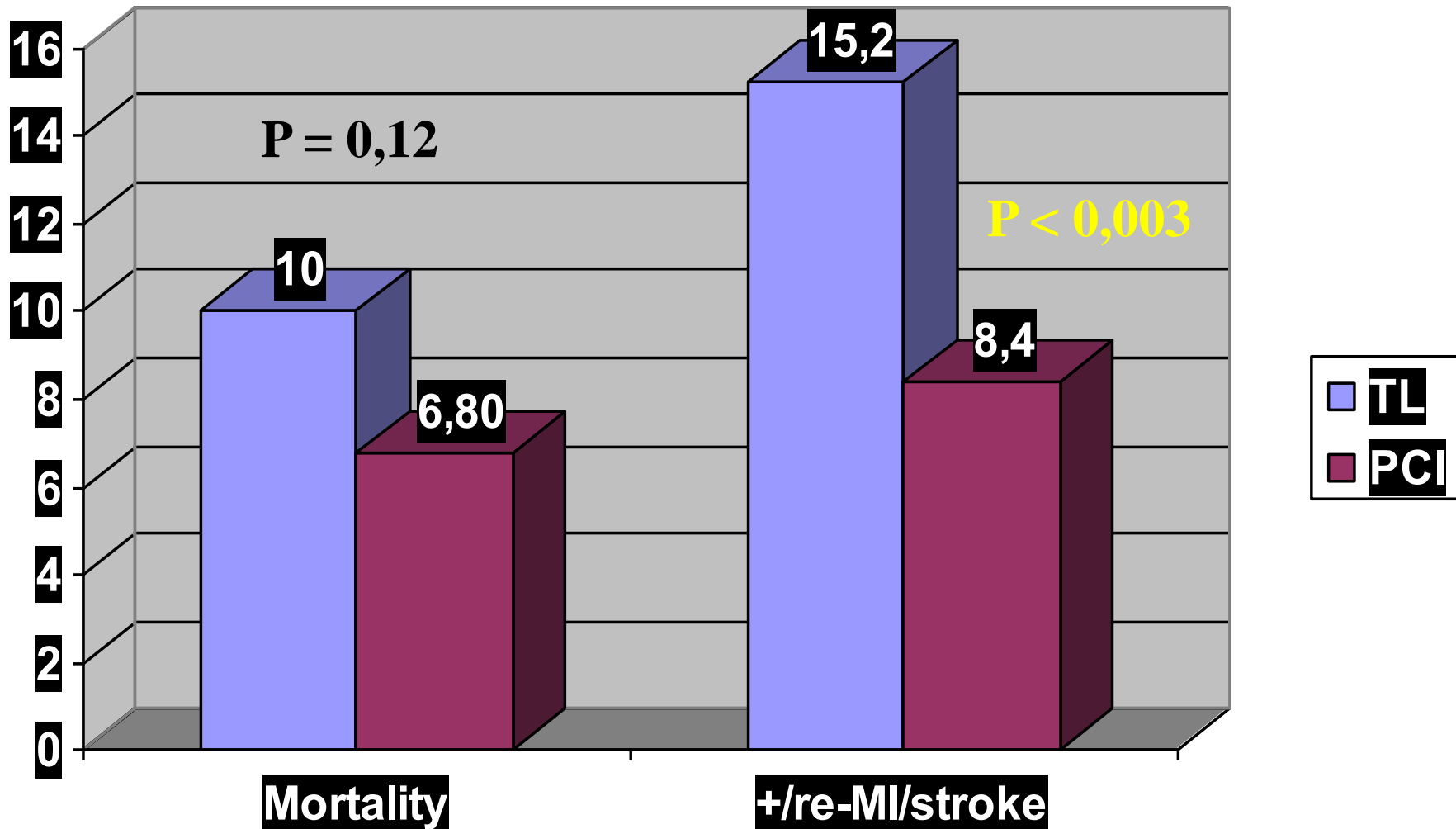
(F. Vermeer, Heart 1999; 82: 426-31;  
P. Widimský, Eur Heart J 2000; 21: 823-31)



**N = 524**

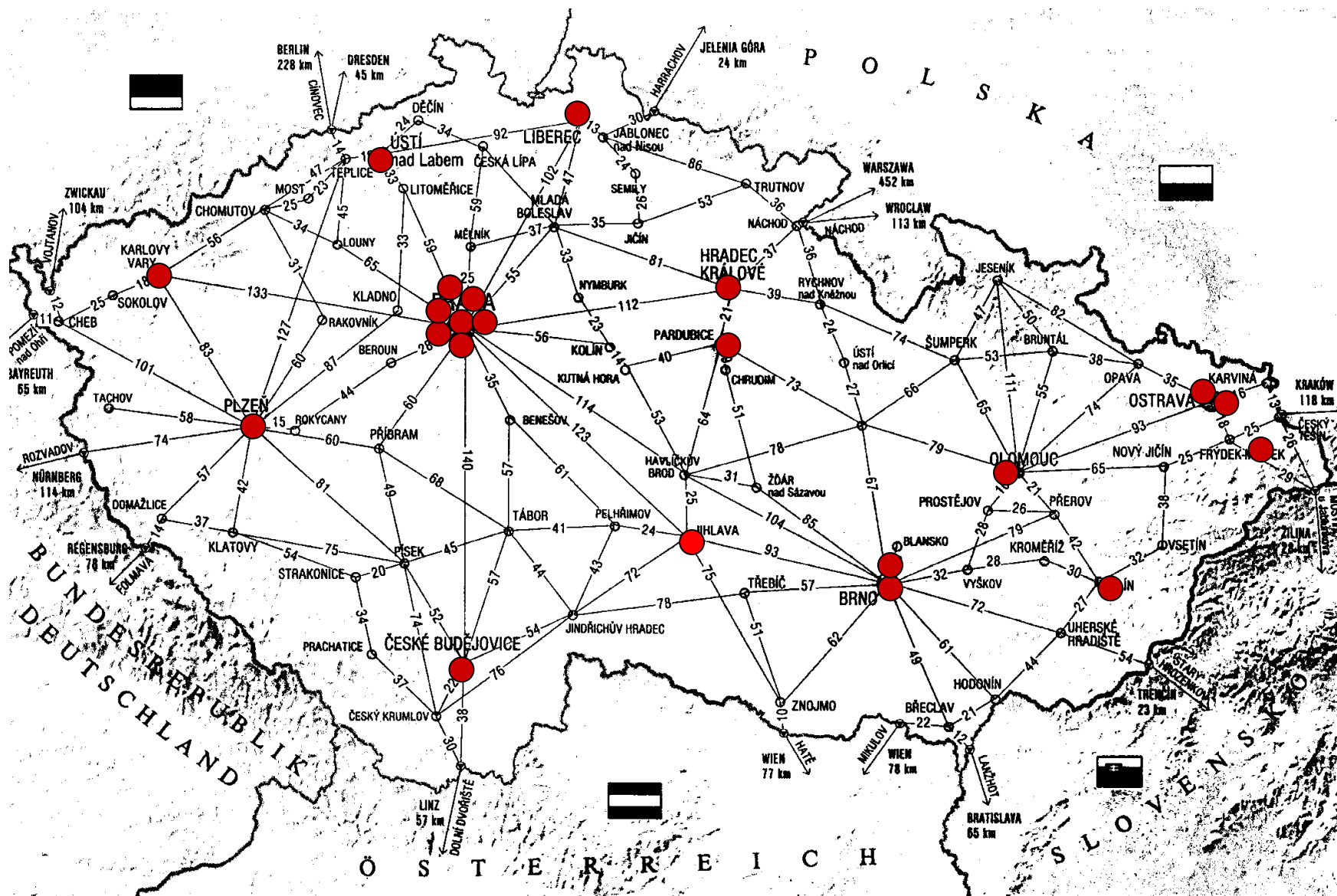
# PRAGUE-2: 30. den

*Eur Heart J. 2003 Jan;24(1):94-104*

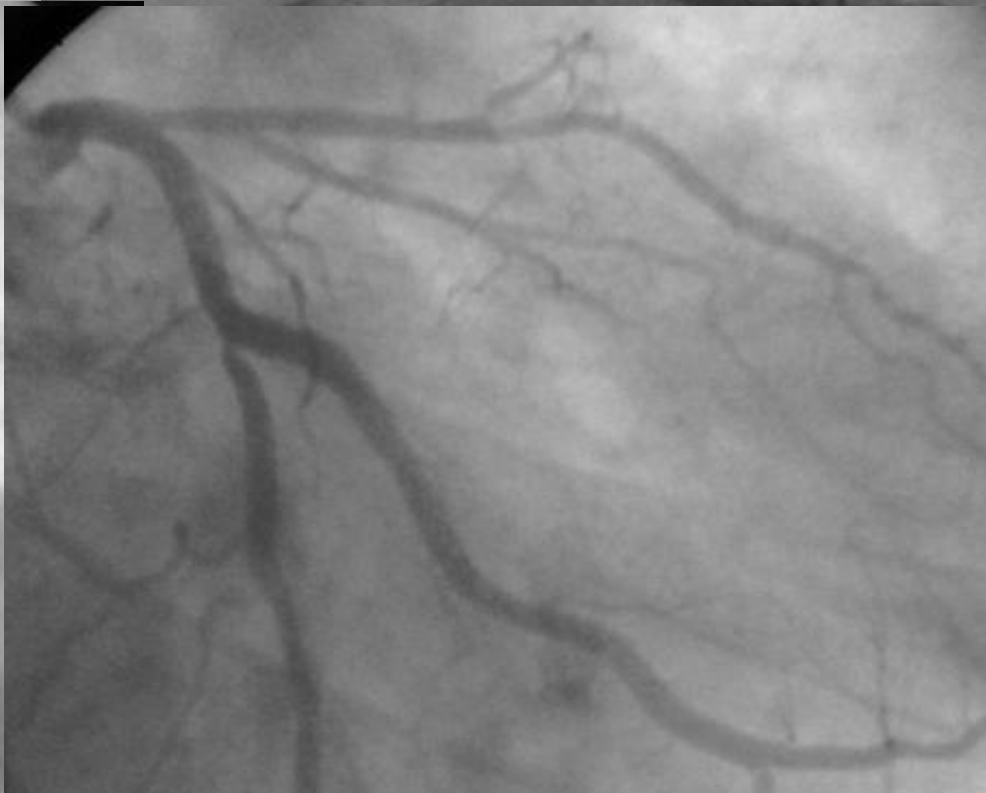


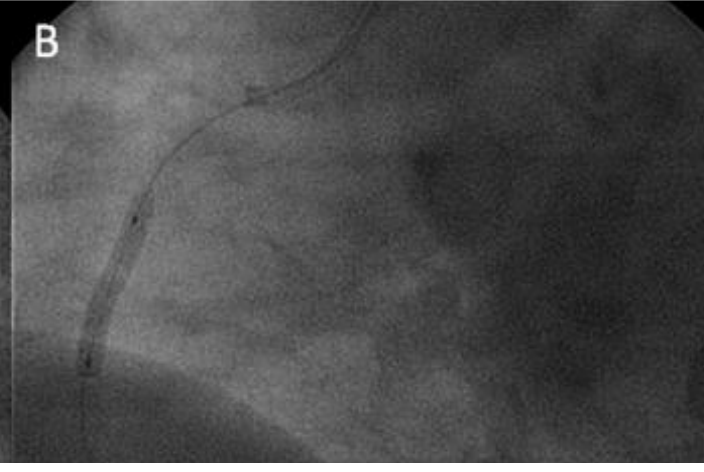
# Primary PCI recommended by official guidelines:

2002 Czech Society of Cardiology  
2003 European Society of Cardiology  
2004 American College of Cardiology



**STEMI**  
**Prague**  
**2013**

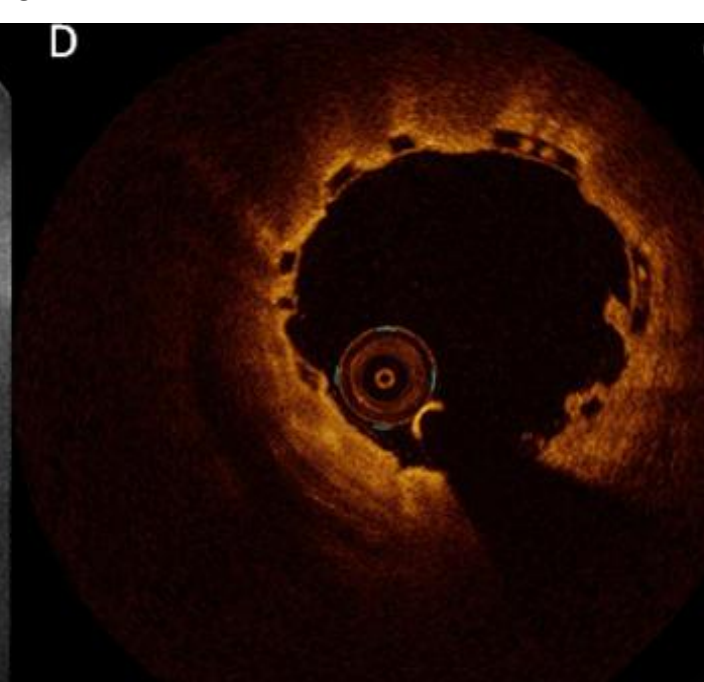
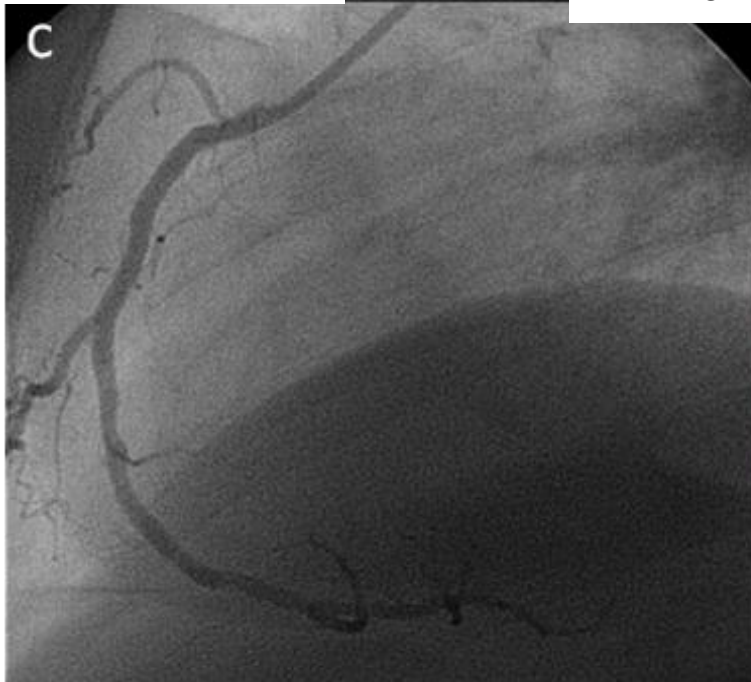




### **PRAGUE 19: Absorb BVS (n=40) in STEMI**

- 0% mortality
- 0% reinfarction during hospital stay
- 2.5% reinfarction (1 pt.)
- 0% stroke
- 0% clinical restenosis within 6 months

- BVS implantation in acute STEMI is feasible and safe
- BVS can be used in 25-33% of STEMI patients.
- OCT can be used safely to control BVS implantation in STEMI.
- Long-term follow-up will elucidate the future role of BVS in STEMI.



# Acute stroke

## Brno

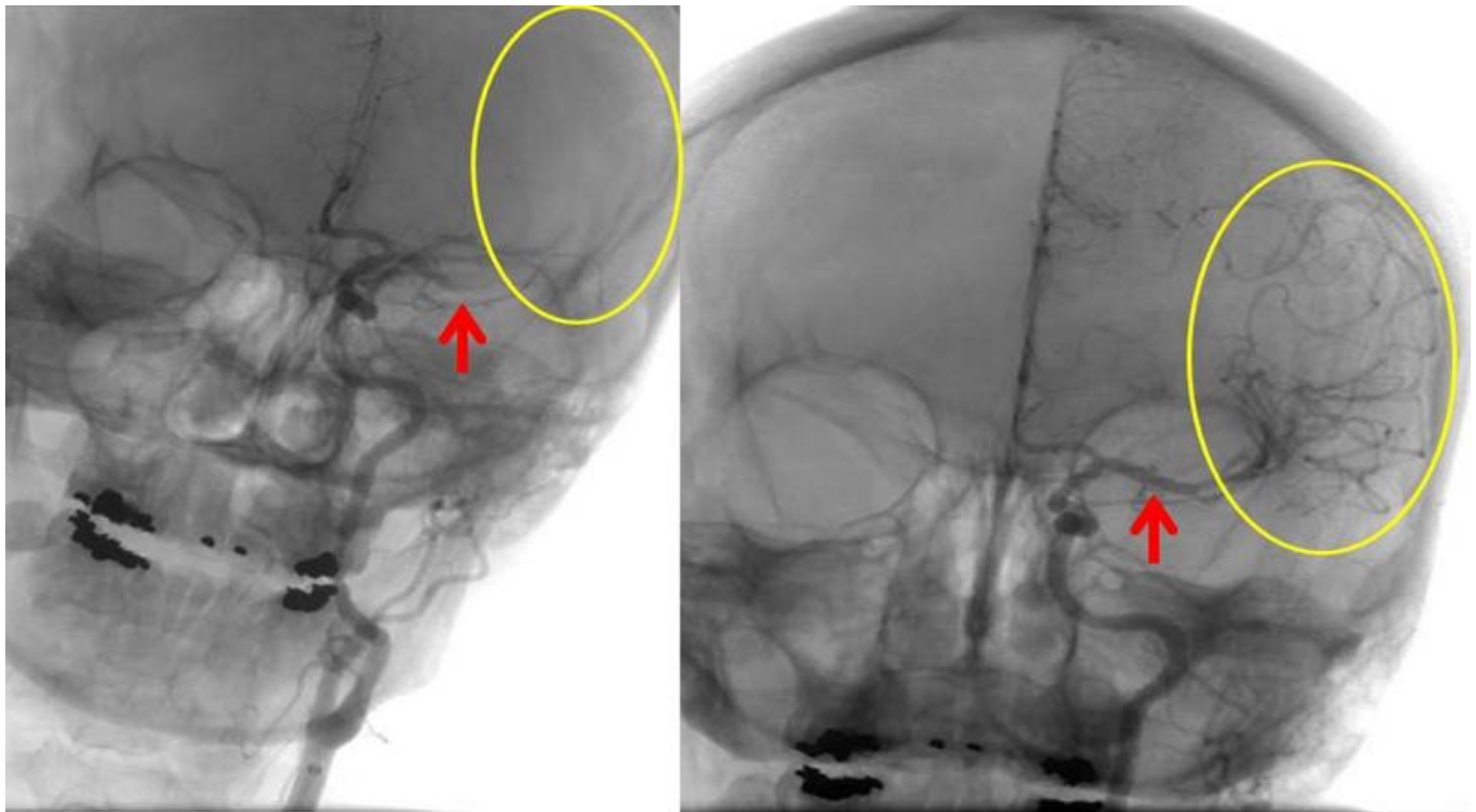
## 2010

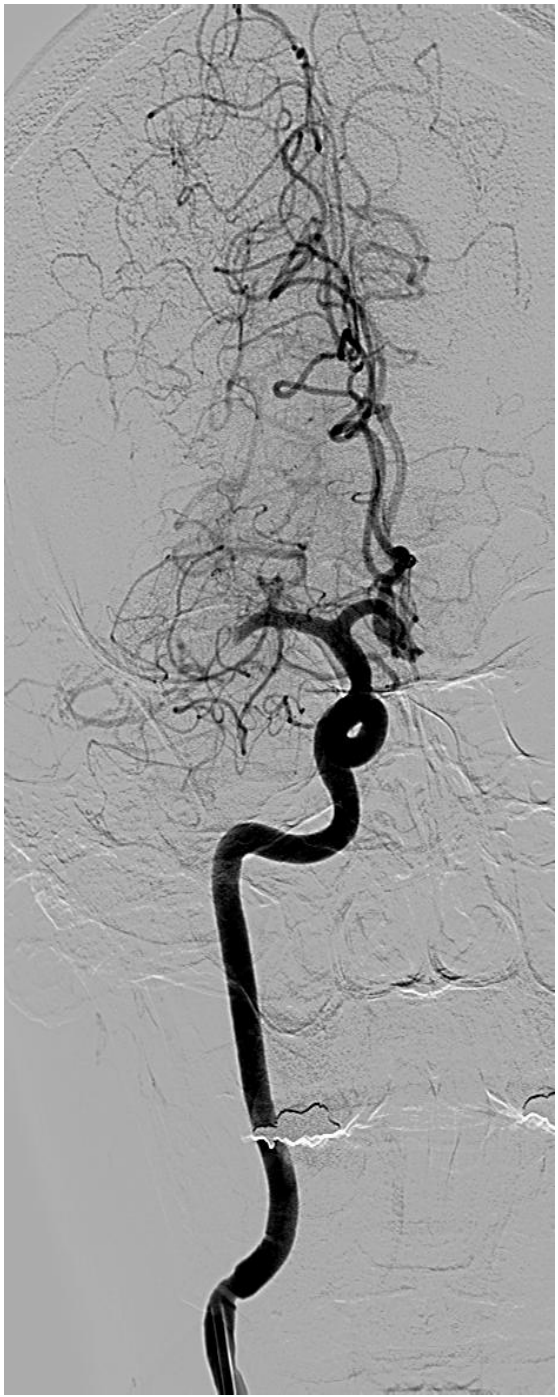


**Václav Chaloupka,  
president of the Czech Society of Cardiology 2008-11:  
acute hemispheric stroke not treated by reperfusion**



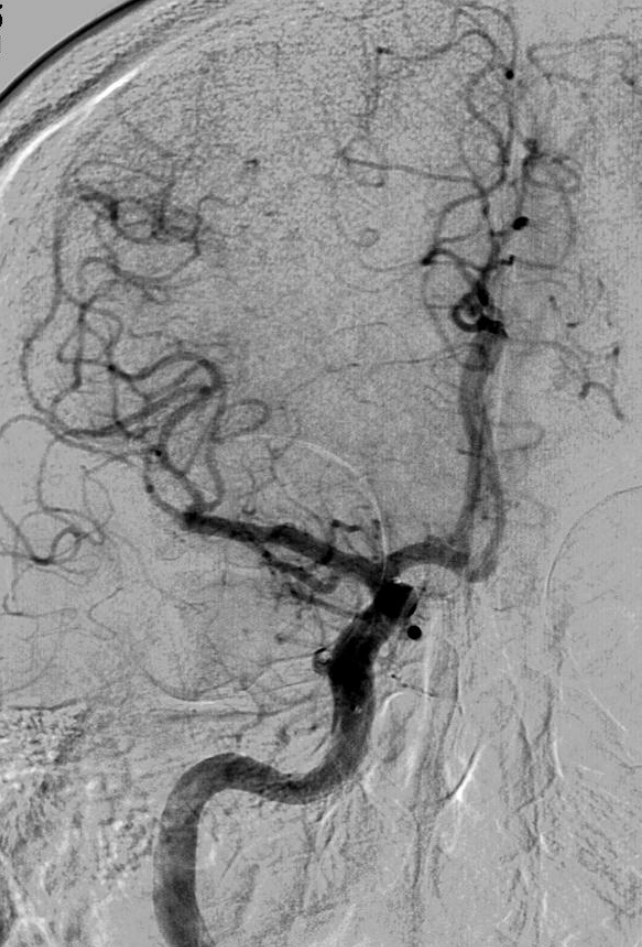
**Acute stroke, Prague 2012:  
Three young females (37-46 years)  
with acute stroke (NIHSS 12-17)  
and full neurologic recovery within 48 hours**



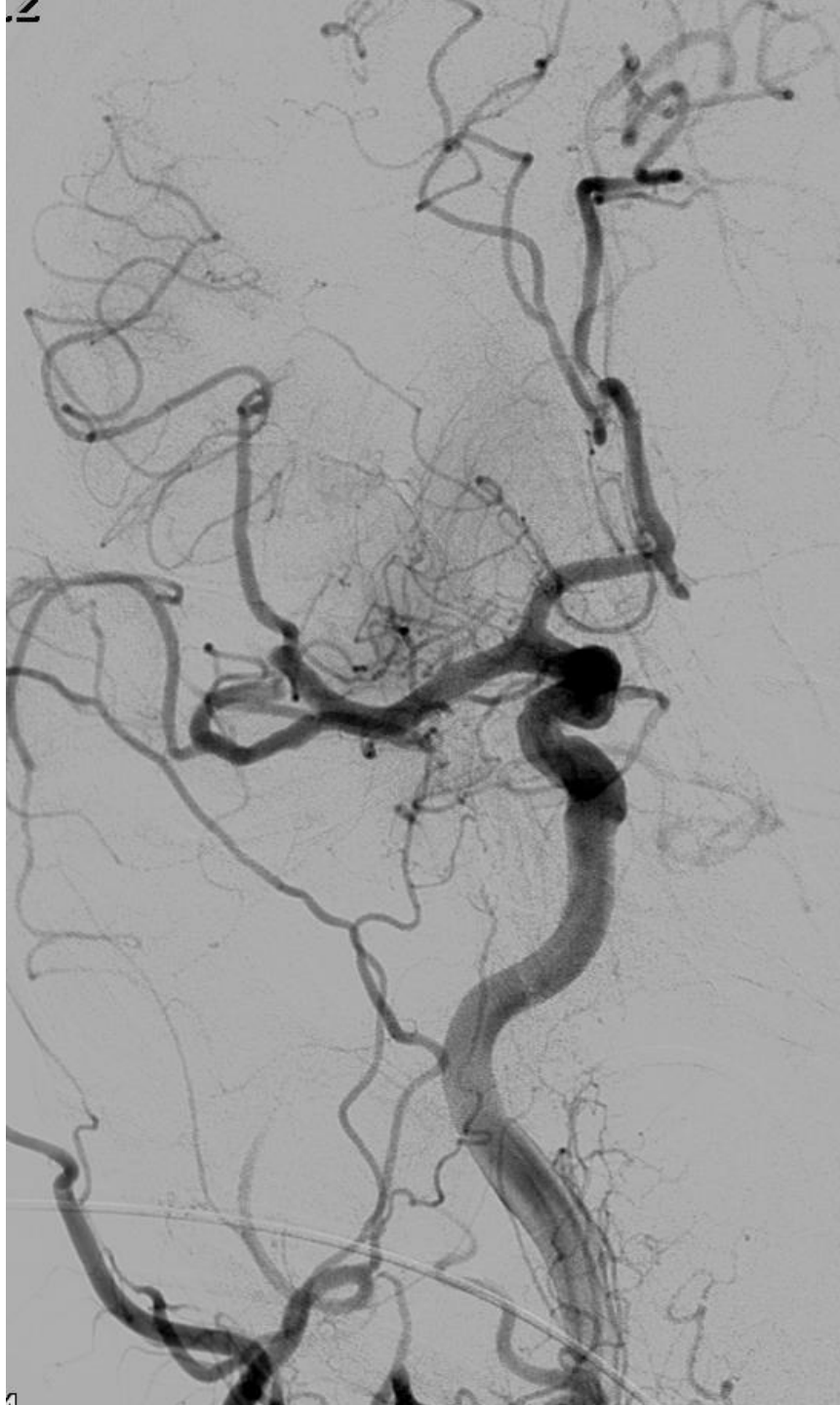


03

02



10:40  
31 cm  
51 17



# Acute stroke and acute MI: SIMILARITIES

|   | Acute myocardial infarction   | Acute ischemic stroke   |
|---|---|---|
| <b>Pathophysiology</b>  | Arterial occlusion + ischemic necrosis                              | Arterial occlusion + ischemic necrosis                              |
| <b>Clinical picture</b>   | Acute onset   | Acute onset   |
| <b>Prognosis</b>  | High mortality (if untreated)                                       | High mortality (if untreated)                                       |
| <b>Effective treatment</b>  | Reperfusion therapy   | Reperfusion therapy   |
| <b>Thrombolytic treatment</b>   | Early reperfusion achieved in <50% of treated patients              | Early reperfusion achieved in <50% of treated patients              |
|   | Bleeding complications may be fatal                                 | Bleeding complications may be fatal                                 |
|   | Early reocclusion is frequent                                       | Early reocclusion is frequent                                       |
| <b>Pharmaco-invasive treatment (thrombolysis + mechanical intervention)</b> | Does not offer superior results to either method if performed alone | Does not offer superior results to either method if performed alone |
| <b>Catheter-based thrombectomy</b>  | Clearly established as the most effective therapy.                  | Emerging as the most effective therapy                              |

# Acute stroke and acute MI: DIFFERENCES

|   | Acute myocardial infarction  | Acute ischemic stroke   |
|---|--|---|
| <b>Etiology</b>   | <b>Uniform: plaque rupture + thrombosis in situ in 90-95%</b>          | <b>Multiple: cardioembolic, arterioembolic, thrombosis in situ, lacunar, cryptogenic.</b> |
| <b>Arterial occlusive thrombus feasible for catheter-based thrombectomy</b>           | <b>Found in 95% of acute coronary angiograms</b>                       | <b>Found only in cca 35% of acute CT-angiograms</b>                                       |
| <b>Time window symptom onset - intervention start (to offer benefit and not harm)</b> | <b>24 hours (48 h in some patients)</b>                                | <b>3 hours (8 hours in some patients)</b>   |
| <b>Reperfusion damage</b>   | <b>Only theoretical, clinically always reperfusion benefit</b>         | <b>Reperfusion damage (bleeding) is a real clinical problem</b>                           |
| <b>Clinical picture</b>   | <b>Pain (dyspnoe) alerts the patient to call early for help</b>        | <b>Neurologic dysfunction + no pain = late medical contact</b>                            |
| <b>Diagnostic method before reperfusion therapy indication</b>                        | <b>ECG (fast, simple, cheap, at the site of first medical contact)</b> | <b>CT (takes more time, expensive, in-hospital)</b>                                       |
| <b>Laboratory diagnostic marker</b>   | <b>troponin</b>  | <b>None yet available</b>   |
| <b>Contraindications for catheter-based thrombectomy</b>                              | <b>None</b>  | <b>Intracranial bleeding or advanced ischemia on CT</b>                                   |
| <b>% of hospitalized patients who undergo reperfusion therapy</b>                     | <b>&gt;90%</b>   | <b>&lt;10%</b>  |

# CZ: acute stroke vs. acute MI

40 000 hospital admissions for stroke or TIA

30 000 hospital admissions for ACS (20 000 for AMI)

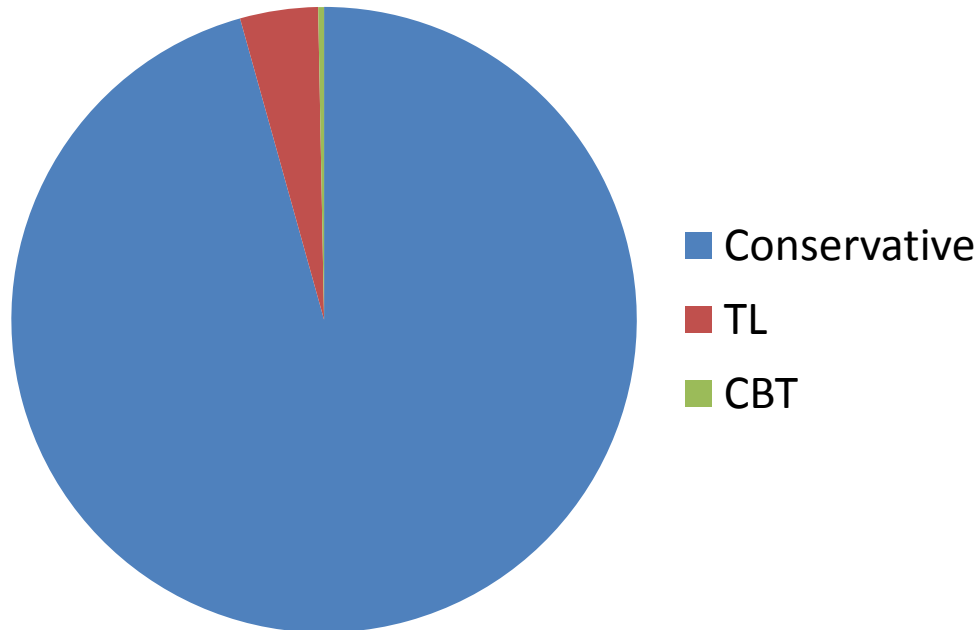
## Stroke

- 120 catheter based thrombectomy (CBT)
- 1600 thrombolysis
- Best center: 32 CBT / year
- Other centers 5-15 CBT / year

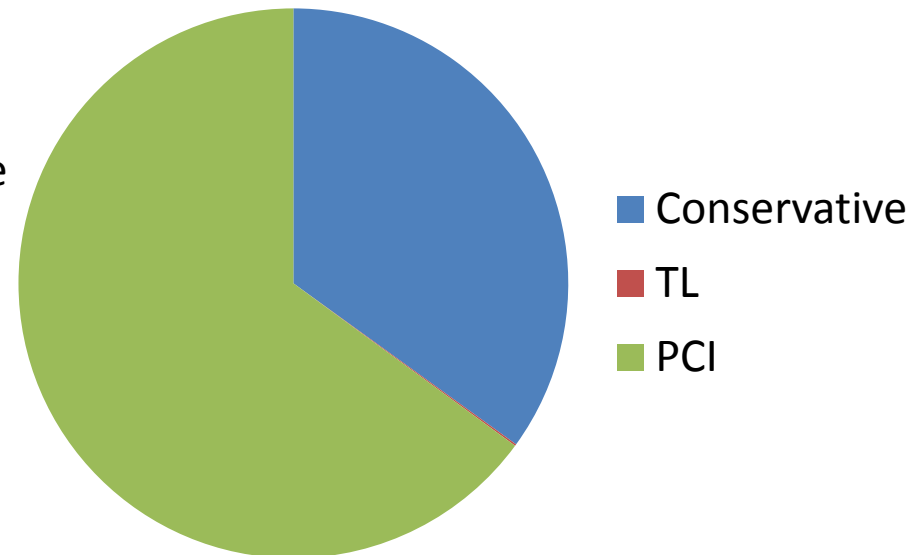
## AMI

- 22 000 acute/early CAG
- 0,4% thrombolysis for STEMI
- Best center: >700 PCI for ACS / year
- Other centers: 200 – 600 PCI for ACS

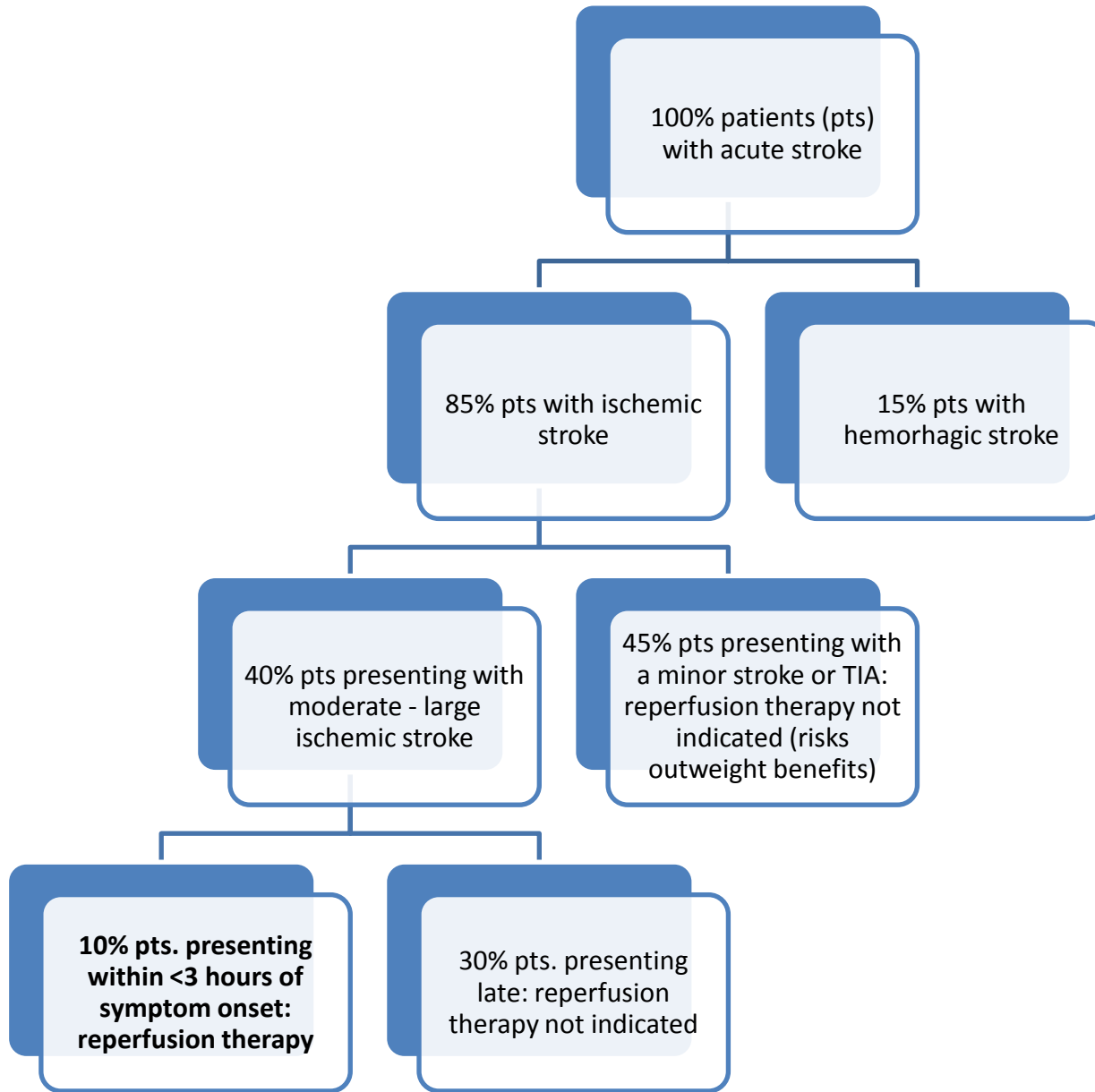
### Acute stroke treatment



### Acute MI (STEMI + nonSTEMI) treatment



# Why only a small minority of acute stroke patients undergo reperfusion therapy ?





# Possible explanations for low use of reperfusion therapy in acute stroke

| Disease related explanations   | Health care related explanations   |
|--|--|
| Many acute strokes are not suitable for reperfusion (e.g. hemorrhagic strokes) | Risks of reperfusion therapy are currently unacceptably high in pts with small strokes or TIAs   |
| Fast development of necrosis   | Many health professionals do not consider acute stroke as „superemergency“ (are not aware of benefits of very early reperfusion therapy) |
| Risk of intracerebral bleeding (hemorrhagic conversion of ischemic stroke)     |  |
| Absence of alerting symptoms (e.g. pain)                                       |  |

**AMI – stroke:  
similar outcome trends**

# I.V. thrombolysis vs. placebo in AMI and in stroke

Lancet 1988; 349-60

NEJM 1995; 1581-7

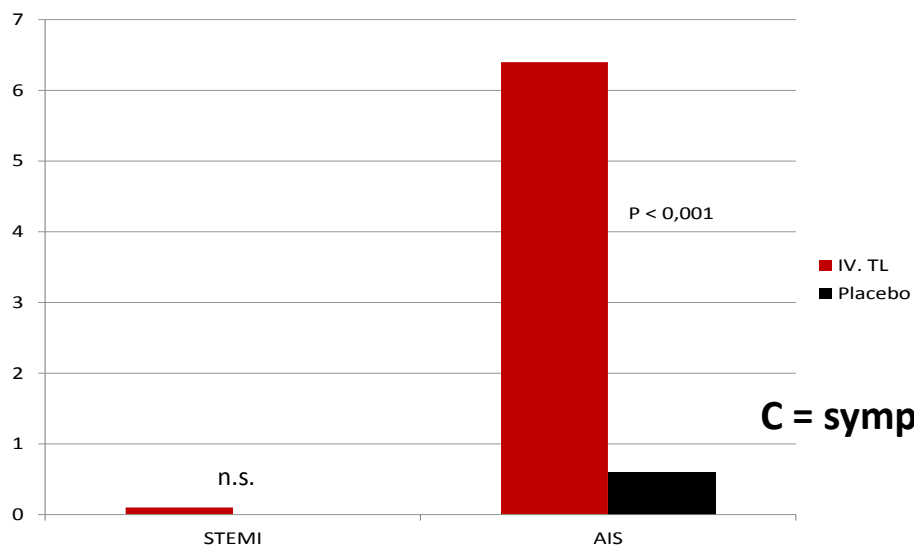
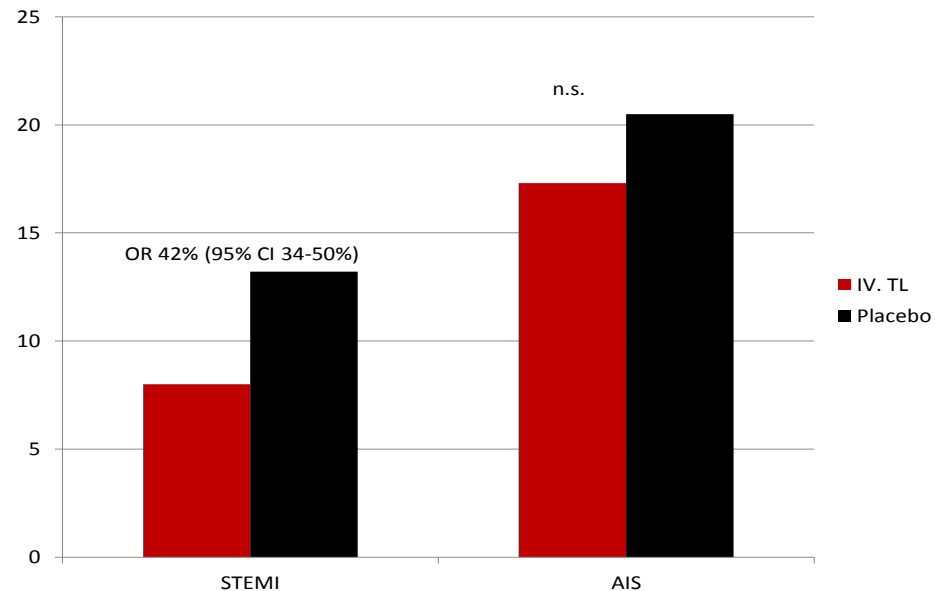
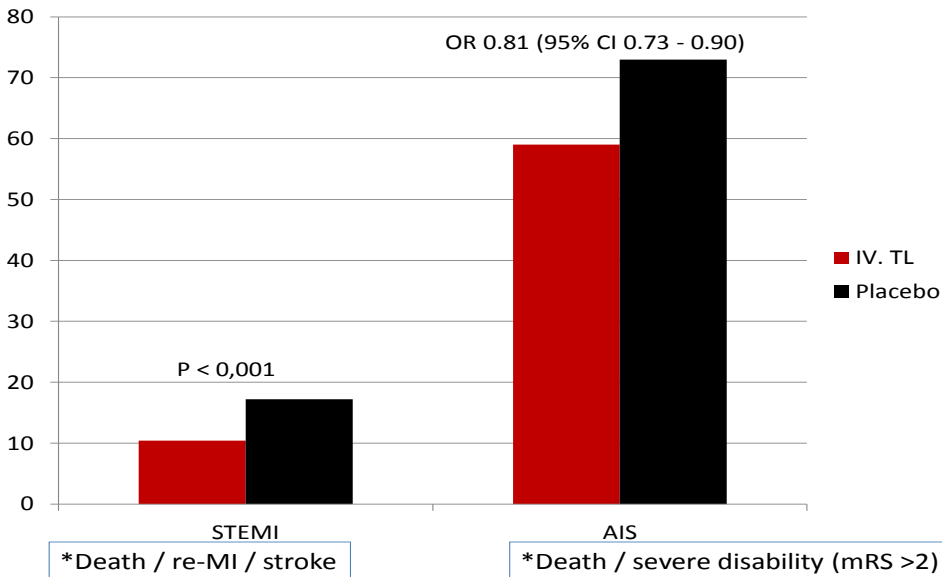
Cochrane Database Syst Rev 2009 Oct 7; (4): CD000213

A = „hard“ clinical endpoints

death / reinfarction / stroke for STEMI

death / severe disability (mRS >2) for stroke

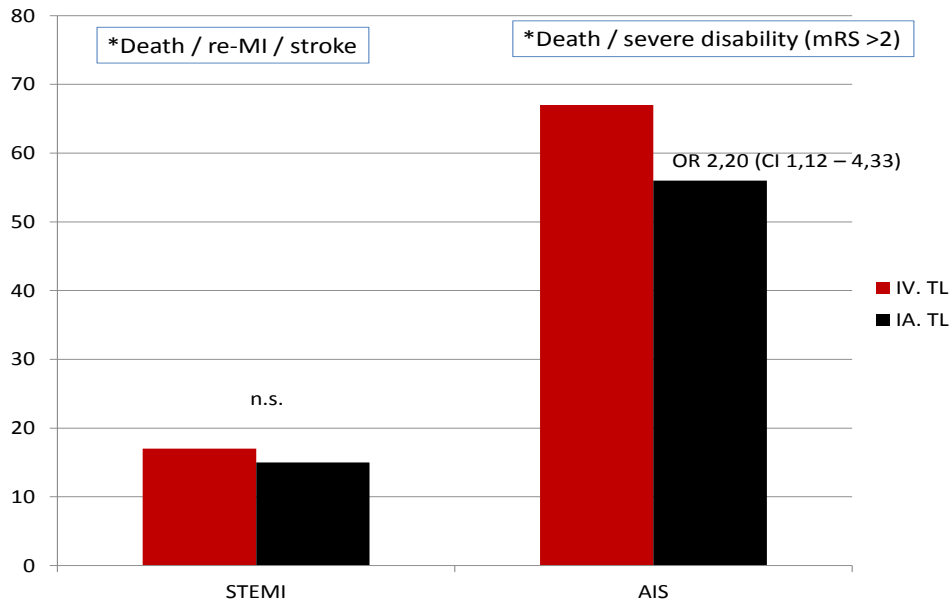
B = all cause mortality



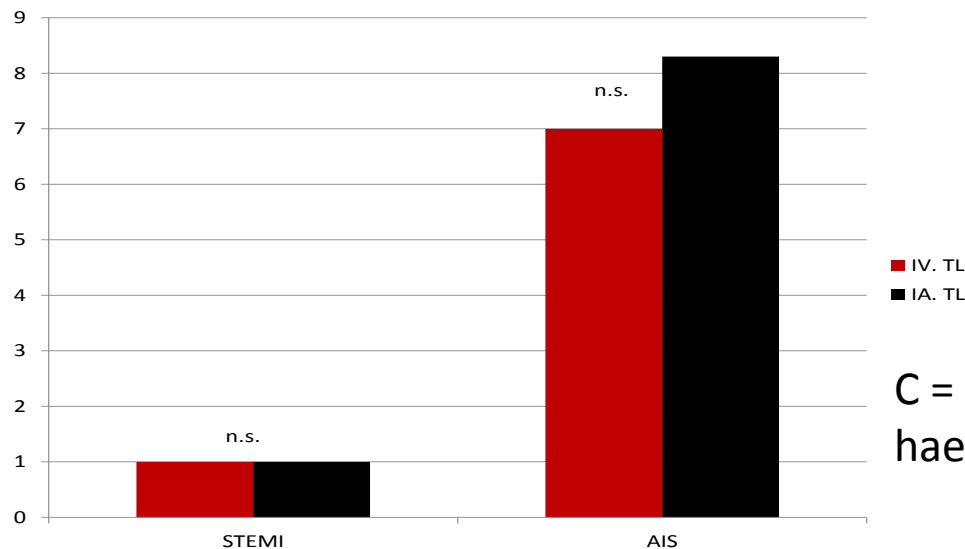
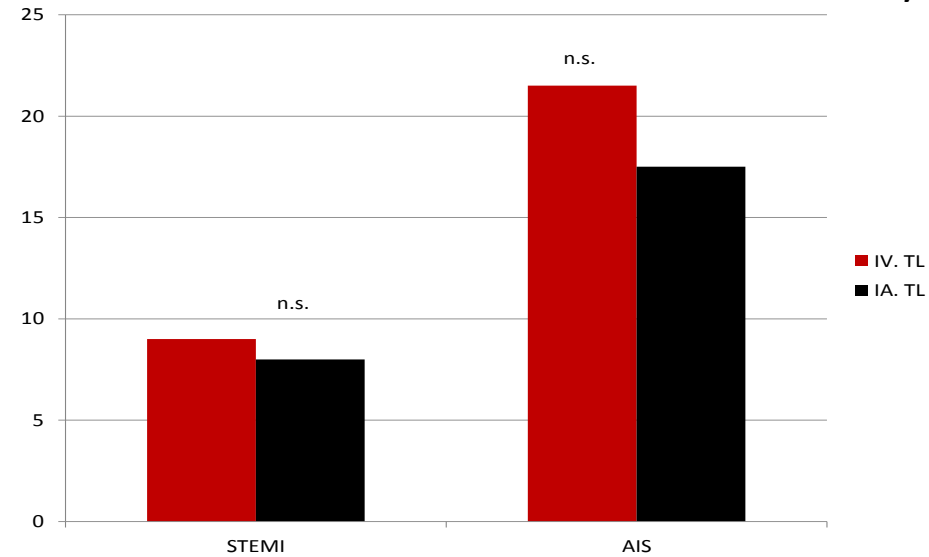
# Intraarterial vs. intravenous thrombolysis in AMI and in stroke

Stroke. 2012;43:1302-1308  
 N Engl J Med 1983; 309: 1477-82.  
 N Engl J Med 1984; 311: 1457-63.  
 Lancet. 1985; 2: 578-82.

A = „hard“ clinical endpoints, death / reinfarction / stroke for STEMI and death / severe disability (mRS >2) for stroke



B = all cause mortality



C = symptomatic intracranial haemorrhage

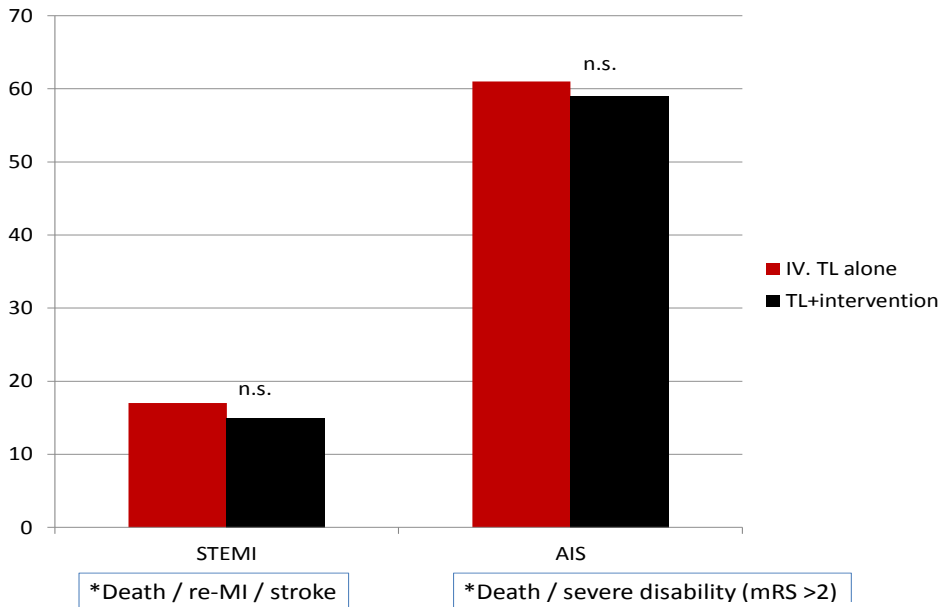
# I.V. thrombolysis vs. facilitated intervention in AMI and in stroke

*Eur Heart J 2000; 823-31.*

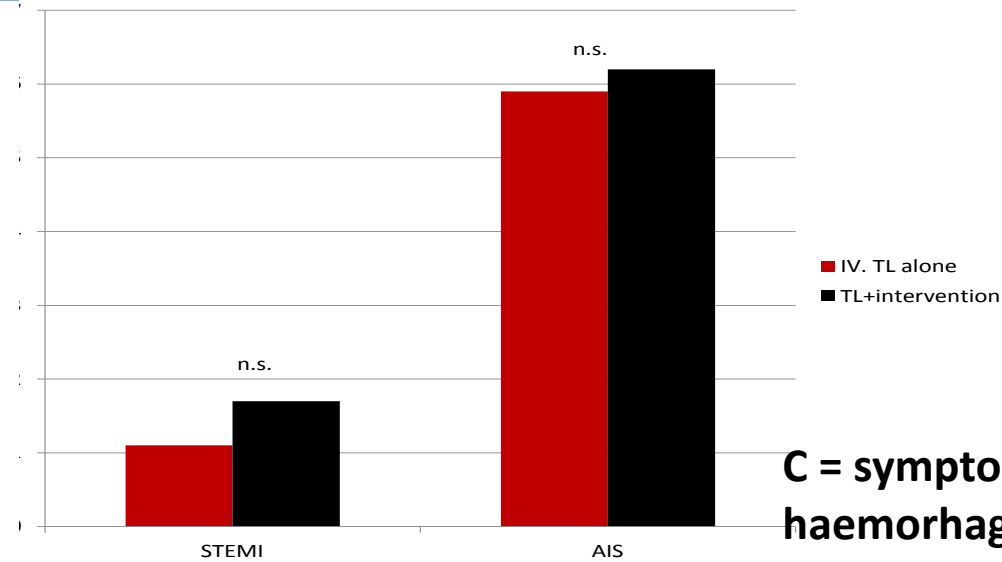
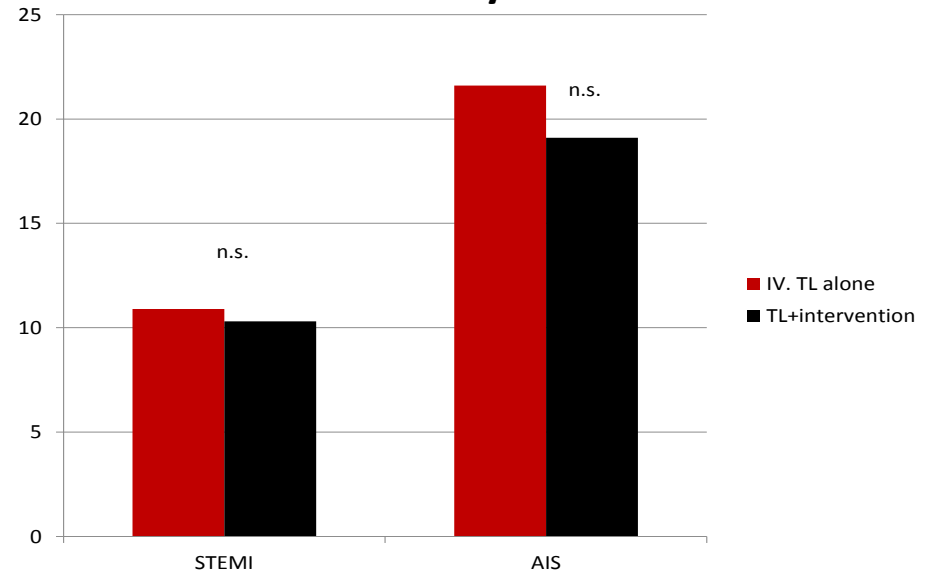
*Heart 1999; 426-31*

*NEJM 2013; 893-903*

**A = „hard“ clinical endpoints death / reinfarction / stroke for STEMI and death / severe disability (mRS >2) for stroke**

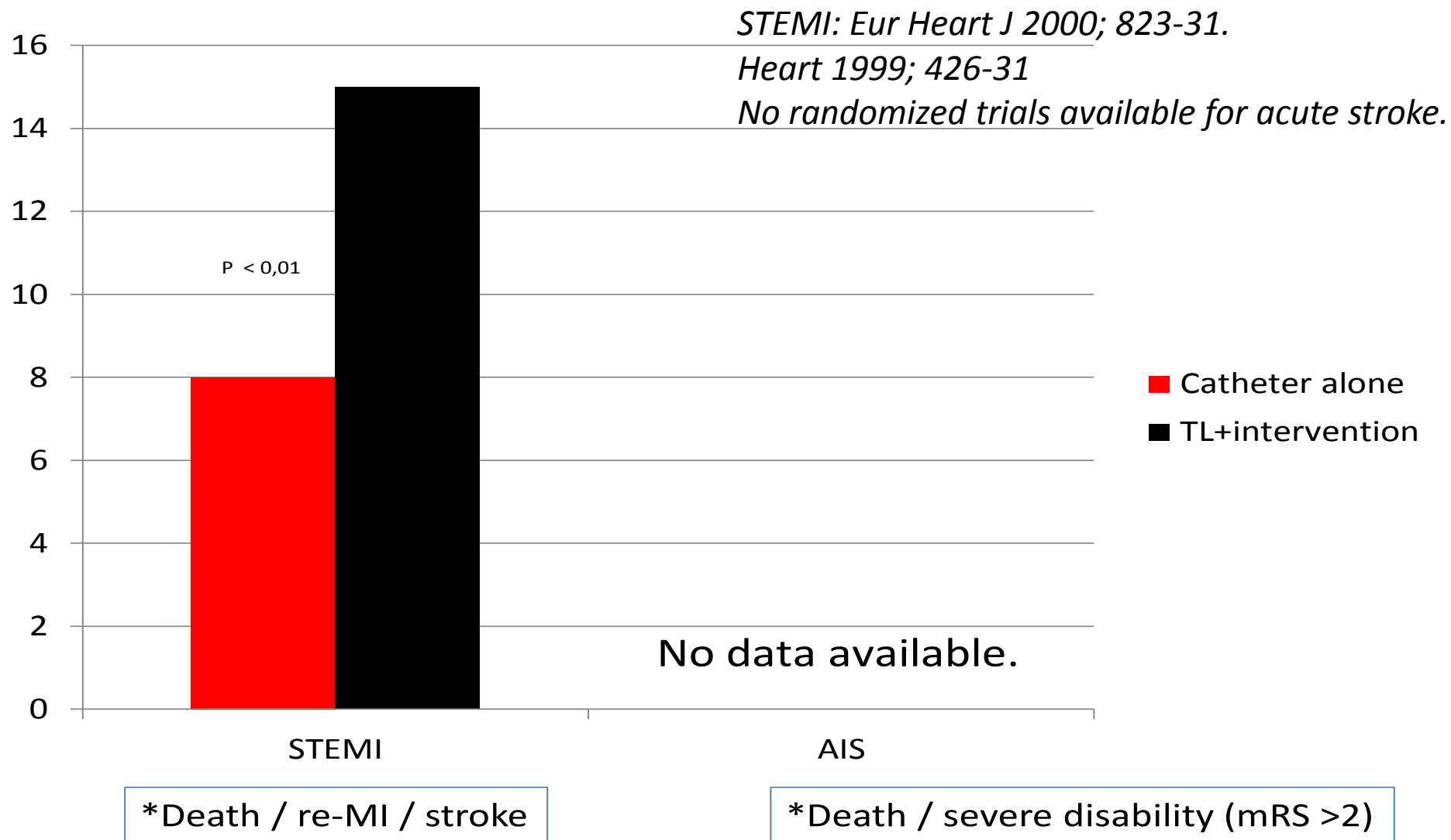


**B = all cause mortality**



**C = symptomatic intracranial haemorrhage**

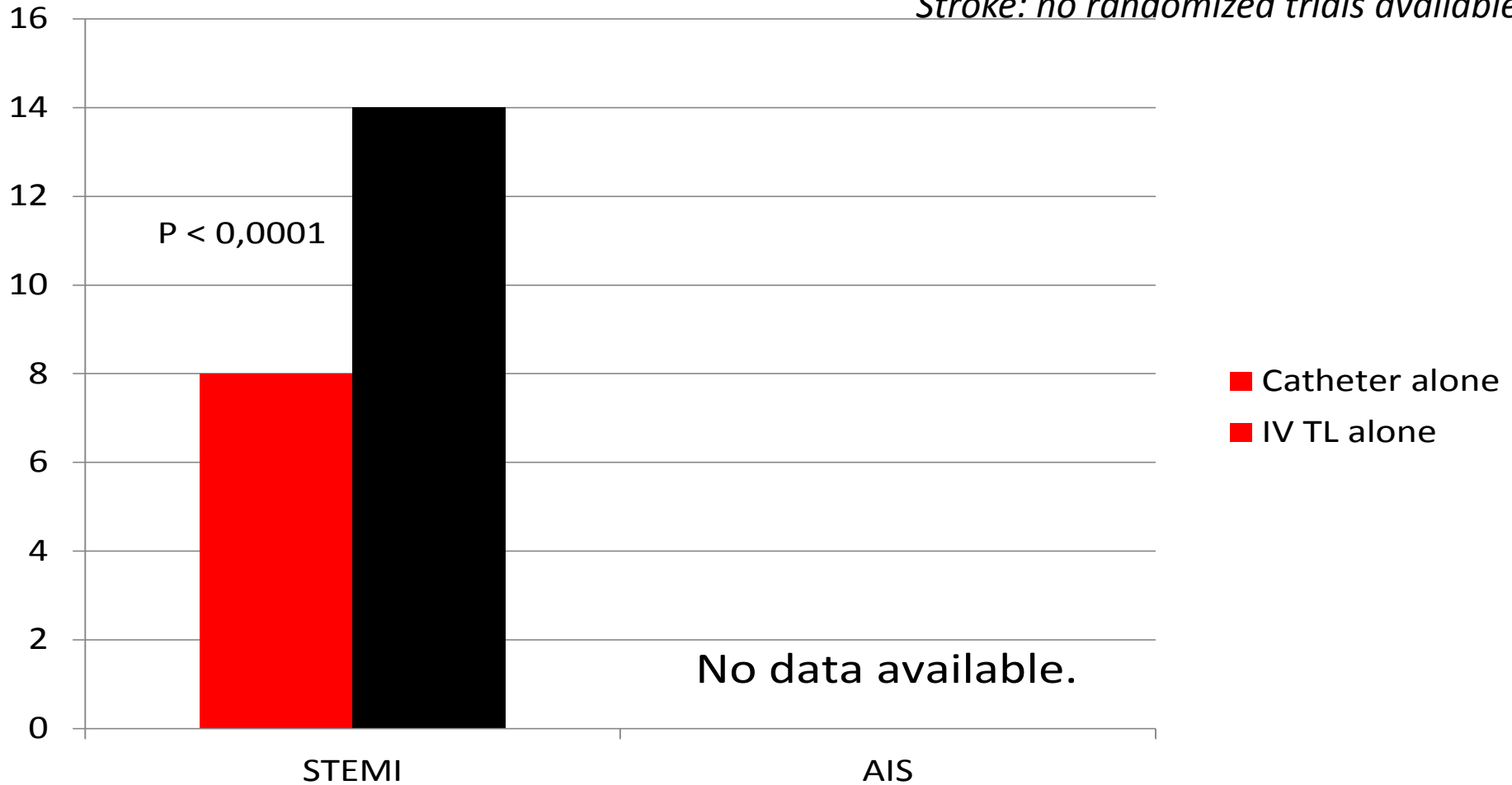
# Facilitated intervention vs. catheter intervention alone in AMI and in stroke



# Primary catheter intervention alone versus intravenous thrombolysis alone in AMI and in stroke.

*STEMI: Lancet 2003; 361: 13-20.*

*Stroke: no randomized trials available*



\*Death / re-MI / stroke

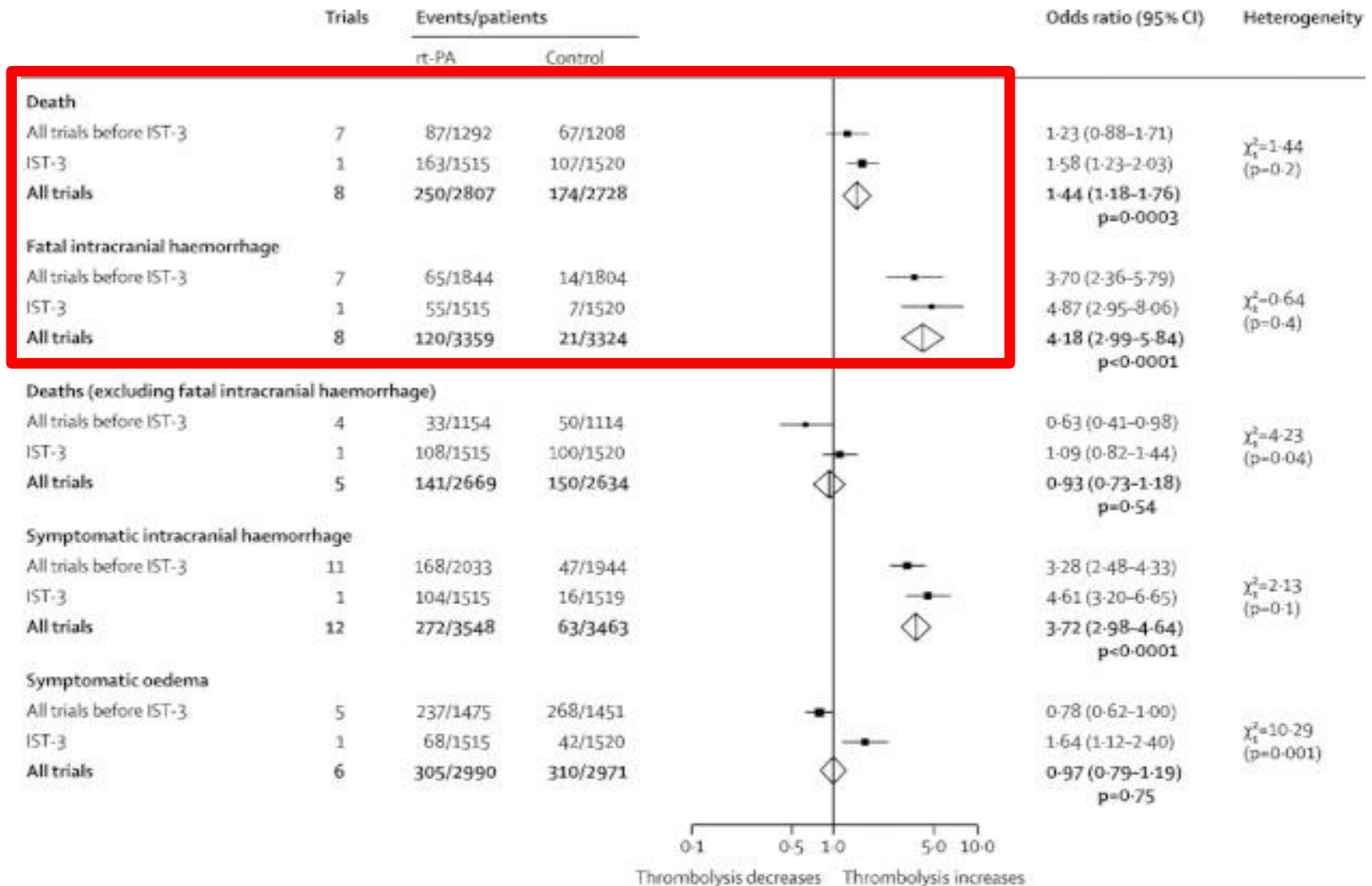
\*Death / severe disability (mRS >2)

**Acute stroke:  
I.V. thrombolysis vs. placebo**



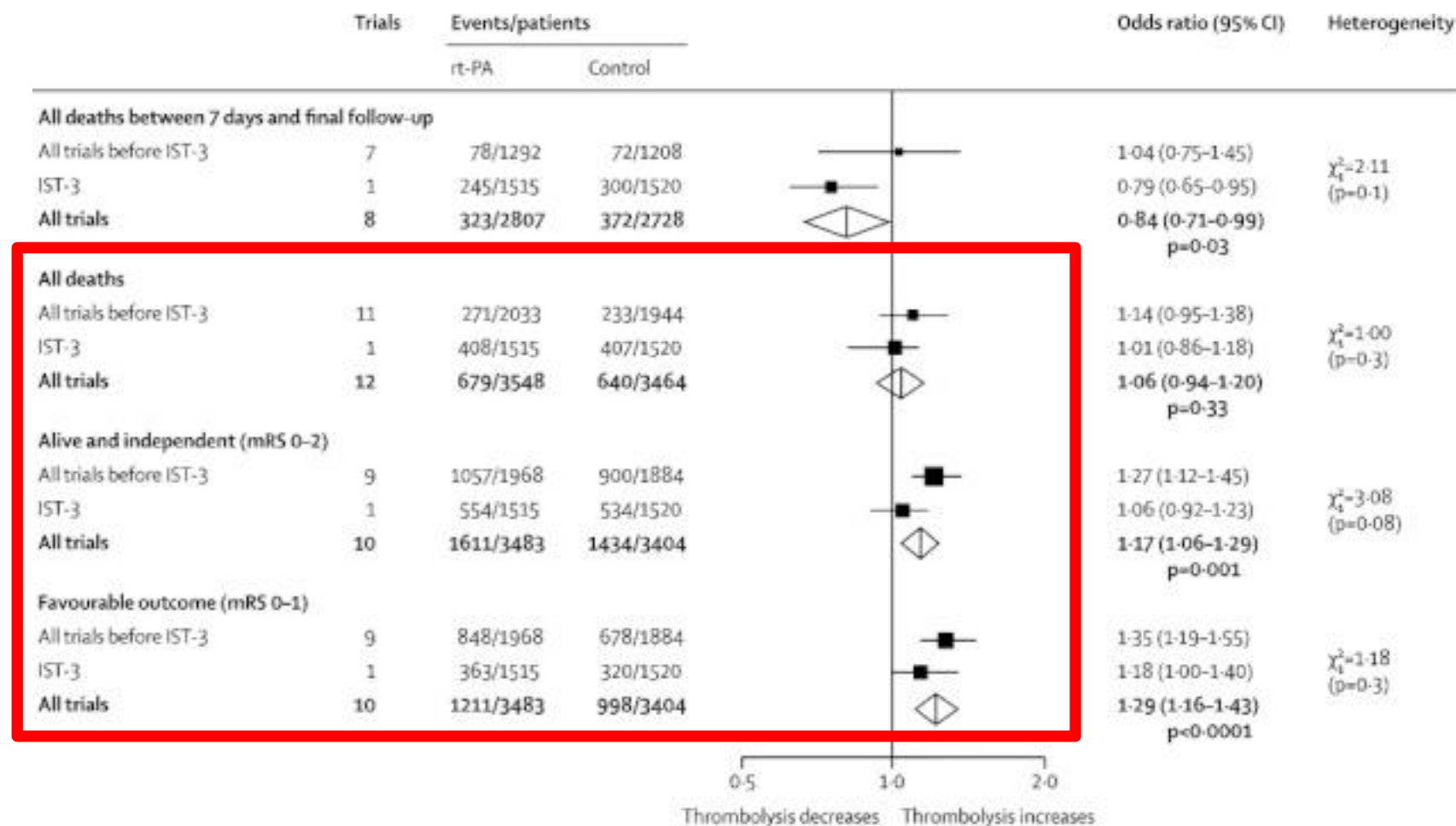
# Thrombolysis increases early (7 days) mortality due to 7.7% risk of symptomatic intracranial haemorrhage

Wardlaw JM et al. rt-PA for acute ischaemic stroke: a meta-analysis of 12 trials  
*Lancet* 2012; 379: 2364–2372.



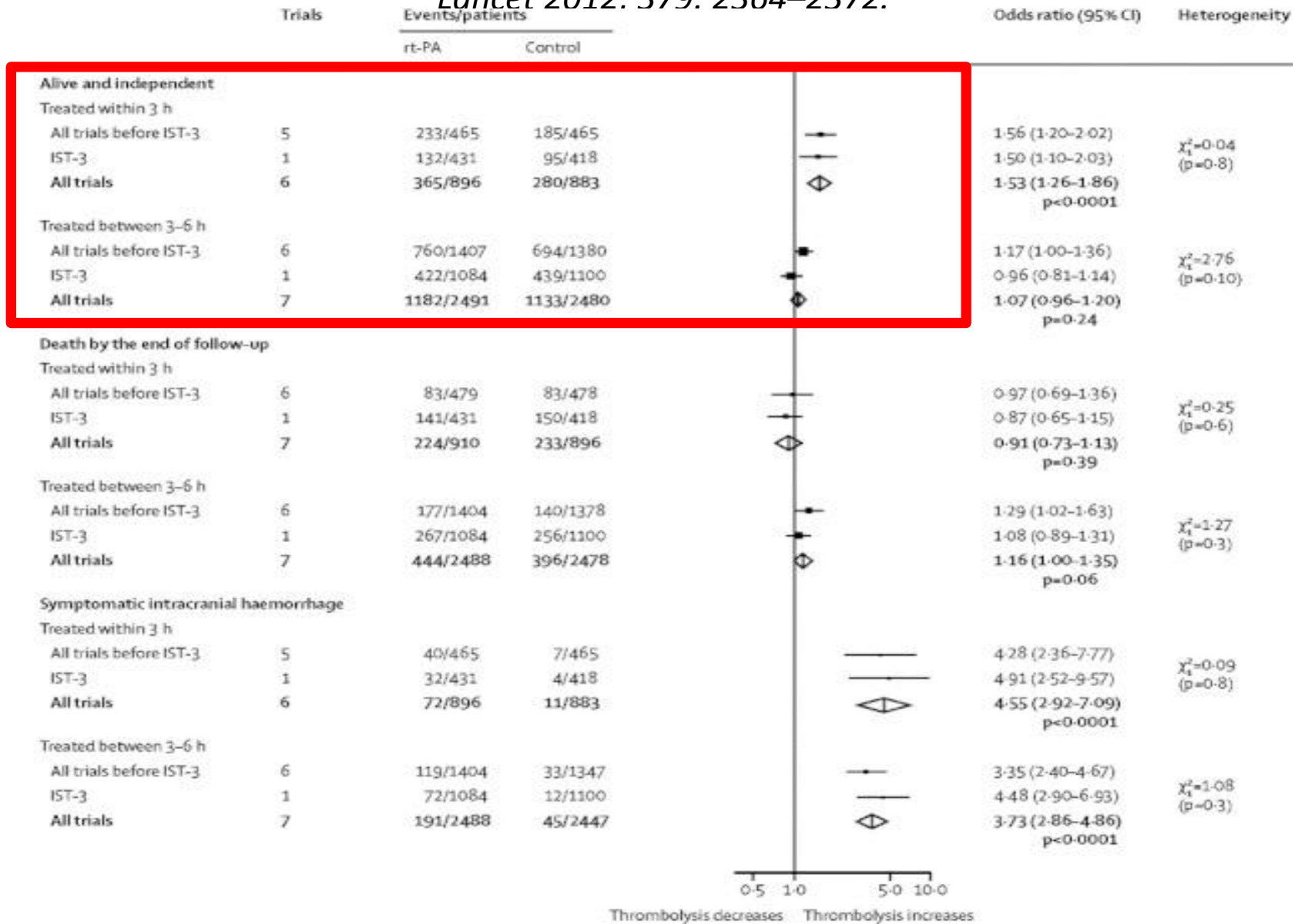
# Thrombolysis improves final stroke outcomes due to improved functional recovery of survivors

Wardlaw JM et al. R-tPA for acute ischaemic stroke: a meta-analysis of 12 trials  
*Lancet* 2012; 379: 2364–2372.



# Thrombolysis is beneficial only when given within <3 hours from stroke onset

Wardlaw JM et al. R-tPA for acute ischaemic stroke: a meta-analysis of 12 trials  
*Lancet* 2012; 379: 2364–2372.



**Acute stroke:  
Facilitated intervention vs.  
I.V. thrombolysis**

# Combined I.V. + I.A. thrombolysis in acute stroke is not superior to simple iv. thrombolysis alone

*Mazighi M et al. Stroke 2012;43:1302-1308.*

- Metaanalysis of 15 trials with iv. (bridging) + ia. TL
- 559 patients, mean NIHSS 17.
- Symptom onset – infusion start 135 min.
- Infusion – angiography 88 min. (!!!)

Table 3. Pooled Rates of Recanalization and Clinical Outcomes

| Outcome                            | Studies, n | Patients, n | Pooled Rates (95% CI) | P Value <sup>a</sup> | I <sup>2</sup> , % |
|------------------------------------|------------|-------------|-----------------------|----------------------|--------------------|
| Main analysis                      |            |             |                       |                      |                    |
| Partial or complete recanalization | 15         | 559         | 69.6 (63.9–75.0)      | 0.011                | 51.3               |
| Complete recanalization            | 13         | 442         | 35.1 (23.0–48.2)      | <0.001               | 87.6               |
| Favorable outcome                  | 15         | 559         | 48.9 (42.9–54.9)      | 0.014                | 50.2               |
| Mortality                          | 15         | 585†        | 17.9 (12.7–23.7)      | <0.001               | 66.6               |
| sICH                               | 15         | 627†        | 8.6 (6.8–10.6)        | 0.65                 | 0                  |
| Sensitivity analysis‡              |            |             |                       |                      |                    |
| Favorable outcome                  | 10         | 399         | 44.3 (39.9–48.8)      | 0.54                 | 0                  |
| Mortality                          | 12         | 474†        | 18.6 (12.3–25.8)      | <0.001               | 72.2               |
| sICH                               | 11         | 501†        | 9.7 (7.3–12.4)        | 0.96                 | 0                  |

CI indicates confidence interval; sICH, symptomatic intracranial hemorrhage.

<sup>a</sup>P associated with  $\chi^2$  test for heterogeneity.

†Including patients eligible for bridging therapy not treated by intra-arterial therapy from Interventional Management of Stroke trials.

‡Restricted to studies with clinical outcome closest to the Interventional Management of Stroke II definition.<sup>6</sup>

## Endovascular Therapy after Intravenous t-PA versus t-PA Alone for Stroke

Joseph P. Broderick, M.D., Yulio Y. Palesch, Ph.D., Andrew M. Demchuk, M.D., Sharon D. Yeatts, Ph.D., Pooja Khatri, M.D., Michael D. Hill, M.D., Edward C. Jauch, M.D., Tudor G. Jovin, M.D., Bernard Yan, M.D., Frank L. Silver, M.D., Rüdiger von Kummer, M.D., Carlos A. Molina, M.D., Bart M. Demaerschalk, M.D., Ronald Budzik, M.D., Wayne M. Clark, M.D., Osama O. Zaidat, M.D., Tim W. Malisch, M.D., Mayank Goyal, M.D., Wouter J. Schonewille, M.D., Mikael Mazighi, M.D., Ph.D., Stefan T. Engelker, M.D., Craig Anderson, M.D., Ph.D., Judith Spiller, R.N., B.S.N., Janice Carrozzella, R.N., B.A., R.T.(R.), Karla J. Rycikborst, R.N., B.N., L. Scott Janis, Ph.D., Renée H. Martin, Ph.D., Lydia D. Foster, M.S., and Thomas A. Tomsick, M.D., for the Interventional Management of Stroke (IMS) III Investigators

- **All 656 participants received intravenous t-PA** (0.9 mg per kilogram), with 10% as a bolus and the remainder infused over a 1-hour period (maximum dose, 90 mg).
- Randomization within 40 minutes after the initiation of the infusion.
- **Mean enrollment rate: 2 patients / center / year (2006-12) !**
- Only 47% patients underwent CT-angiography at baseline
- **Group A (intravenous t-PA, n = 222, median NIHSS = 16)**
- **Group B (endovascular- therapy, n = 434, median NIHSS = 17):** angiography as soon as possible (interhospital transfer allowed). **No angiographic evidence** of a treatable occlusion = no additional treatment. Treatable vascular occlusion = endovascular intervention with an approach chosen by the site neurointerventionalist (thrombectomy with the **Merci, Penumbra or Solitaire**, or **endovascular t-PA infusion**). Angiographic procedure had to begin within 5 hours and be completed within 7 hours after the onset of stroke. Heparin 2000 U bolus, followed by an infusion of 450 U /hour during endovascular therapy, discontinued at the end of the procedure.
- **Death / disability (mRS >2): 59,2% (endovascular) vs. 61,3% (iv. tPA), n.s.**

# IMS-III outcomes

Broderick JP et al. NEJM 2013

| Table 2. Primary and Secondary Safety End Points.†‡                             |                                   |                                     |         |
|---|-----------------------------------|-------------------------------------|---------|
| End Point   | Endovascular Therapy<br>(N = 434) | Intravenous t-PA Alone<br>(N = 222) | P Value |
| Death — no. (%)   |                                   |                                     |         |
| Within 7 days   | 52 (12.0)                         | 24 (10.8)                           | 0.57    |
| Within 90 days  | 83 (19.1)                         | 48 (21.6)                           | 0.52    |
| Intracerebral hemorrhage within 30 hr — no. (%)                                 |                                   |                                     |         |
| Symptomatic   | 27 (6.2)                          | 13 (5.9)                            | 0.83    |
| Asymptomatic  | 119 (27.4)                        | 42 (18.9)                           | 0.01    |
| Parenchymal hematoma identified within 30 hr —<br>no./total no. (%)‡            |                                   |                                     |         |
| Type 2  | 25/417 (6.0)                      | 13/207 (6.3)                        | 0.90    |
| Type 1  | 15/417 (3.6)                      | 3/207 (1.4)                         | 0.12    |
| Hemorrhage — no./total no. (%)  |                                   |                                     |         |
| Subarachnoid  | 48/417 (11.5)                     | 12/207 (5.8)                        | 0.02    |
| Intraventricular  | 27/417 (6.5)                      | 10/207 (4.8)                        | 0.40    |
| Major complication due to nonintracerebral bleeding<br>within 5 days — no. (%)‡ | 13 (3.0)                          | 5 (2.3)                             | 0.55    |
| Recurrent stroke within 90 days — no. (%)                                       | 22 (5.1)                          | 14 (6.3)                            | 0.54    |
| Device or procedural complication — no. (%)‡                                    | 70 (16.1)                         | —                                   |         |

## A Trial of Imaging Selection and Endovascular Treatment for Ischemic Stroke

Chelsea S. Kidwell, M.D., Reza Jahan, M.D., Jeffrey Gornbein, Dr.P.H., Jeffrey R. Alger, Ph.D., Val Nenov, Ph.D., Zahra Ajani, M.D., Lei Feng, M.D., Ph.D., Brett C. Meyer, M.D., Scott Olson, M.D., Lee H. Schwamm, M.D., Albert J. Yoo, M.D., Randolph S. Marshall, M.D., Philip M. Meyers, M.D., Dileep R. Yavagal, M.D., Max Wintermark, M.D., Judy Guzy, R.N., Sidney Starkman, M.D., and Jeffrey L. Saver, M.D., for the MR RESCUE Investigators\*

- 118 patients within 8 hours (***mean 5.5 h***) ***after the onset of anterior-circulation strokes*** randomized to undergo mechanical embolectomy (***Merci or Penumbra***) or standard care.
- ***Mean enrollment rate: <1 patient / center / year ! (2004-11)***
- Randomization was stratified according to whether the patient had a favorable penumbral pattern (58% pts.) or a nonpenumbral pattern (42% pts.).
- Revascularization in the embolectomy group achieved in 67%.
- 3-months mortality 21%, symptomatic intracranial hemorrhage 4% (both groups)
- Mean mRS 3.9 vs. 3.9 ( $p = 0.99$ ).
- ***Embolectomy was not superior to standard care even among patients with a favorable penumbral pattern (mean score, 3.9 vs. 3.4;  $P = 0.23$ )***



ORIGINAL ARTICLE

## Endovascular Treatment for Acute Ischemic Stroke

Alfonso Ciccone, M.D., Luca Valvassori, M.D., Michele Nichelatti, Ph.D.,  
Annalisa Sgoifo, Psy.D., Michela Ponzio, Ph.D., Roberto Sterzi, M.D.,  
and Edoardo Boccardi, M.D., for the SYNTHESIS Expansion Investigators\*

- 362 patients with acute stroke (median NIHSS = 13) within 4.5 hours randomized to endovascular therapy
- ***i.a. t-PA + mechanical clot disruption with a micro-guidewire (n = 109) or clot retrieval device in a small proportion only (Solitaire n = 18, Penumbra n = 9, Trevo n = 5, Merci n = 5)***
- median time from stroke onset to the start of treatment was 3.75 hours for endovascular therapy and 2.75 hours for intravenous t-PA (P<0.001).
- ***Death or disability (mRS >1) at 3 months: 69,6% (endovascular) vs. 65,2% (i.v., p=0.16).***
- symptomatic intracranial hemorrhage within 7 days occurred in 6% of the patients in each group

**„Endovascular therapy“ of acute stroke:**

**senseless, misleading term mixing apples with oranges ! Term should be abandoned.**

**If there is any future, it lies in true primary CBT !!!**

- **i.a. thrombolysis (useless !)**
- **facilitated intervention (not superior to iv. thrombolysis alone)**
- **rescue intervention after failed thrombolysis (value not known, possibly low due to delays)**
- **intracerebral balloon angioplasty or stenting (value questionable, possibly none)**
- **true primary (timely, without thrombolysis) catheter-based thrombectomy (minority of patients in all trials, outdated devices)**

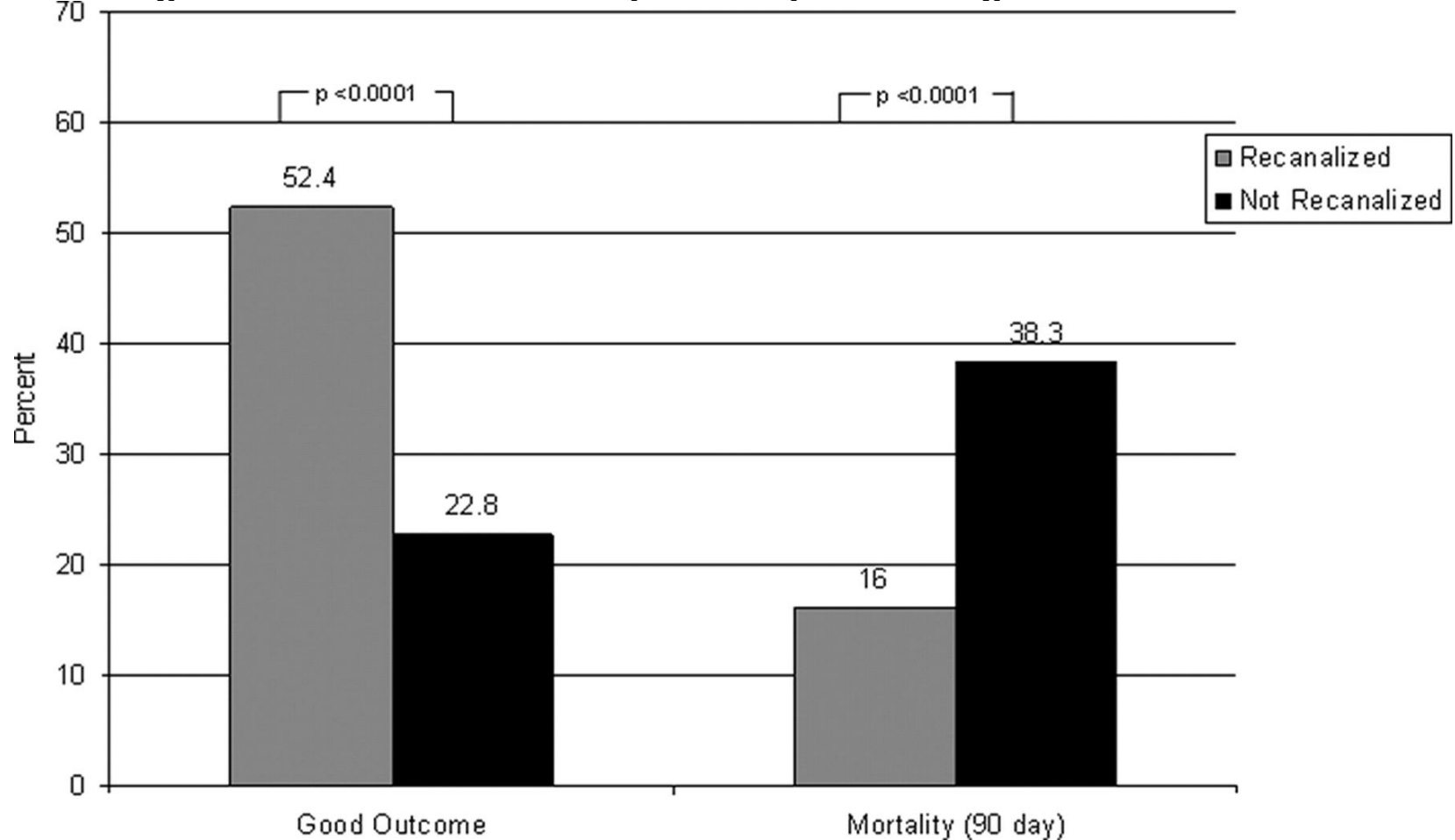
**Acute stroke:  
Primary (direct)  
catheter-based thrombectomy**

**Dorn F et al. Endovascular Treatment of Acute Intracerebral Artery Occlusions with the Solitaire Stent: Single-Centre Experience with 108 Recanalization Procedures. Cerebrovasc Dis 2012;34:70–77.**

- 104 patients treated with the Solitaire<sup>®</sup> stent retriever
- 75% of them received also thrombolysis.
- recanalization rate 78%.
- mean NIHSS decreased from 15,3 (before) to 7,8 (after treatment).
- Mortality was 16% (anterior circulation) and 47,8% (posterior circulation).
- Intracranial bleeding occurred in 8%.

# Imaging-based endovascular therapy for acute anterior circulation stroke treated >8 hours from time last seen well (n=237)

Rates of good outcomes and mortality at 90 days according to revascularization status.



Jovin T G et al. Stroke 2011;42:2206-2211

Jovin TG et al. Stroke 2011 Aug;42(8):2206-11.

67-years old female with tandem occlusion (ICA + MCA), NIHSS=20, presenting 11 h after stroke onset !

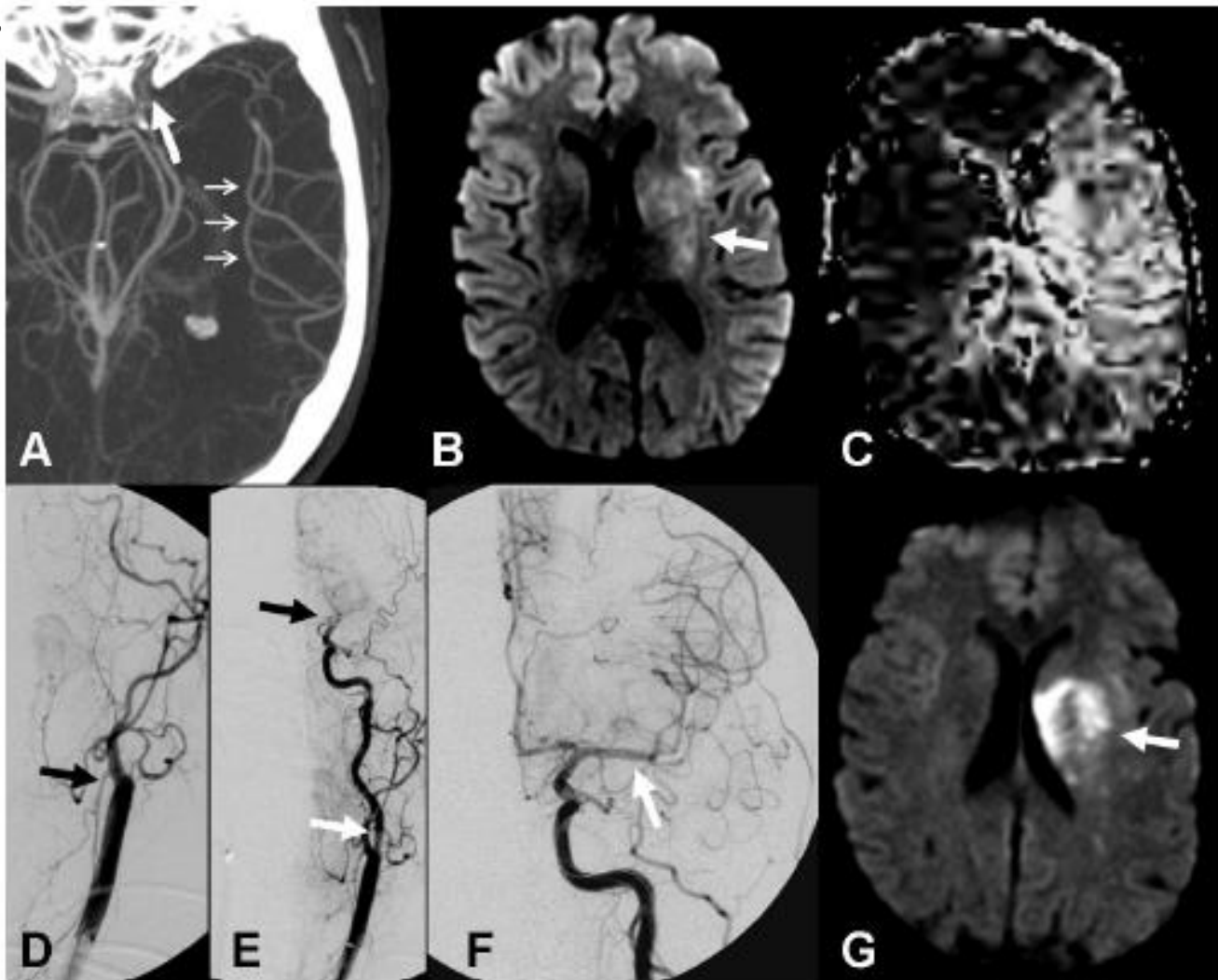
A: CTA shows distal MCA branches (small arrows) = collateral flow.

B: MRI small ischemia, but C: large penumbra.

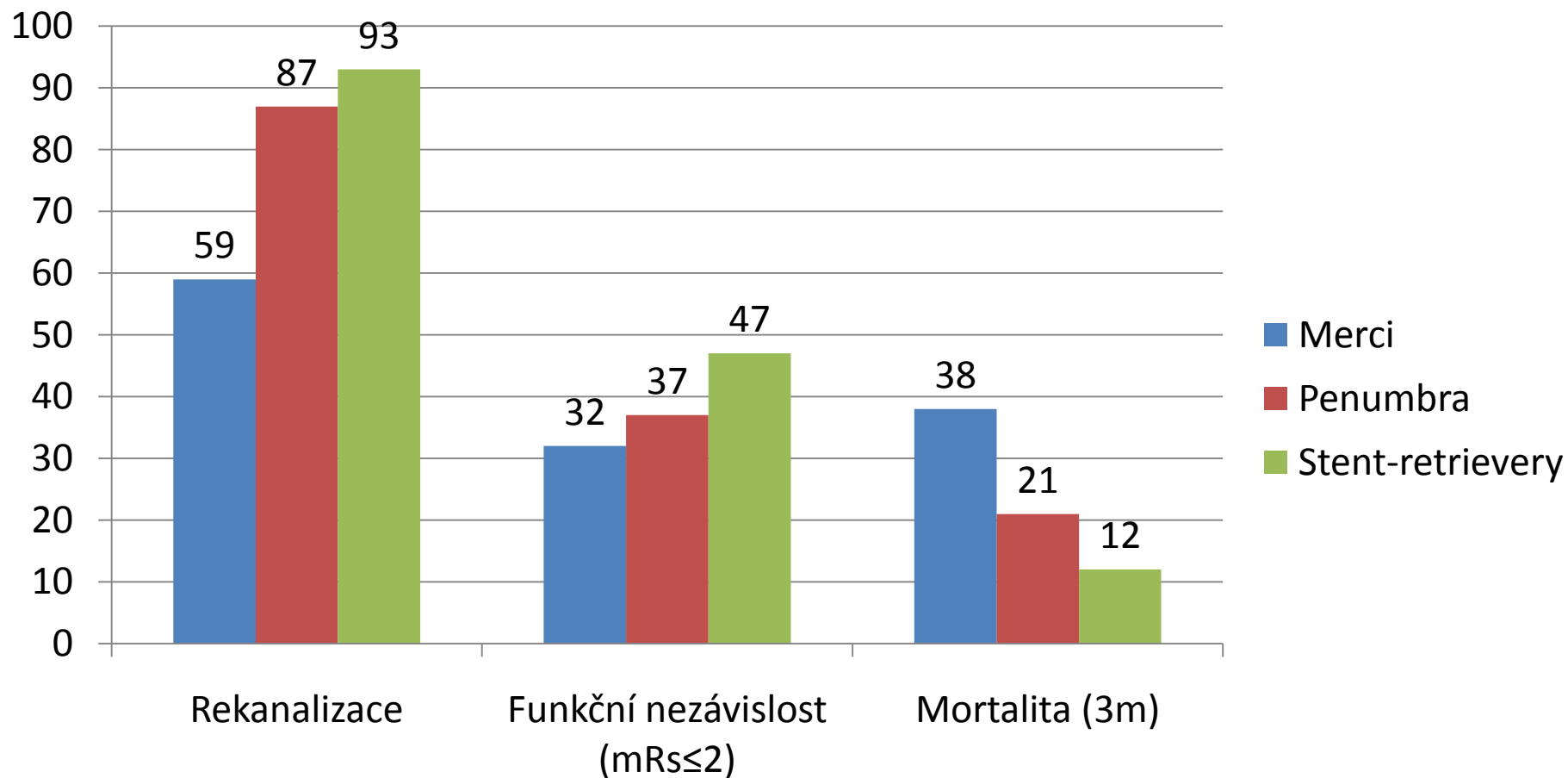
D-F: This CT+MR finding led to catheter-based intervention on both occlusion sites

G: MRI after 24 h: infarct, but nearly entire penumbra saved

3 months later: NIHSS=4, mRS=2.



**Almekhlafi MA et al. A Meta-Analysis of Observational Intra-Arterial Stroke Therapy Studies Using the Merci Device, Penumbra System, and Retrievable Stents. AJNR Am J Neuroradiol. 2012 Jul 26. [Epub ahead of print]**



- Metaanalýza 16 registrů katetrizačních trombektomií: 4x Merci ( $n= 357$ ), 8x Penumbra ( $n= 455$ ), 4x moderní stent-retrievery Solitaire® či Trevo® ( $n= 113$ )

# Protocols of the Cardiocenter Vinohrady for the use of catheter-based thrombectomy versus iv. thrombolysis

1. **Catheter-based thrombectomy (CBT) is the primary treatment strategy** and should be done without lytics. Thrombolysis will not be combined with CBT.
2. Intravenous thrombolysis (TL) is the secondary treatment strategy whenever CBT cannot be initiated timely (see table). **Decision to use thrombolysis means automatically, that the intervention team will not be alerted.**

This strategy is based on the following facts from many trials and metaanalyses:

- Thrombolysis increase the risk of **intracranial bleeding** 3-fold to 10-fold
- The only subgroup of patients deriving **mortality benefit** from thrombolysis are patients treated within < 90 minutes from stroke onset
- **Intraarterial thrombolysis** was never shown to be superior to intravenous TL
- Catheter **intervention after TL** or simultaneously with TL is not superior to TL alone
- The best outcomes seem to be achieved with **direct CBT alone** (without TL) whenever the intervention can be initiated timely



## Catheter-based thrombectomy vs. Thrombolysis in acute stroke

|                                       | CT scan – expected<br>CBT start<br><45 min. | CT - CBT<br>45 - 60 min. | CT - CBT<br>>60 min. |
|---------------------------------------|---|--------------------------|----------------------|
| Stroke onset – CT<br>scan<br><90 min. | <b>CBT</b>                                  | <b>TL</b>                | <b>TL</b>            |
| Stroke onset - CT<br>90 - 180 min.    | <b>CBT</b>                                  | <b>CBT</b>               | <b>TL</b>            |
| Stroke onset - CT<br>180 - 360 min.   | <b>CBT</b>                                  | <b>CBT</b>               | <b>CBT</b>           |

# Thrombolysis, catheter intervention or both ?

- *Thrombolysis decreases the risk of severe disability but at the price of increased mortality in all subgroups except very early treatment (<90 minutes).*
- *Intraarterial thrombolysis has no added value over intravenous*
- *Direct catheter based thrombectomy (CBT) may be the best treatment option if performed without delay.*
- *This may be implemented by close cooperation between neurologists and cardiologists (STEMI 24/7 networks used for acute stroke).*

# Summary

- *The latest generation of stent retrievers is able to recanalize >70% of occluded intracranial arteries (approximately twice more compared to thrombolysis).*
- *However, it is not yet known whether this translates to better clinical outcomes.*
- *The sufficient data on outcomes after primary CBT (without thrombolysis) are still missing and trials comparing iv. thrombolysis versus primary CBT are urgently needed.*

# **Cave ! Acute stroke intervention is much more difficult task compared to primary PCI:**

- **Extremely complex logistics**
- **Few suitable patients = lack of proper staff training, delays in therapy**
- **Difficult pharmacotherapy (high risk for i.c. bleed)**
- **Very short time window (when therapy can help)**
- **Procedural technique**

# Future ?

- The only approach to be compared with simple i.v. thrombolysis in future trials should be ***catheter-based thrombectomy with modern stent-retrievers***
- Time delay between diagnosis (CT or MR) and invasive angiography should be <45 minutes.
- To organize this in acute stroke setting is a real challenge !



**45-years mother from 3 children  
11:30 sudden loss of consciousness, hemiplegia  
12:30 CT scan  
13:00 transfemoral angiography  
13:30 thrombectomy (Solitaire)  
13:45 conscious, speaking  
16:00 moving (photo)  
Next morning willing to go home (mRS 0)**