

LINC Flash Presentation

Timing of Carotid Bifurcation Repair
after Symptoms:
How Does It Affect Stroke Risk?

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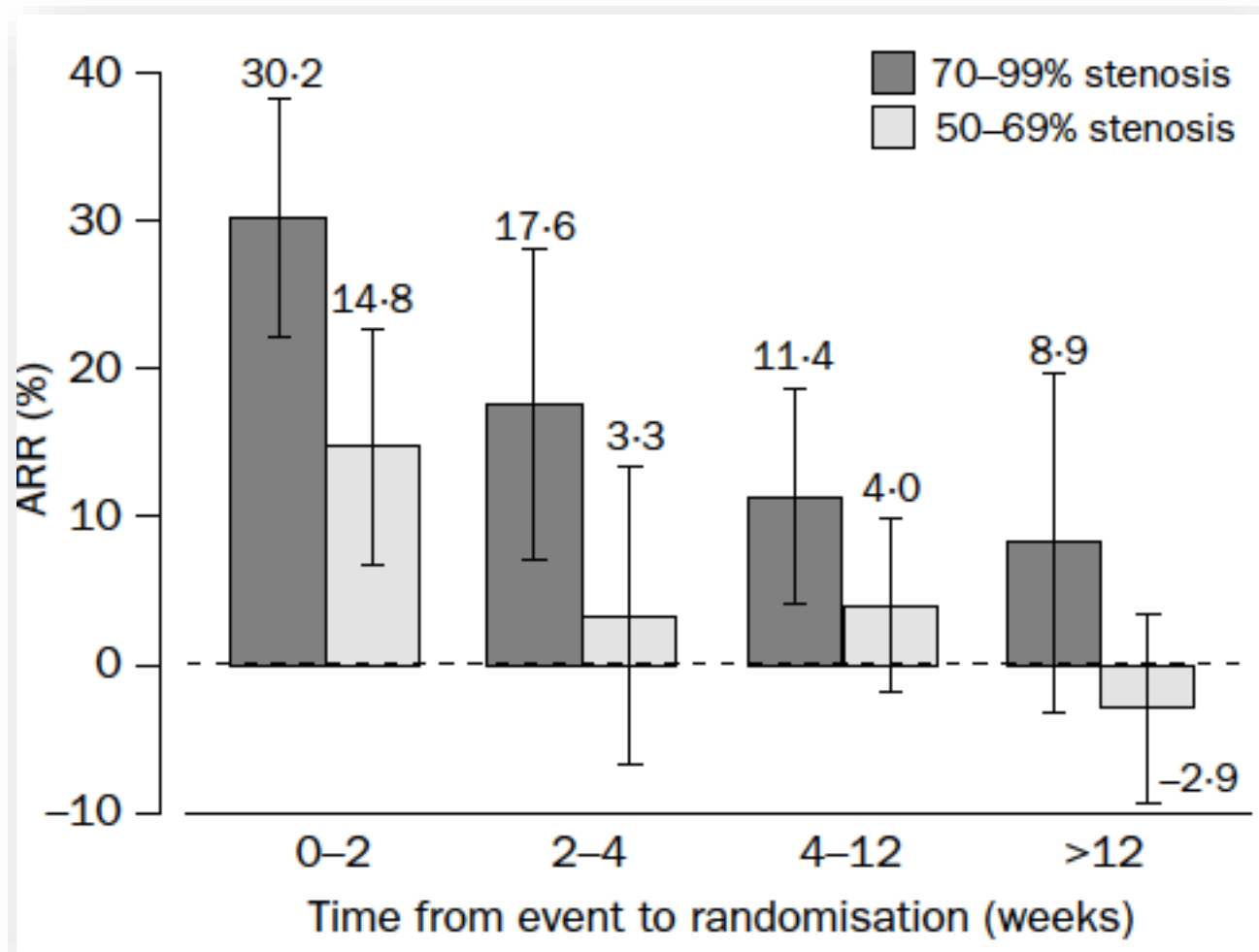
Natural History TIA/Minor Stroke

- Stroke recurrence after first symptoms¹
 - 6.4% days 2-3
 - 19.5% within 7 days
 - 26% within 14 days
- After TIA symptoms²
 - 50% incidence of second event is within 48 hours

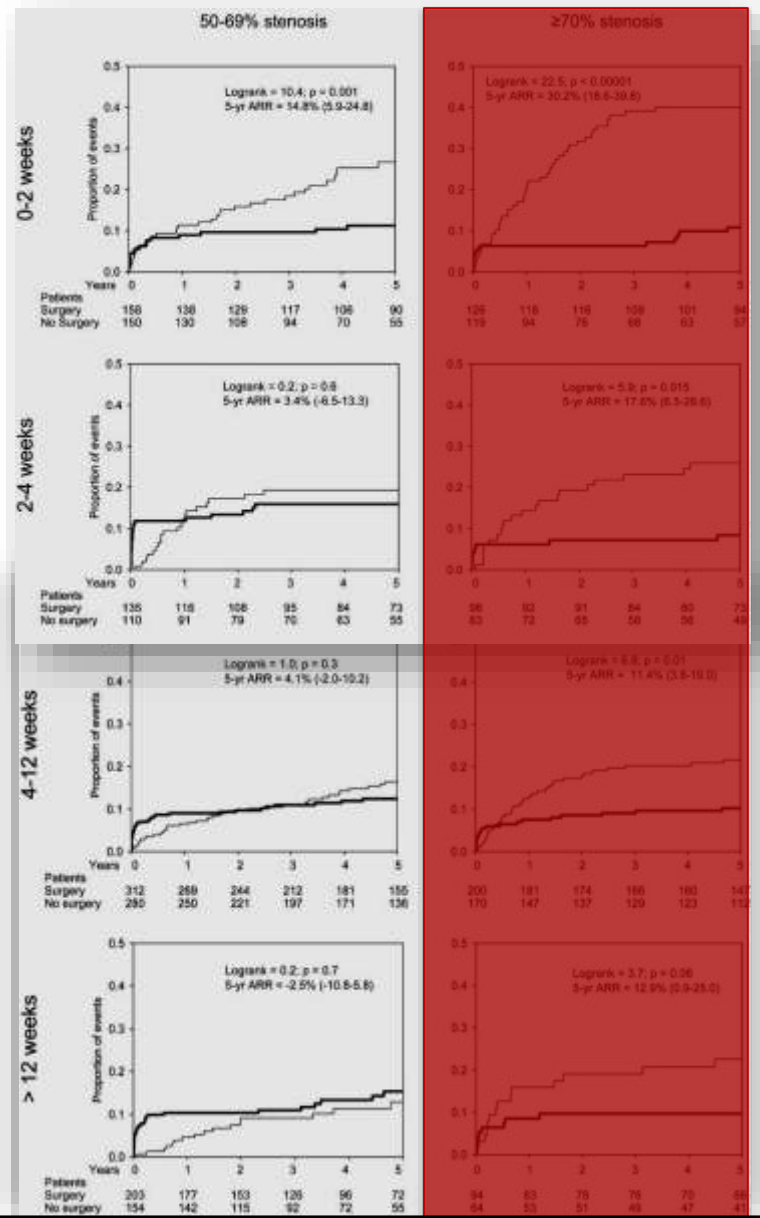
¹Tsantilas J Cardiovasc Surg 2015, 56:845

²Amarenco NEJM 2016 374(16):1533

NASCET data on timing of CEA



Benefit of CEA decreases with time from event



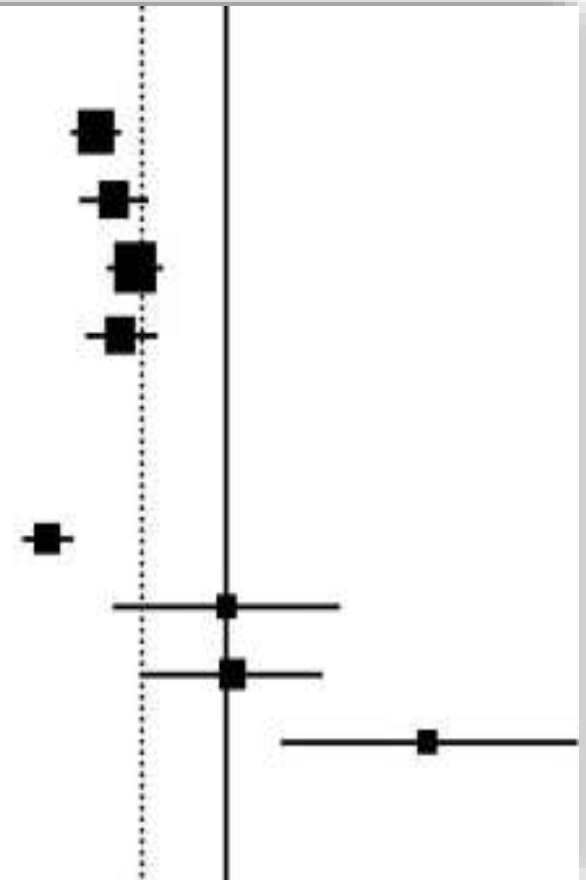
Effect of CEA timing especially pronounced in females

Time since last event: males

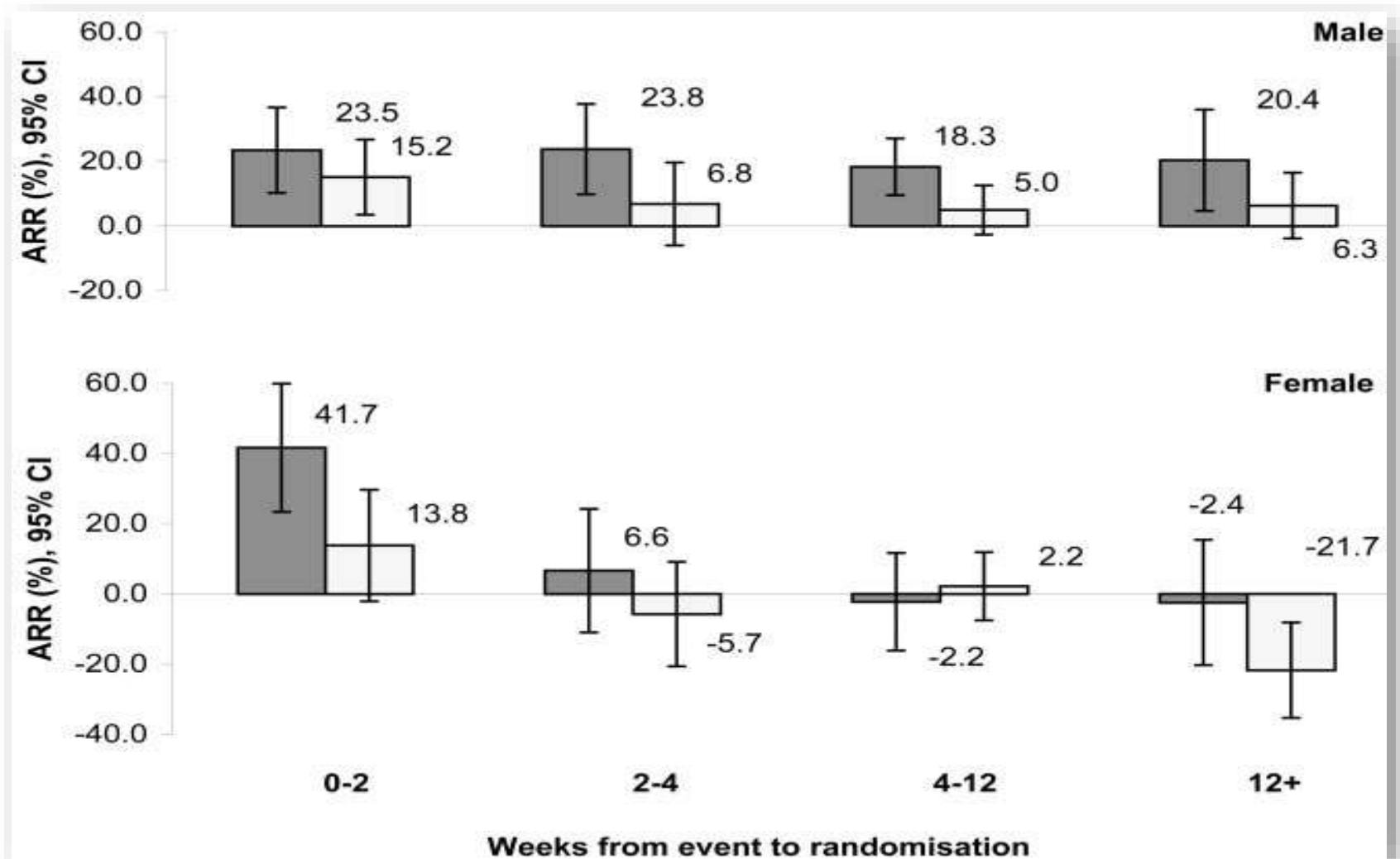
<2 weeks	20 / 178	52 / 185	0.39	0.33 - 0.47
2-4 weeks	16 / 139	33 / 136	0.45	0.35 - 0.58
4-12 weeks	37 / 365	60 / 317	0.52	0.43 - 0.64
>12 weeks	19 / 208	27 / 146	0.47	0.36 - 0.61

Time since last event: females

<2 weeks	10 / 106	28 / 84	0.28	0.23 - 0.33
2-4 weeks	13 / 94	8 / 57	1.00	0.44 - 2.26
4-12 weeks	19 / 147	16 / 133	1.04	0.54 - 1.99
>12 weeks	17 / 89	3 / 72	4.30	1.48 - 12.46



Sex, stenosis and time to CEA all influence benefit of CEA



AHA/ASA recommends CEA within 2 weeks of symptoms

AHA/ASA Guideline

Guidelines for Prevention of Stroke in Patients With Ischemic Stroke or Transient Ischemic Attack

A Statement for Healthcare Professionals From the American Heart Association/American Stroke Association Council on Stroke

Co-Sponsored by the Council on Cardiovascular Radiology and Intervention

The American Academy of Neurology affirms the value of this guideline.

Ralph L. Sacco, MD, MS, FAHA, FAAN, Chair; Robert Adams, MD, FAHA, Vice Chair;
Greg Albers, MD; Mark J. Alberts, MD, FAHA; Oscar Benavente, MD;
Karen Furie, MD, MPH, FAHA; Larry B. Goldstein, MD, FAHA, FAAN;
Philip Gorelick, MD, MPH, FAHA, FAAN; Jonathan Halperin, MD, FAHA;
Robert Harbaugh, MD, FACS, FAHA; S. Claiborne Johnston, MD, PhD; Irene Katzan, MD, FAHA;
Margaret Kelly-Hayes, RN, EdD, FAHA; Edgar J. Kenton, MD, FAHA, FAAN; Michael Marks, MD;
Lee H. Schwamm, MD, FAHA; Thomas Tomsick, MD, FAHA

Stroke. 2006;37:577-617.

The management of symptomatic carotid disease accelerates

- 2004: pooled analysis of trials suggested CEA for symptomatic bifurcation stenosis within two weeks
- 2006 AHA/ASA guidelines made formal recommendation
 - 2017 paper analyzing treatment trends from coded data:
 - Reduction in time to CEA from 25 days in 2005 to 6 days in 2013
 - CEA use increased from 40% in 2005 to 73% in 2013
- 2007 UK National Stroke Strategy recommends therapy for symptomatic ICA >70% within 48 hours of TIA or minor stroke

CEA outcomes with early surgery

- 2 single center studies showed no difference in risk of stroke or mortality related to timing of CEA after neurologic event
- 1 study showed increased periprocedural risk with early CEA
 - 11.5% within 48 hrs (Possible inclusion of crescendo/evolution)
 - 3.6% from 3-7 days
- German study, retrospective review
 - 56366 elective CEA for symptomatic ICA stenosis, grouped by days from event: I: 0-2 II: 3-7 III:8-14 IV: 15-180
 - In hospital: any stroke or death
 - I: 3.0% II: 2.5% III: 2.6% IV: 2.3%

Sharpe et al. 2013

Rantner 2015

(Stromberg et al. Swedvasc Registry. Stroke 2012)

Tsantilas et al. Stroke 2016; 47:2783

What about CAS, TCAR?

A Meta-analysis of the Risk of CAS Compared with CEA in Symptomatic Patients

Pooled data analysis from 3 randomized trials of CEA vs. CAS:
EVA-3S, SPACE, and ICSS.

Periprocedural Stroke or Death	CAS (n = 1,434)	CEA (n = 1,405)	Adjusted HR (95% CI)
Days from Symptoms			
≤ 7	9.4%	2.8%	3.4 (1.01-11.8)
8-14	8.1%	3.4%	2.7 (0.8-8.9)
>14	7.3%	4.0%	2.6 (0.8-8.0)

CREST: Outcomes by symptomatic status

	CAS	CEA	diff	HR	P value
Stroke end point (any stroke within periprocedural† period)					
All stroke end points					
Asymptomatic	15 (2.5±0.6)	8 (1.4±0.5)	1.2 (−0.4 to 2.7)	1.88 (0.79 to 4.42)	0.15
Symptomatic	37 (5.5±0.9)	21 (3.2±0.7)	2.3 (0.1 to 4.5)	1.74 (1.02 to 2.98)	0.043
Major stroke					
Asymptomatic	3 (0.5±0.3)	2 (0.3±0.2)	0.2 (−0.6 to 0.9)	1.50 (0.25 to 9.95)	0.66¶
Symptomatic	8 (1.2±0.4)	6 (0.9±0.4)	0.3 (−0.8 to 1.4)	1.32 (0.46 to 3.80)	0.61¶
Minor stroke					
Asymptomatic	12 (2.0±0.6)	6 (1.0±0.4)	1.0 (−0.4 to 2.4)	2.06 (0.77 to 5.51)	0.15
Symptomatic	29 (4.3±0.8)	15 (2.3±0.6)	2.0 (0.1 to 4.0)	1.91 (1.03 to 3.57)	0.042
Days from sx's to Rx:	36.3±39.6	40.9±42.9			

National Database Query

Nationwide Trends in Carotid Endarterectomy and Carotid Artery Stenting in the Post-CREST Era

Tyler S. Cole, MD; Andrew W. Mezher, BS; Joshua S. Catapano, MD; Jakub Godzik, MD; Jacob F. Baranoski, MD; Peter Nakaji, MD; Felipe C. Albuquerque, MD; Michael T. Lawton, MD; Andrew S. Little, MD; Andrew F. Ducruet, MD

Background and Purpose—The CREST (Carotid Revascularization Endarterectomy Versus Stenting Trial) demonstrated equivalent composite outcomes between carotid endarterectomy (CEA) and carotid artery stenting (CAS) for treating carotid stenosis. We investigated nationwide trends in these procedures and associated periprocedural stroke, myocardial infarction, death, cost, and readmission rates since CREST outcomes were published.

Methods—We queried the Nationwide Readmissions Database to identify patients undergoing CEA and CAS for asymptomatic and symptomatic carotid stenosis from 2010 to 2015. Patients were matched based on demographics, comorbidities, and severity of illness.

Results—In total, 378 354 CEA and 57 273 CAS patients were treated during this 6-year period. CEA volume decreased by an average of 2669 procedures annually ($P=0.001$) with stable CAS volume ($P=0.225$). After matching, CEA patients had a higher rate of periprocedural stroke than CAS patients, driven by increased stroke risk in symptomatic CEA patients (8.1% versus 5.6%; odds ratio, 1.47 [CI, 1.29–1.68]; $P<0.001$) but a lower rate of overall inpatient mortality (0.8% versus 1.4%; odds ratio, 0.57 [CI, 0.48–0.68]; $P<0.001$). CEA patients were less likely to be readmitted within 30 days (7.2% versus 8.0%; odds ratio, 0.90 [CI, 0.84–0.96]; $P=0.018$) and 90 days (12.3% versus 14.1%; odds ratio, 0.86 [CI, 0.81–0.90]; $P<0.001$), and mean hospital costs were lower for CEA compared with CAS (\$14 433 versus \$19 172; $P<0.001$).

Conclusions—The procedural treatment of carotid stenosis has changed dramatically in the post-CREST era. When matched for characteristics and illness severity, patients undergoing CEA had a higher rate of perioperative stroke than patients undergoing CAS, primarily among symptomatic patients. These findings are in contrast to the findings of CREST, which showed nearly twice the risk of stroke in CAS patients compared with CEA patients. CEA was associated with lower procedure cost and readmission rate. (*Stroke*. 2020;51:579-587. DOI: 10.1161/STROKEAHA.119.027388.)

Early carotid angioplasty and stenting may offer non-inferior treatment for symptomatic cases of carotid artery stenosis

Michael M Wach,^{1,2} Travis M Dumont,^{1,2} Maxim Mokin,^{1,2} Tareq Kass-Hout,^{3,4}
Kenneth V Snyder,^{1,2,3,5,6} L Nelson Hopkins,^{1,2,5,6,7} Elad I Levy,^{1,2,5,6}
Adnan H Siddiqui^{1,2,5,6}

- Retrospective single-center case series, 2009-2012, N=221
- Symptomatic carotid stenosis treated with CAS
- No significant difference in composite outcome of stroke/MI/death 30 days postop, stratified by timing of revascularization (overall 5%)
 - < 48h: 7.1%
 - Day 3-7: 4.5%
 - 1-2 weeks: 2.8%
 - 2-12 weeks: 3.7%

CAS in experienced hands shows no differential in outcomes by timing of Rx

- Higher mortality for CAS < 48h may be due to higher preoperative NIHSS (5.9 vs. 4.0, $p < 0.01$)
- CAS within 48h may provide non-inferior result compared with after 48h

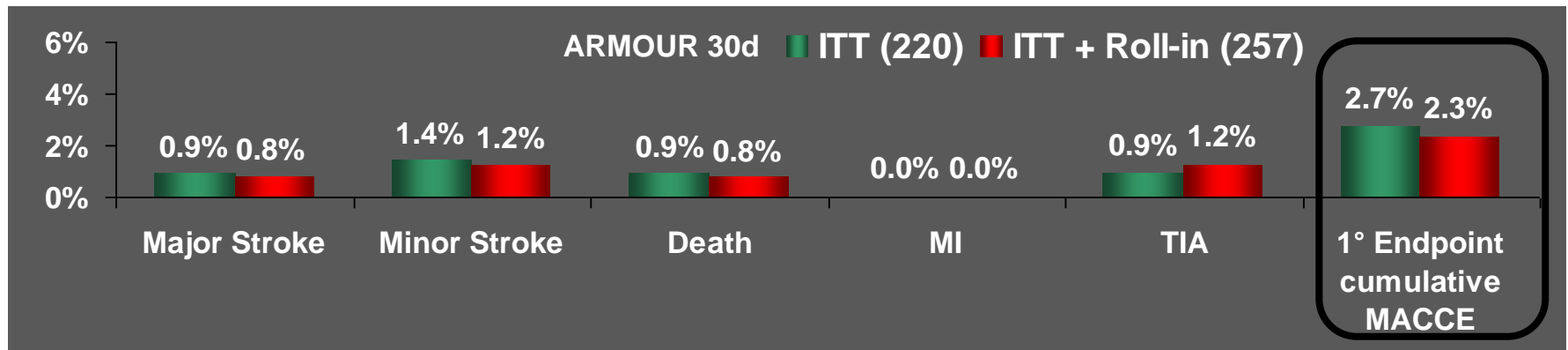
Table 4 Comparison of perioperative complication rates within and after 2 days*

	≤2 days	>2 days	p Value (Fisher exact test)
No of patients	70	151	
Hemorrhage	2 (2.9%)	2 (1.3%)	0.593
Ischemic stroke	1 (1.4%)	3 (2.0%)	1.000
MI	0 (0.0%)	1 (0.7%)	1.000
Death	3 (4.3%)	0 (0.0%)	0.031
Stroke/MI/death	5 (7.1%)	6 (4.0%)	0.331

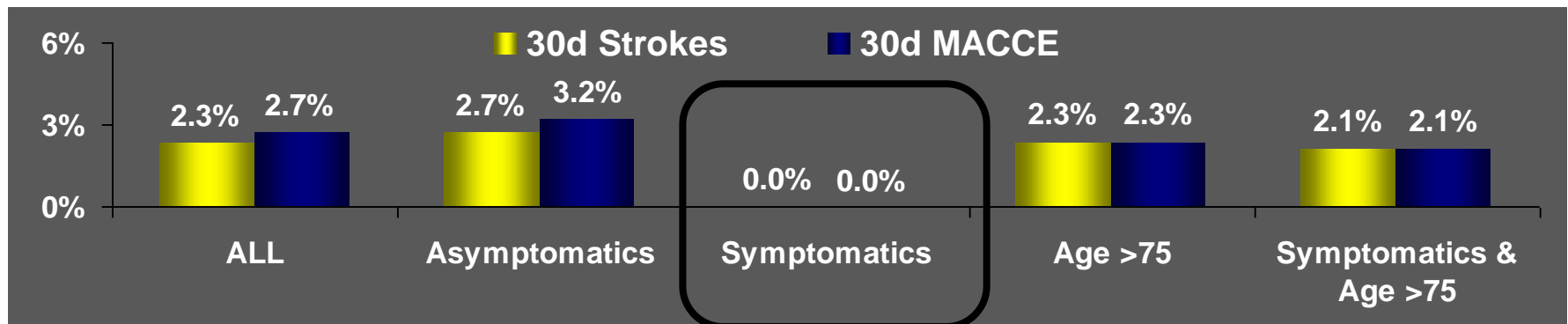
*Patients who died due to stroke or myocardial infarction (MI) complications were counted once in their respective stroke or MI category, once in their death category and only once in the combined category. Thus, the combined category is not simply the sum of all complication rates.

ARMOUR: Flow-arrest with compelling outcomes in symptomatic patients

30d Results (ITT & Full Population)



30d Results by Symptoms and Age (ITT)



No data on TCAR

Concluding Remarks

- Timing of carotid revascularization after symptom onset still a topic of debate
- Guidelines suggest CAS/CEA within 2 weeks
- Randomized controlled trial data are needed to assess:
 - specific timing (e.g. < 48h vs. > 48h-2wks)
 - Specific method of carotid revascularization (CEA vs. CAS vs. TCAR)

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