



Time to Reperfusion in Acute Myocardial Infarction: Review on Controversies and the Result of Contrast MRI Study

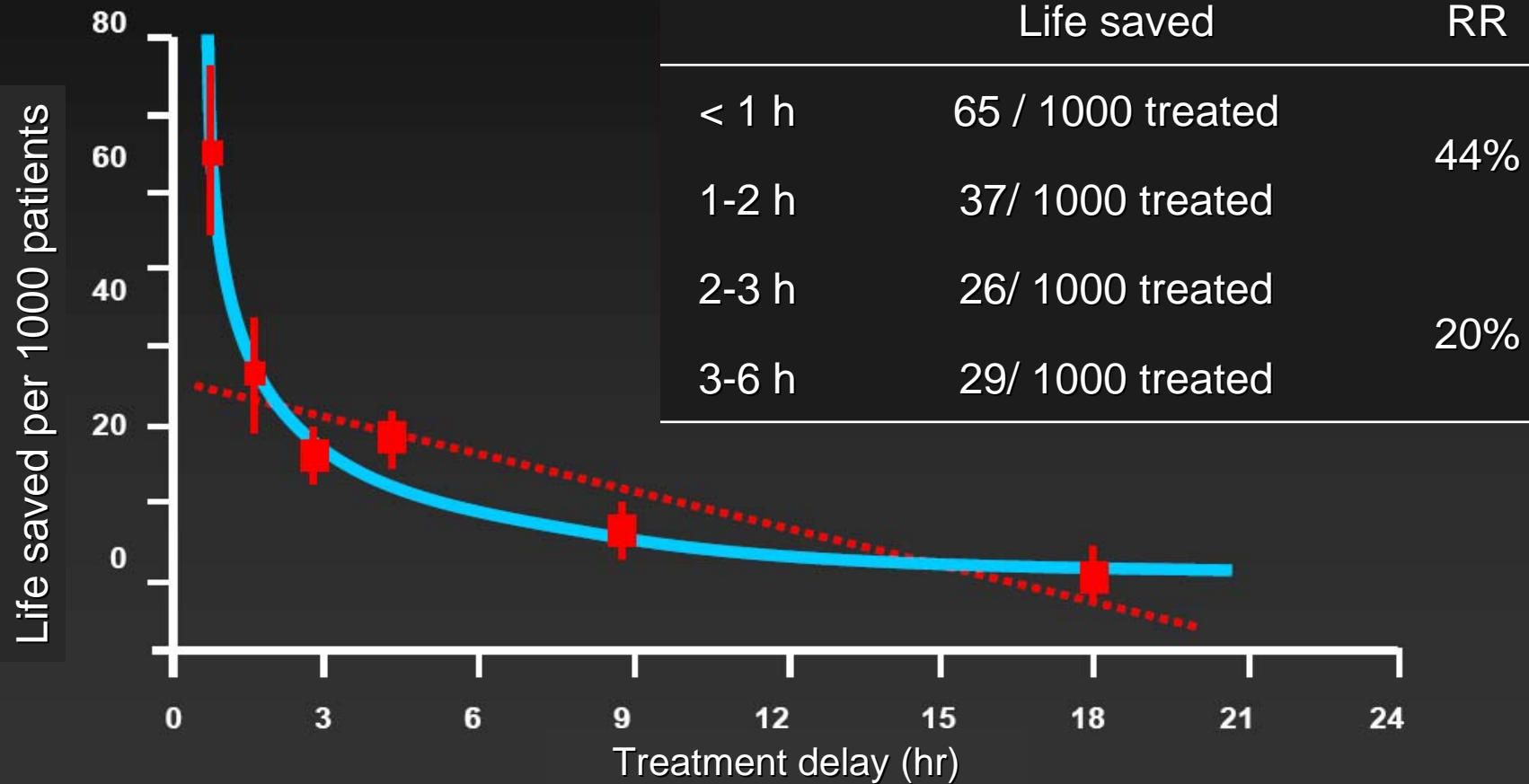
Hyeon-Cheol Gwon, Joo Yong Hahn, Young Bin Song

Cardiac&Vascular Center, Samsung Medical Center

Sungkyunkwan University School of Medicine



Life Saved by Fibrinolytic Therapy is a Function of Door-to-Needle Time

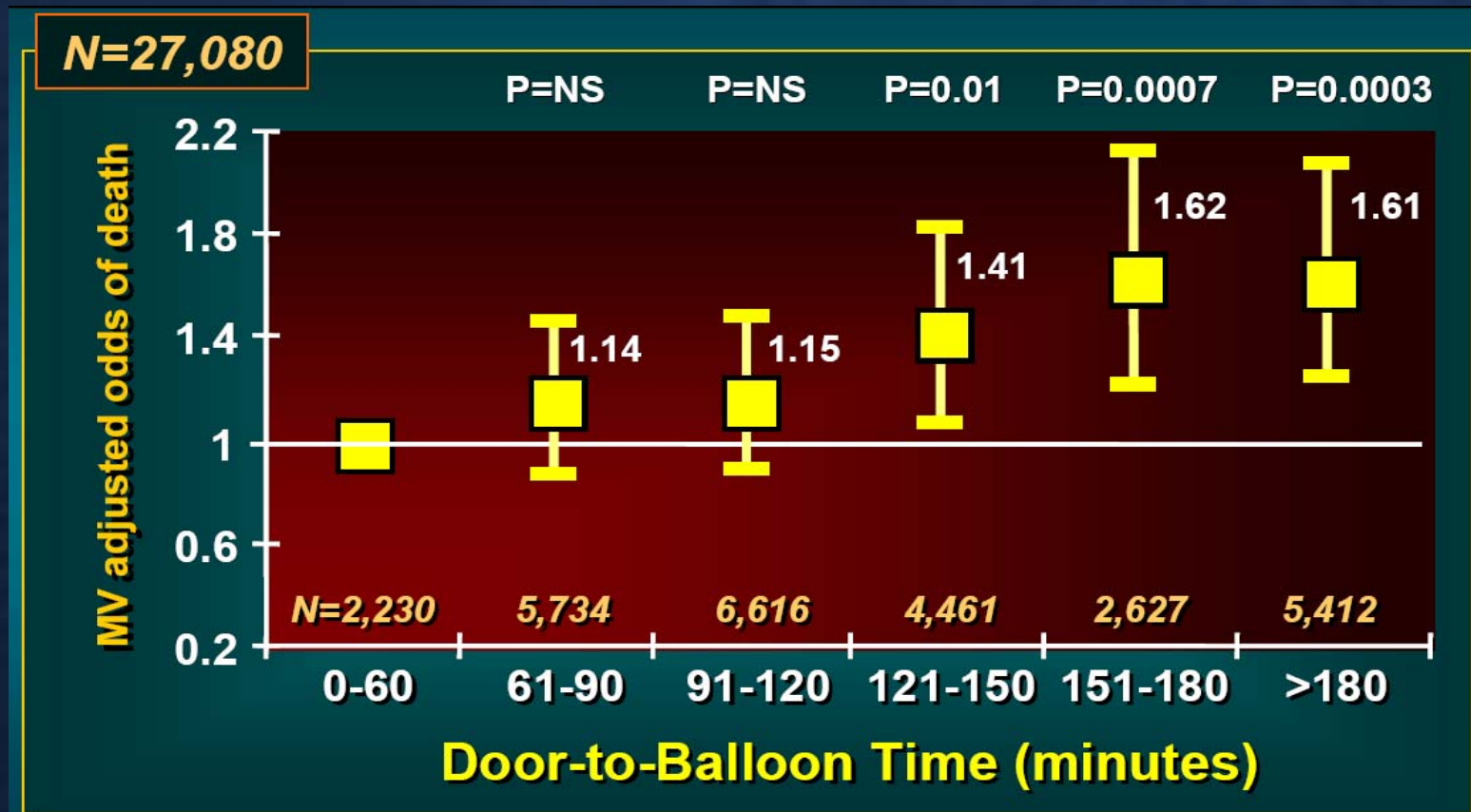




Door-to-Balloon Time and Mortality

AHA/ACC guideline 2004

Class I: Door-to-balloon time: ≤ 90 minutes (Evidence B)





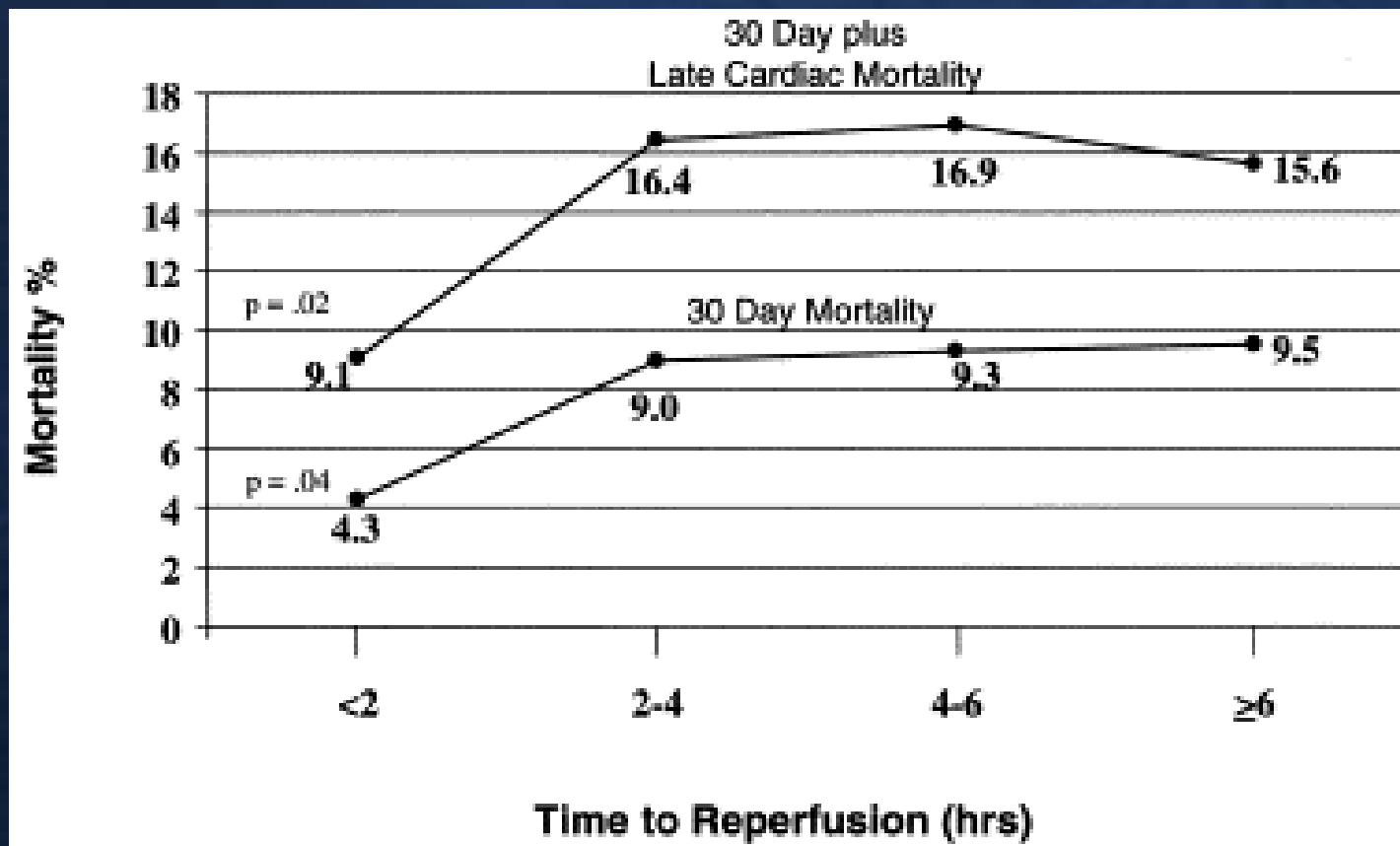
Initial time Variable and Mortality in Primary PCI

- ✓ *Dependent on symptom-to-balloon time for **all patients***
 - * *De Luca G, JACC 2003* *Brodie BR, AHJ 2006*
- ✓ *Time dependent only for **high-risk patients***
 - * *Antoniucci D, AJC 2002*
- ✓ *Relatively time independent **after 2 h of symptom***
 - * *Brodie BR, JACC 1998*
- ✓ *Time dependent with symptom-to-balloon time but **NOT for door-to-balloon time***
 - * *Cannon CP, JAMA 2000* *McNamara RL, JACC 2006*
- ✓ ***No association** between mortality and door or symptom-to-balloon time*
 - * *Brodie BR, AJC 2001* *Zijlstra F, EHJ 2002*



Symptom-to-Balloon Time and 30-Day Mortality

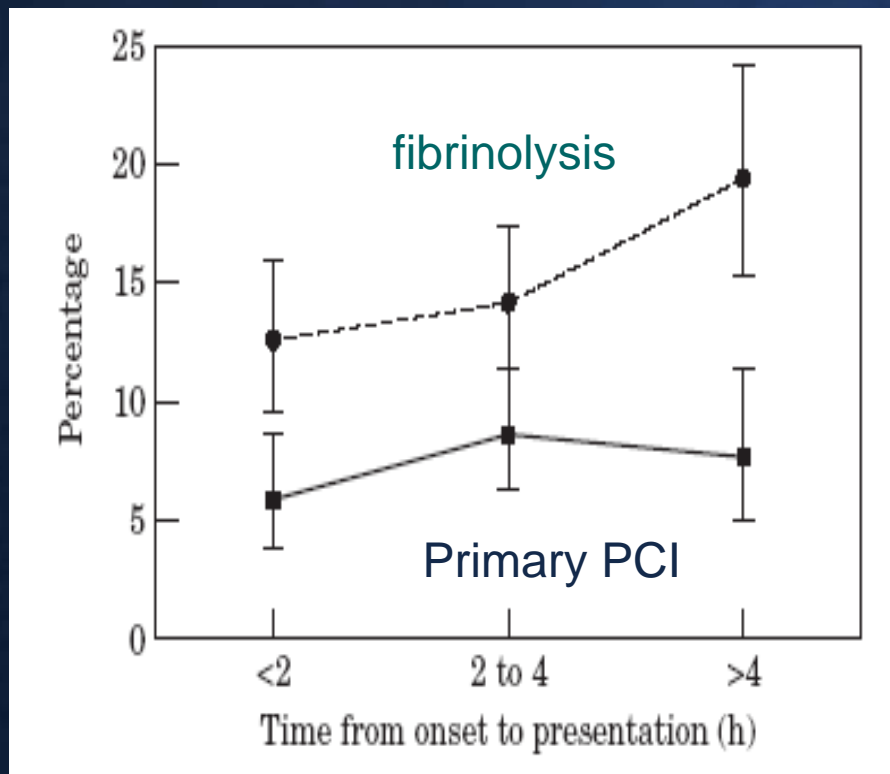
Relatively time independent after 2 h of symptom



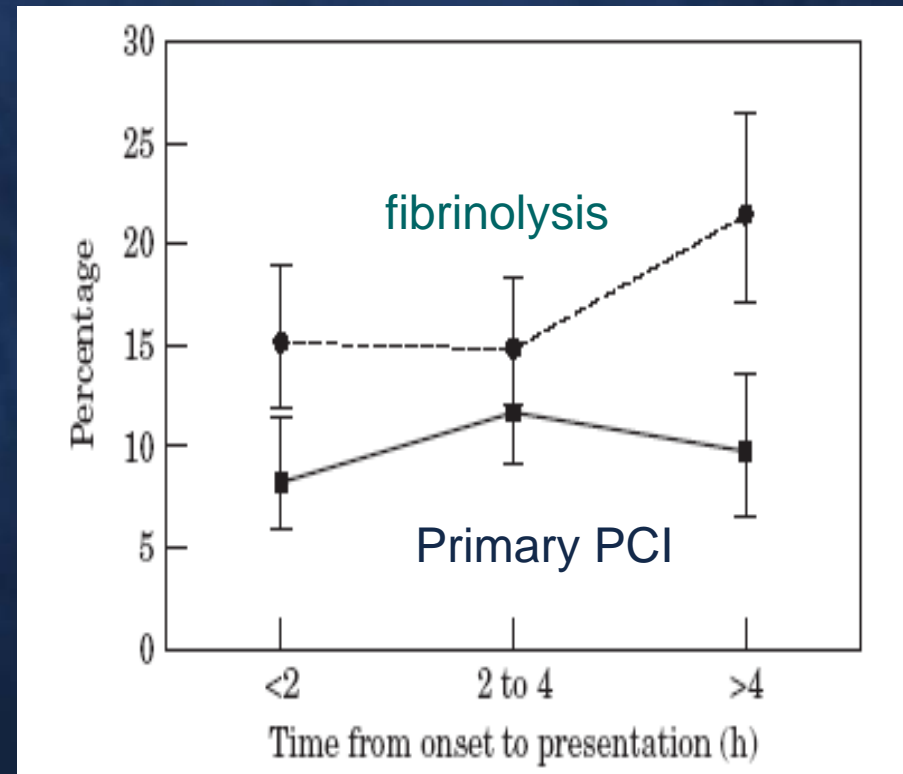
Symptom-to-Balloon Time

Time dependent for fibrinolysis but not for primary PCI

30-day Death/MI/Stroke



6-month Death/MI/Stroke





Impact of Initial Delay of Primary PCI

Korean AMI Registry (KAMIR)

- 1416 patients who met inclusion criteria, out of 5069 patients in KAMIR (2005. 11 – 2007.1)
- Inclusion criteria
 - Primary PCI within 12 hours of symptom onset in STEMI
 - Available 1-month follow-up data (92.5% FU rate)



Impact of Initial Delay of Primary PCI

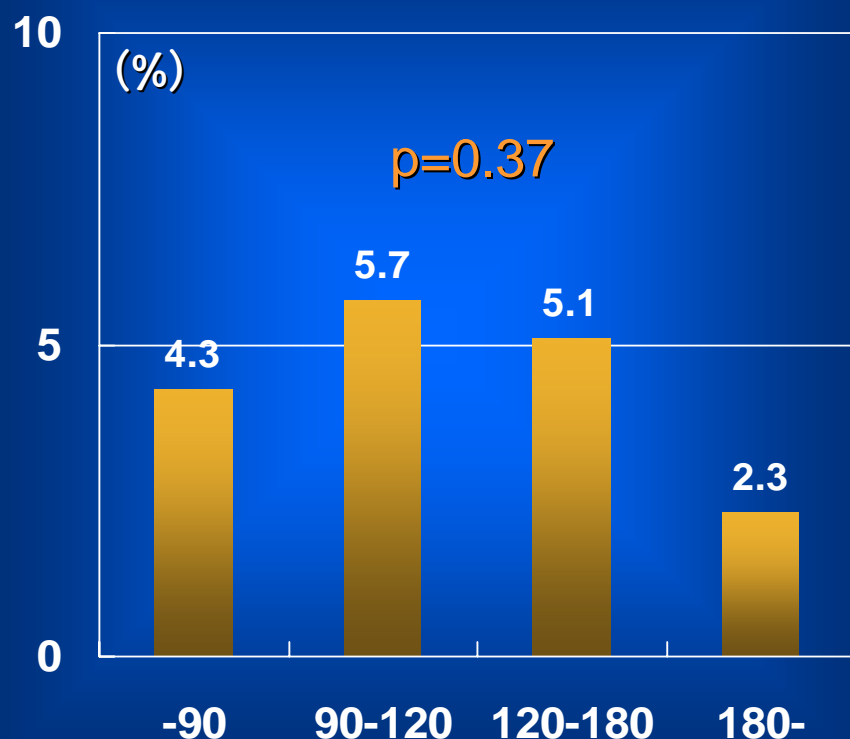
Korean AMI Registry (KAMIR)

- Symptom onset-to-door time
 - median time: 163 min [90 - 285]
 - ≤ 120 min : 36 %
- Door-to-balloon time
 - median time: **90 min** [65 - 136] **106 min in NRMI-4**
 - ≤ 90 min : 51 %
- Symptom onset-to-balloon time
 - median time : 274 min [185 - 442]
 - ≤ 240 min : 42 %
- 1-month mortality
 - 62 death / 1416 patients = **4.4%** **4.5% in NRMI-4**

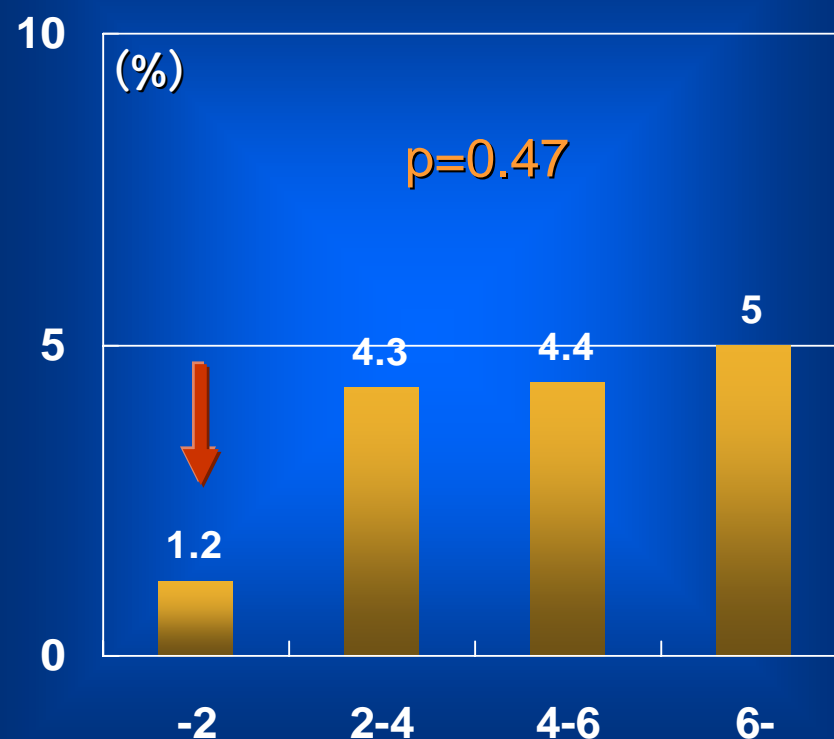


Impact of Initial Delay of Primary PCI on 30-day Mortality in KAMIR

Door-to-Balloon Time (Min)



Symptom-to-Balloon Time (Hr)

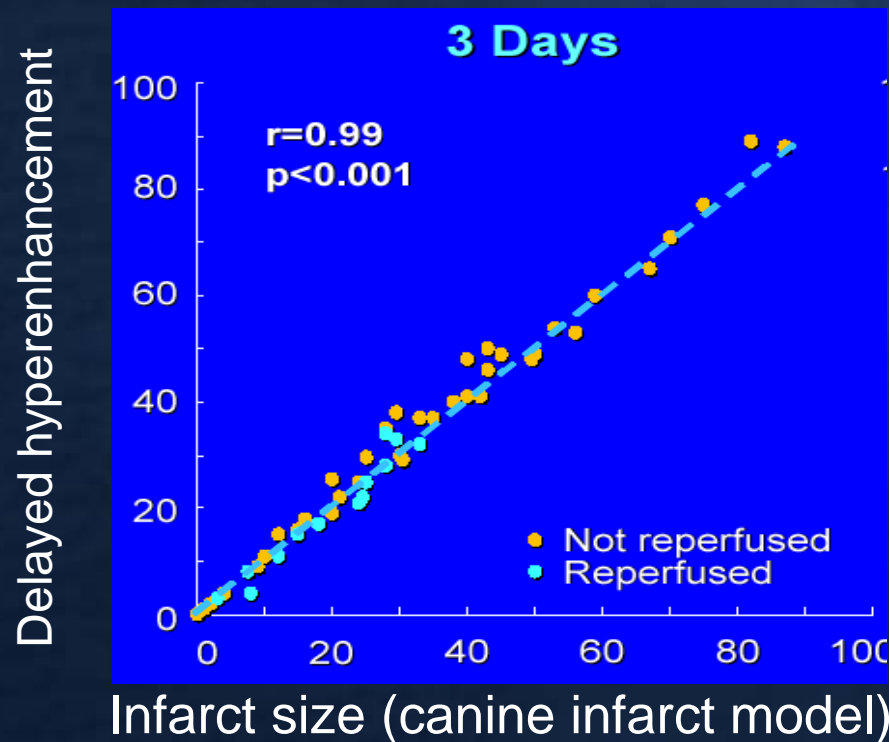


No significant impact on mortality in any subgroup



Infarct Size Measurement by MRI

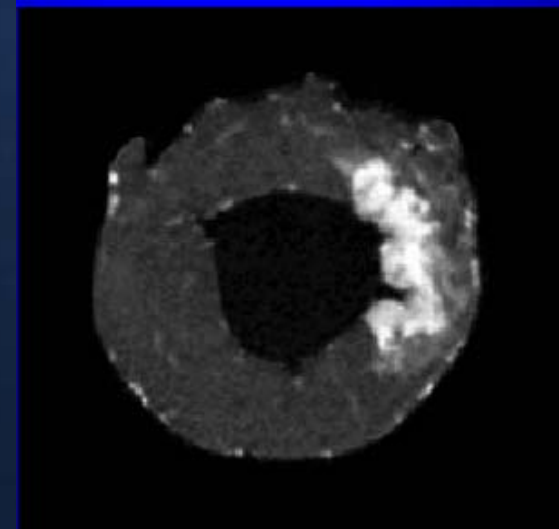
Delayed hyperenhancement (DHE) in contrast-enhanced magnetic resonance imaging (CE-MRI)



TTC



CE-MRI





Ischemic Duration Was Associated With Transmural Necrosis After Primary PCI

Table 3. Ischemic Time and Enzymatic Data According to the CE-MR Evidence of TN and/or SMO in Patients Without TIMI Flow Grade 3 of Infarct-Related Artery at Index Angiography

	TN-/SMO-	TN+/SMO-	TN+/SMO+
Patients, n (%)	19 (29.7)	22 (34.4)	23 (35.9)
Time to treatment, min*	90 ± 40	177 ± 101	255 ± 145
Peak of troponin I, µg/l†	53 ± 50	110 ± 107	137 ± 97

- Limitation of the study
 - No data on infarct size
 - Semi-quantitative measurement of infarct transmuralilty
 - Small sample size

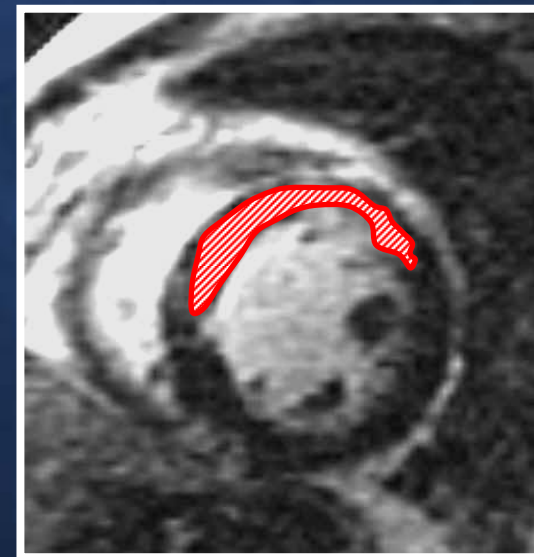
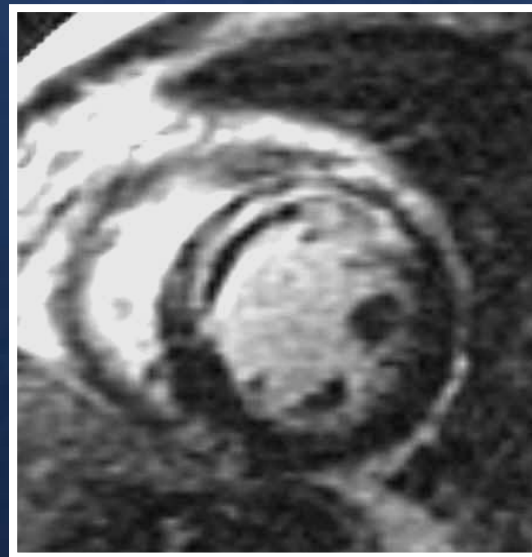


The Aim of the Study

- To evaluate the impact of time to reperfusion on myocardial **infarct size & infarct transmural**ity in patients undergoing primary PCI for STEMI within 12 hours of symptom onset.
- CE-MRI: Quantitative measurements of infarct transmurality as well as infarct size

Infarct Size Measurement by MRI

= Volume% of delayed Hyper-enhancement

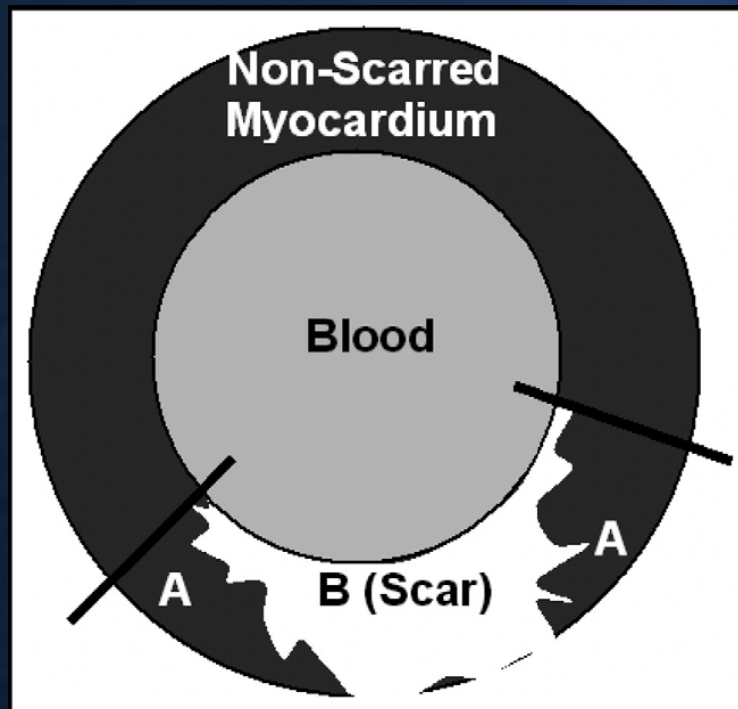


Delayed myocardial imaging 5-15 minutes after injection in short-axial planes with IR-prepared fast GRE seq. (FOV, 40 cm; slice thickness, 6 mm; TI, 200-300 ms)

Area measurement

Sum of each area \times Slice thickness = Infarct volume
Infarct size = infarct volume / myocardial volume \times 100 (%)

Quantitative Measurement of Infarct Transmurality



- Transmurality in each slice
= $B / (A+B)$
- Infarct transmurality
= the average transmurality of all segments with infarction.



Baseline characteristics

- 77 patients enrolled
- Male: 66 (86%)
- Age: 56 years (49-70)
- Symptom-to-balloon time: 259 min (162-370)
- Door-to-balloon time: 100 min (70-125)
- MRI: within 1 month after primary PCI



Baseline Characteristics

Grouped by Symptom-to-Balloon Time

Symptom-to-balloon time, min	< 180 (n=23)	180 ~ 360 (n=34)	> 360 (n=20)	<i>P</i> value
Age (years)	54±9	57±11	57±12	0.45
Male	21 (91%)	29 (85%)	16 (80%)	0.57
Diabetes	5 (22%)	9 (27%)	3 (15%)	0.62
Hypertension	8 (35%)	10 (29%)	10 (50%)	0.31
Dyslipidemia	10 (44%)	11 (32%)	6 (30%)	0.59
Current smoker	19 (83%)	20 (59%)	8 (40%)	0.02
Anterior infarction	14 (61%)	17 (50%)	15 (75%)	0.19



Baseline Characteristics

Grouped by Symptom-to-Balloon Time

Symptom-to-balloon time, min	< 180 (n=23)	180 ~ 360 (n=34)	> 360 (n=20)	P value
LAD / LCx / RCA	14 / 2 / 7	16 / 4 / 14	15 / 0 / 5	0.28
Multivessel	10 (44%)	15 (44%)	8 (40%)	0.96
Baseline TIMI 0/1	17 (74%)	25 (74%)	17 (85%)	0.59
Final TIMI 3 flow	22 (96%)	33 (97%)	18 (90%)	0.52
Collateral flow	1 (4%)	4 (12%)	4 (20%)	0.28
Myocardial blush 0/1	5 (22%)	15 (44%)	5 (25%)	0.15
No reflow	2 (9%)	1 (3%)	2 (10%)	0.52
GP IIb/IIIa inhibitor	4 (17%)	7 (21%)	11 (55%)	0.009
Distal protection	8 (35%)	7 (21%)	4 (20%)	0.41



Baseline Characteristics

Grouped by Door-to-Balloon Time

Door-to-balloon time, min	< 90 (n=30)	90 ~ 120 (n=27)	> 120 (n=20)	P value
Age (years)	59±10	54±10	55±11	0.27
Male	25 (83%)	26 (96%)	15 (75%)	0.11
Diabetes	5 (17%)	7 (26%)	5 (25%)	0.66
Hypertension	13 (43%)	10 (37%)	5 (25%)	0.42
Dyslipidemia	12 (40%)	8 (30%)	7 (35%)	0.72
Current smoker	15 (50%)	21 (78%)	11 (55%)	0.08
Anterior infarction	18 (60%)	16 (59%)	12 (60%)	0.99



Baseline Characteristics

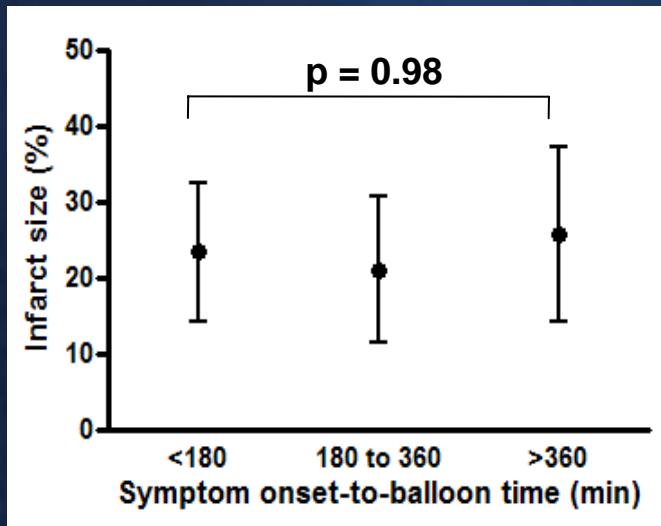
Grouped by Door-to-Balloon Time

Door-to-balloon time, min	< 90 (n=30)	90 ~ 120 (n=27)	> 120 (n=20)	P value
LAD / LCx / RCA	17 / 2 / 11	16 / 3 / 8	12 / 1 / 7	0.93
Multivessel	13 (43%)	12 (44%)	8 (40%)	0.95
Baseline TIMI 0/1	21 (70%)	22 (82%)	16 (80%)	0.54
Final TIMI 3 flow	30 (100%)	25 (93%)	18 (90%)	0.24
Collateral flow	3 (10%)	2 (7%)	4 (20%)	0.39
Myocardial blush 0/1	9 (30%)	9 (33%)	7 (65%)	0.93
No reflow	1 (3%)	3 (11%)	1 (5%)	0.47
GP IIb/IIIa inhibitor	5 (17%)	11 (41%)	6 (30%)	0.13
Distal protection	7 (23%)	5 (19%)	7 (35%)	0.42

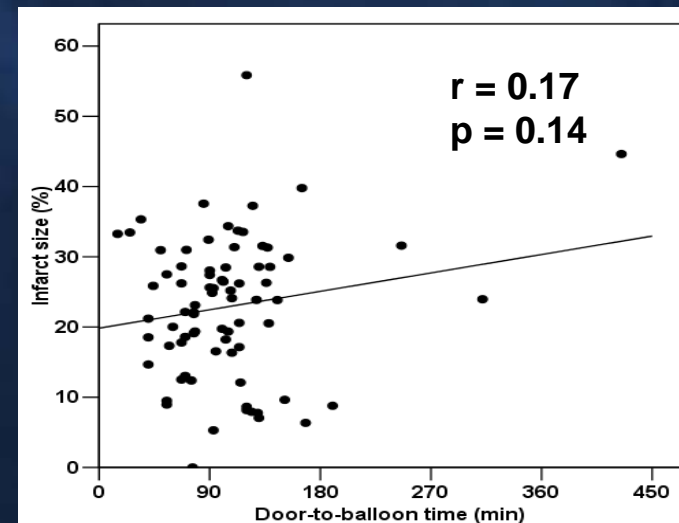
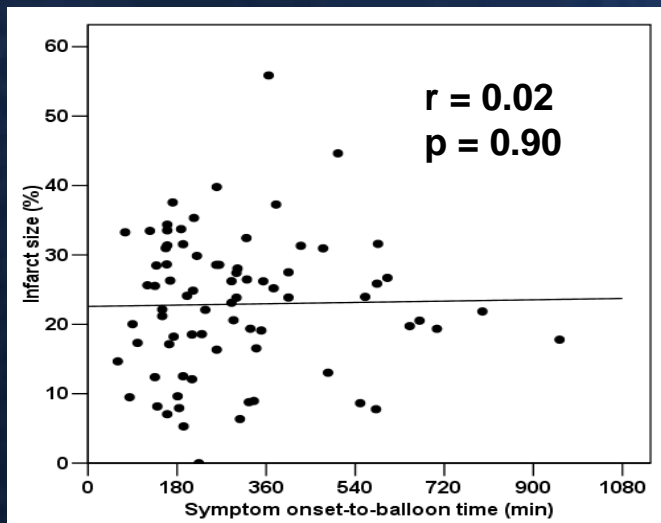
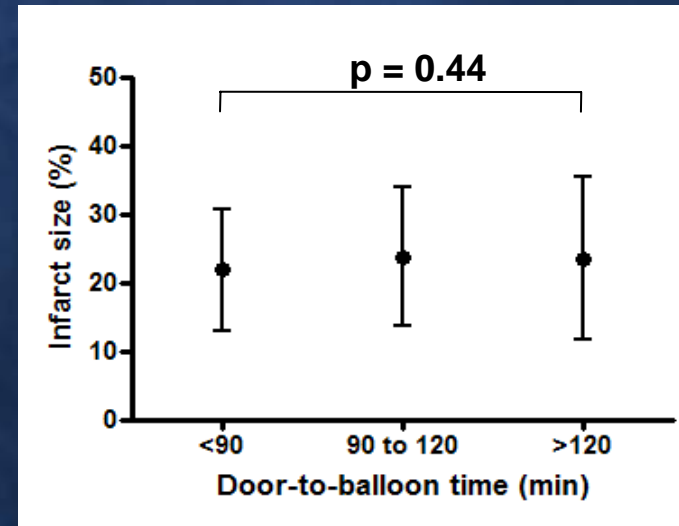


Infarct Size

Symptom-to-Balloon Time

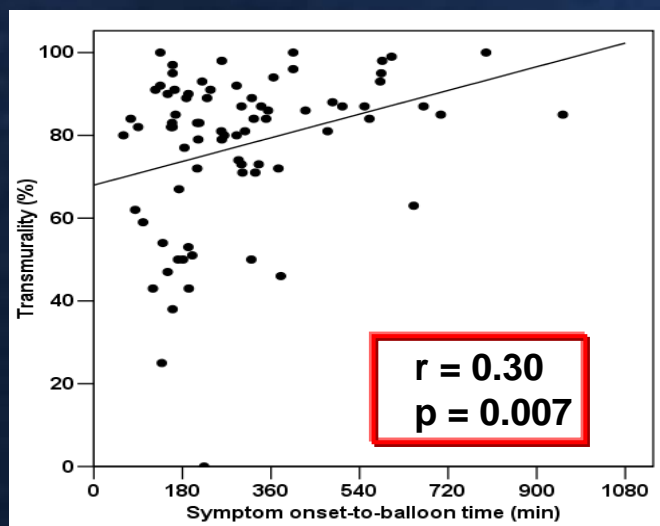
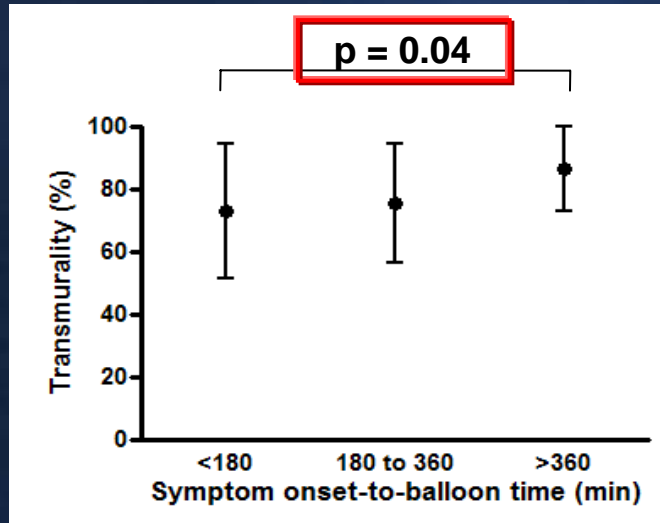


Door-to-Balloon Time

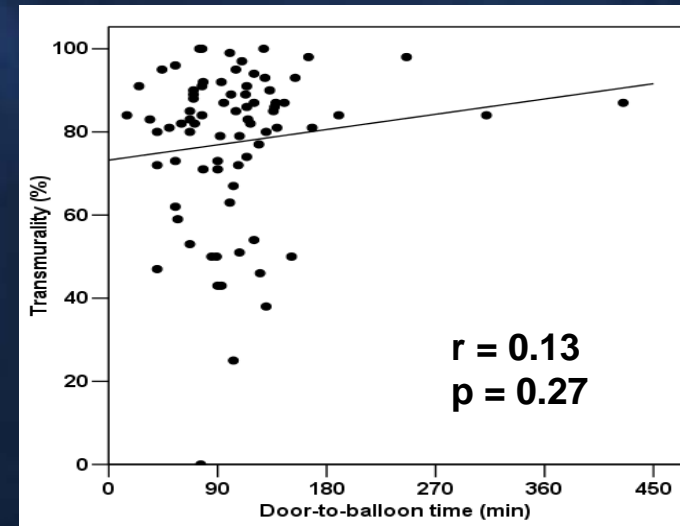
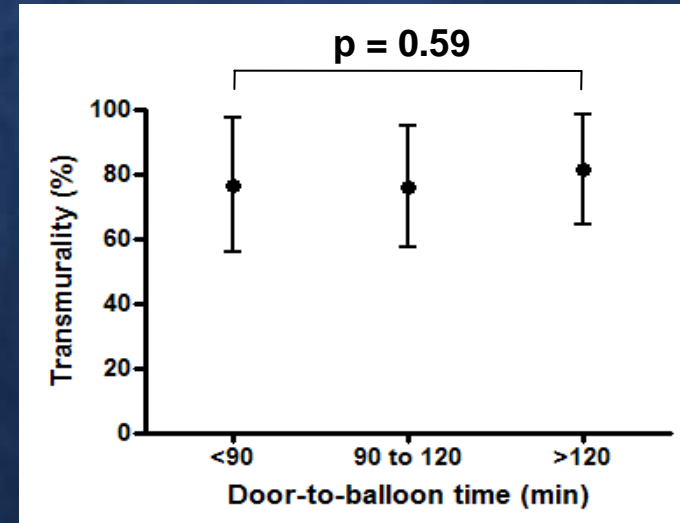


Infarct Transmurality

Symptom-to-Balloon Time



Door-to-Balloon Time





Independent Predictors of Infarct Size and Transmurality

	Odds ratio	95% CI	<i>P</i> value
Infarct size > 25%			
Anterior infarction	4.51	1.38 – 14.72	0.013
Transmurality > 75%			
Use of GP IIb/IIIa inhibitors	0.06	0.01 – 0.41	0.004
Symptom-to-balloon time (per 30 min)	1.34	1.08 – 1.66	0.008



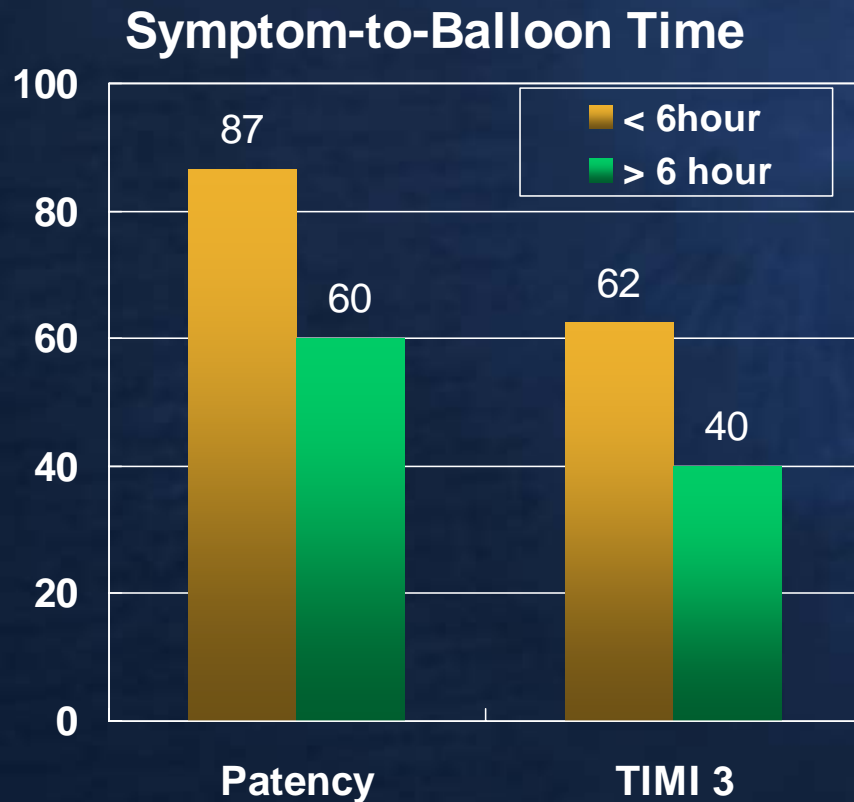
Why the Outcome of Primary PCI is Less Time-dependent?

- Successful reperfusion is more time-dependent after fibrinolysis than after primary PCI.
- High TIMI 3 flow was achieved after primary PCI even in the patients with late presentation.

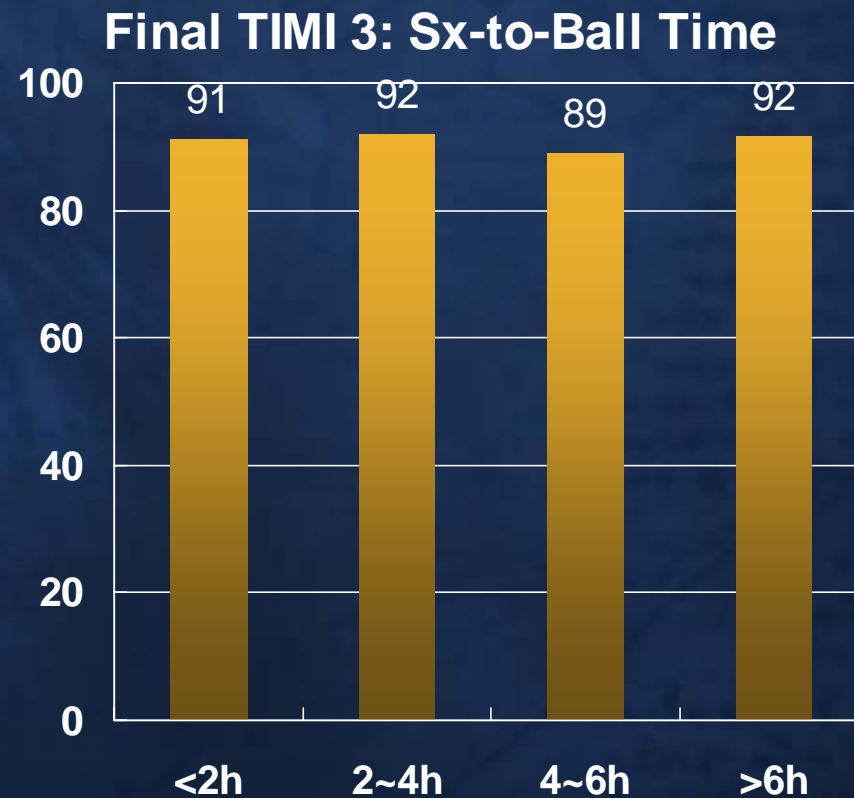


Successful Reperfusion is Time-dependent after Fibrinolysis, but not after Primary PCI

Fibrinolysis



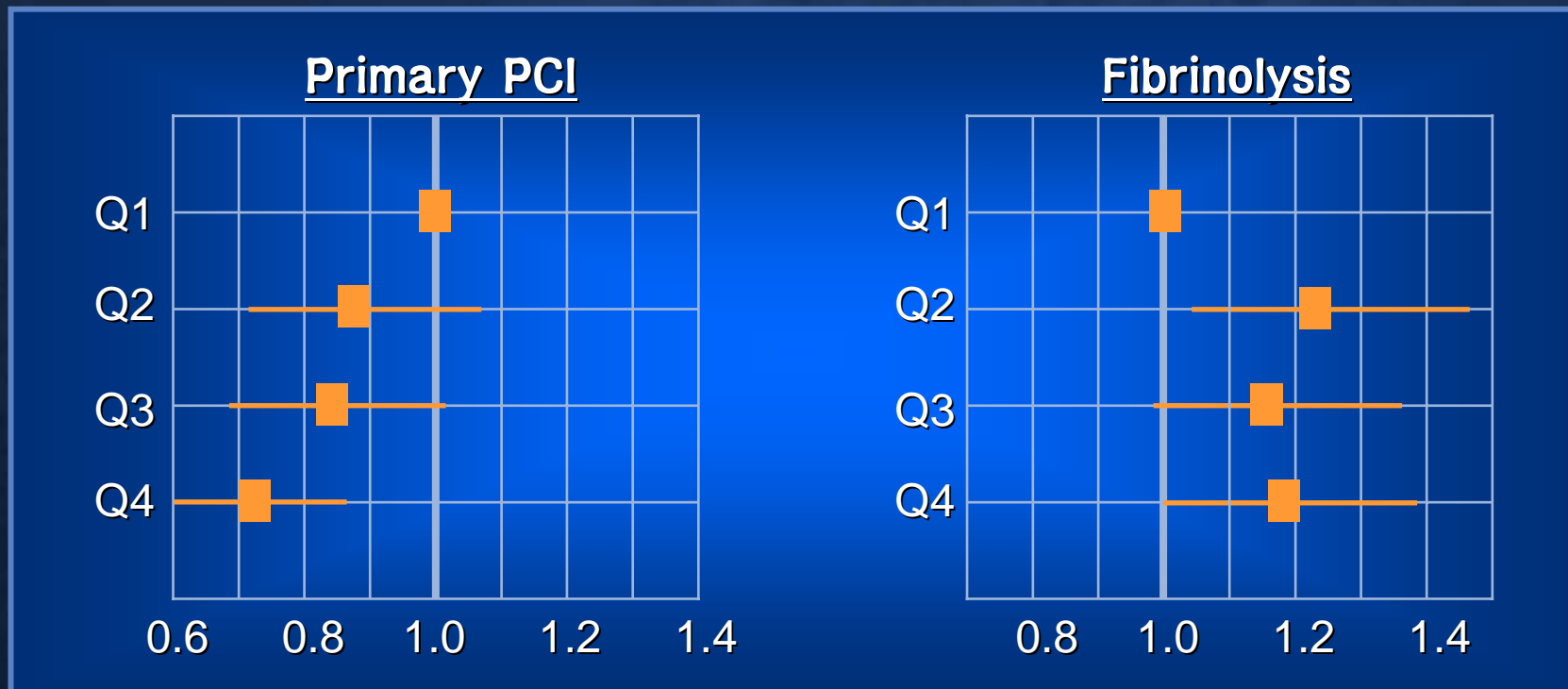
Primary PCI





PCI volume and Mortality

Relative risk of 30-day mortality





Summary and Conclusion

- Clinical outcome and infarct size is less dependent on the time-to-reperfusion in primary PCI, may reach a plateau in less than 3 hours of symptom onset.
- The effort to reduce the time delay is still valuable both in the hospital and outside of the hospital.



Symptom onset-to-Balloon Time & Mortality

