# CORONARY BYPASS SURGERY CAROTID ARTERY DISEASE AND STROKE

Jesse Weinberger, MD

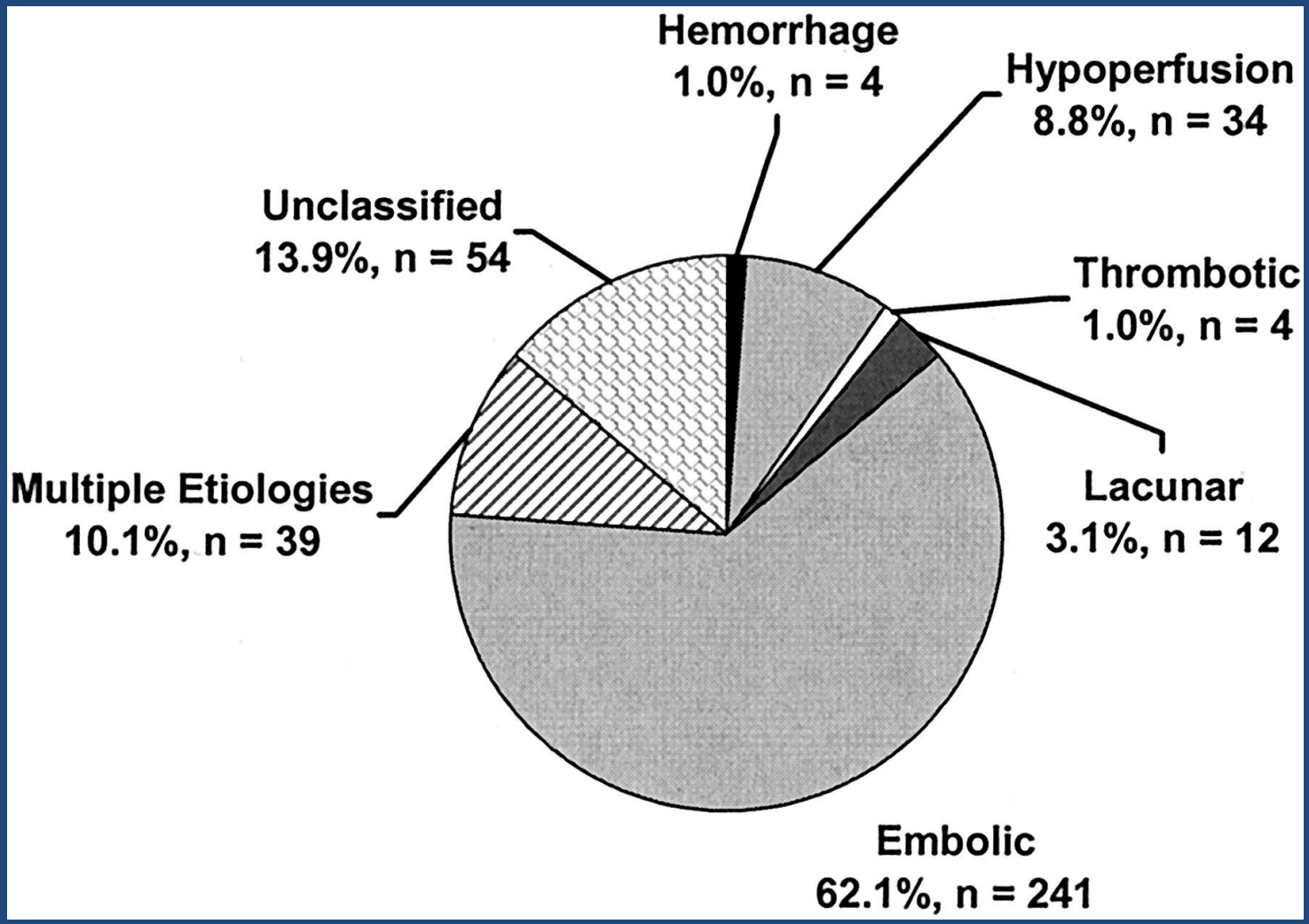
Icahn School of Medicine at Mount Sinai

# Disclosure Statement of Financial Interest

Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

| Affiliation/Financial Relationship | Company |
| --- | --- |
| • Consulting Fees/Honoraria | • Novartis<br>• Boehringer Ingelheim |

## Figure 1. Classification of stroke mechanism.




Likosky D S et al. Stroke 2003;34:2830-2834

# Carotid Artery Disease and CABG

Naylor et al Eur J Vasc and Endovasc Surg 2002;23:283

- Review Coronary Bypass Surgery 1970-2000
- Overall Stroke Rate 2.0% 36,797 CABG's, 38.3% 24 hours.
- Risk Stroke < 50% stenosis 2.0% (CI 1.7-2.3)
- Risk Stroke 50-100% 8.4% (CI 6.0-10.7)
- Risk of Ipsilateral Stroke
- <50% stenosis 78/8142 (1%) 50-99% 6/256 (2.3%) Occlusion 7/63 (11%)

# C
# Carotid Endarterectomy and CABG

Naylor et al Eur J Vasc Endovasc Surg 2003;25:380

- Review of 97 studies, 8972 Carotid Ops
- CEA + CABG
  Death 4.6%(4.1-5.2) Stroke 4.6%(CI 3.9-5.4) MI 3.6(3.0-4.2)
- CABG then CEA
  Death 2.0%(0.0-6.1) Stroke 6.3%(CI 1.0-11.7) MI 0.9(0.5-1.4)
  CEA then CABG
  Death 3.9%(1.1-6.7) Stroke 2.7%(CI 1.6-3.9) MI 6.5(3.2-9.7)

# Carotid Artery Disease and CABG

Naylor et al Eur J Vasc and Endovasc Surg 2002;23:283

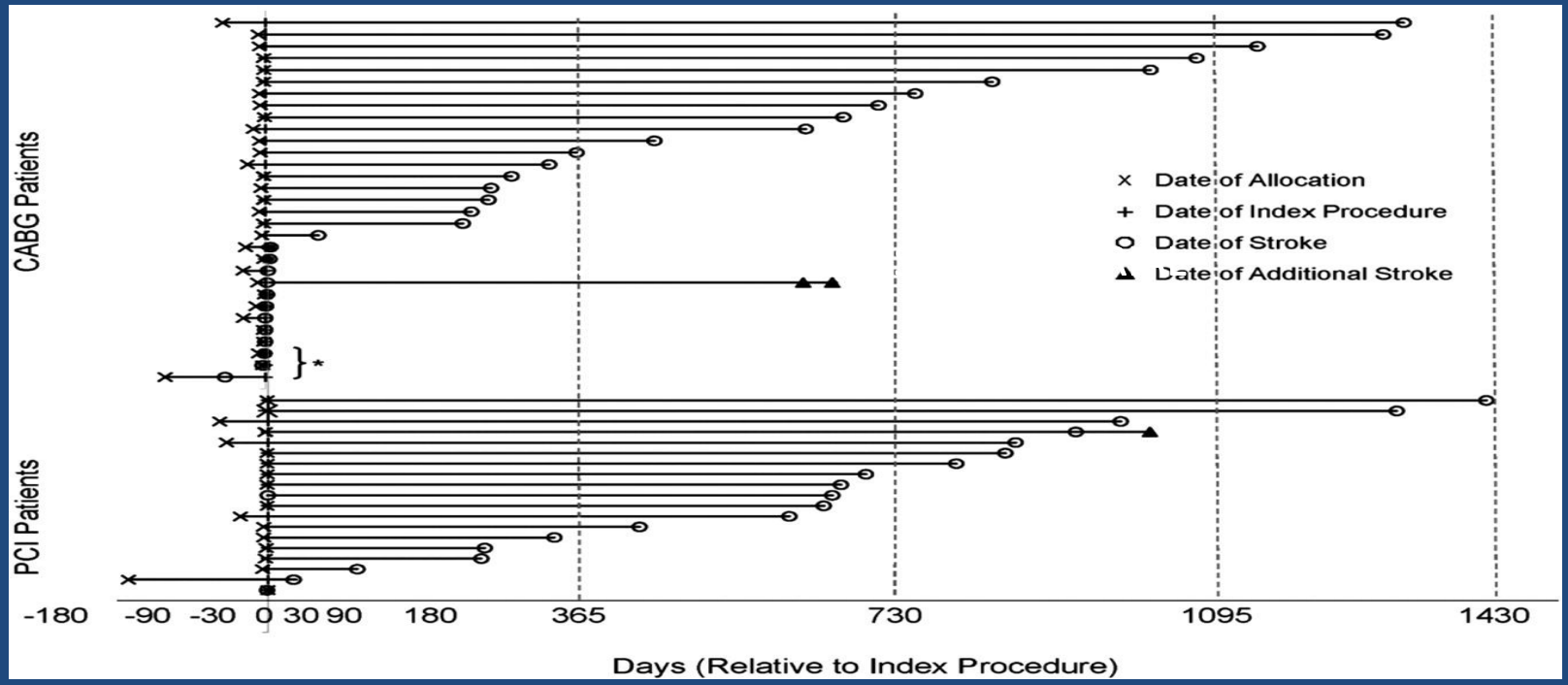
- 6.8% (4.3-9.2) of 9939 patients in 8 studies of coronary bypass had prior TIA/CVA
- Peri-operative Stroke Rate during CABGwith prior TIA/CVA 8.5% (4.9-12.0), without prior TIA/CVA 2.2% (1.9-3.1).
- (Extent of carotid artery disease not included in this data.)

# Risk of Stroke CABG and Carotid Stenosis

Furlan etal Stroke 1985;16:797-799

| Carotid stenosis | N | ipsilat stroke: | intraop | postop | total |
|---|---|---|---|---|---|
| 50-99% | 90 | | 1 | | 1(1.1%) |
| >90% | 16 | | | 1 | 1(6.2%) |
| occluded | 49 | | 1 | | 1(2.0%) |
| Total | 155 | | | | 3 (2.0%) |

# Analysis of Stroke Occurring in the SYNTAX Trial Comparing Coronary Artery Bypass Surgery and Percutaneous Coronary Intervention in the Treatment of Complex Coronary Artery Disease




JACC: Cardiovascular Interventions Volume 6, Issue 4 2013 344 - 354

**Analysis of Stroke Occurring in the SYNTAX Trial Comparing Coronary Artery Bypass Surgery and Percutaneous Coronary Intervention in the Treatment of Complex Coronary Artery Disease**

30 DAY STROKE CABG 9

30 DAY STROKE PCI 2

CAROTID STENOSIS CABG 8.4%

CAROTID STENOSIS PCI 8.1%

NO CORRELATION

# Table 1

***Table 1*** *Cohort demographics*

| | CEA (n = 178,959) | CABG (n = 471,881) | CEA and CABG: Same day (n = 1,230) | CEA and CABG: Spacing unknown (n = 5,807) | *p* |
|---|---|---|---|---|---|
| Age, mean ± SD, years | 69.1 ± 11.4 | 64.8 ± 12.2 | 70.3 ± 8.5 | 68.0 ± 11.5 | <0.0001* |
| Female, % | 45.4 | 35.6 | 33.9 | 38.5 | <0.0001† |
| Hospital size, % | | | | | <0.0001† |
| Small | 8.7 | 5.4 | 5.8 | 5.4 | |
| Medium | 26.8 | 22.8 | 19.2 | 22.0 | |
| Large | 64.5 | 71.8 | 75.0 | 72.6 | |
| Hospital location and teaching status, % | | | | | <0.0001† |
| Rural | 9.2 | 2.7 | 2.5 | 2.6 | |
| Urban, nonteaching | 54.7 | 43.9 | 37.3 | 45.4 | |
| Urban, teaching | 36.1 | 53.4 | 60.2 | 52.1 | |
| Duration of stay, mean ± SD, days | 4.0 ± 5.6 | 8.8 ± 9.2 | 12.1 ± 10.1 | 11.8 ± 12.3 | <0.0001* |
| Died in hospital, % | 1.3 | 3.4 | 4.7 | 5.8 | <0.0001† |
| Postoperative CVA, % | 1.3 | 1.4 | 5.4 | 4.8 | <0.0001† |
| Death or postoperative CVA, % | 2.48 | 4.52 | 9.65 | 9.73 | |

* Wilcoxon rank sum.
† Chi-square.

CEA = carotid endarterectomy; CABG = coronary artery bypass graft surgery; CVA = cerebrovascular accident.

**Mortality from combined carotid endarterectomy and coronary artery bypass surgery in the US.**

Dubinsky, Richard; MD, MPH; Lai, Sue; Min PhD, MBA

Neurology. 68(3):195-197, January 16, 2007.
DOI: 10.1212/01.wnl.0000250328.74755.5f

Table 1 Cohort demographics

# Table 2

***Table 2*** *Logistic regression model for combined outcomes of death or postoperative stroke*

| Effect | Comparison | Slope estimate | Odds Ratio | 95% CI | *p* |
|---|---|---|---|---|---|
| Combined CEA–CABG | CABG only | 0.4510 | 1.38 | 1.27–1.50 | <0.0001 |
| CEA only | CABG only | −0.5794 | 0.49 | 0.48–0.51 | <0.0001 |
| Female | Male | −0.081 | 0.85 | 0.83–0.88 | <0.0001 |
| Age > 65 years | Age ≤ 65 years | 0.4019 | 2.34 | 2.17–2.30 | <0.0001 |
| Urban, teaching hospital | Rural | 0.0484 | 1.09 | 1.02–1.16 | 0.0002 |
| Urban, nonteaching hospital | Rural | −0.0134 | 1.02 | 0.96–1.09 | 0.3026 |
| Charlson | | 0.3488 | 1.42 | 1.41–1.43 | <0.0001 |

CEA = carotid endarterectomy; CABG = coronary artery bypass graft surgery.

**Mortality from combined carotid endarterectomy and coronary artery bypass surgery in the US.**

Dubinsky, Richard; MD, MPH; Lai, Sue; Min PhD, MBA

Neurology. 68(3):195-197, January 16, 2007.
DOI: 10.1212/01.wnl.0000250328.74755.5f

Table 2 Logistic regression model for combined outcomes of death or postoperative stroke

From: **Strokes After Cardiac Surgery and Relationship to Carotid Stenosis**

Arch Neurol. 2009;66(9):1091-1096. doi:10.1001/archneurol.2009.114

**Table 3. Significant Carotid Stenosis and Stroke in 3942 Patients Undergoing Preoperative Carotid Evaluation**

| Degree of Carotid Stenosis | No. of Patients | No. (%) of Patients With Stroke |
|---|---|---|
| ≥50% | 239 | 18 (7.5) |
| 50%-79% | 123 | 6 (4.9) |
| ≥80%, Nonocclusive | 71 | 5 (7.0) |
| Occlusion | 45 | 7 (15.6) |

**Figure Legend:**

Significant Carotid Stenosis and Stroke in 3942 Patients Undergoing Preoperative Carotid Evaluation

From: **Strokes After Cardiac Surgery and Relationship to Carotid Stenosis**

Arch Neurol. 2009;66(9):1091-1096. doi:10.1001/archneurol.2009.114

**Table 2. Distribution of Postoperative Stroke in Patients With Significant Carotid Stenosis**

| Category | No. of Patients |
|---|---|
| No. of patients with ≥50% stenosis and postoperative stroke | 18 |
| Strokes in stenotic/occluded artery | 4 |
| Stenotic[a] | 1 |
| Occluded | 3 |
| Strokes outside the stenotic/occluded artery | 14 |
| Contralateral | 3 |
| Posterior circulation | 10 |
| Watershed | 1 |

[a] Patient had an ipsilateral 60% stenosis.

**Figure Legend:**

Distribution of Postoperative Stroke in Patients With Significant Carotid Stenosis

From: **Strokes After Cardiac Surgery and Relationship to Carotid Stenosis**

Arch Neurol. 2009;66(9):1091-1096. doi:10.1001/archneurol.2009.114

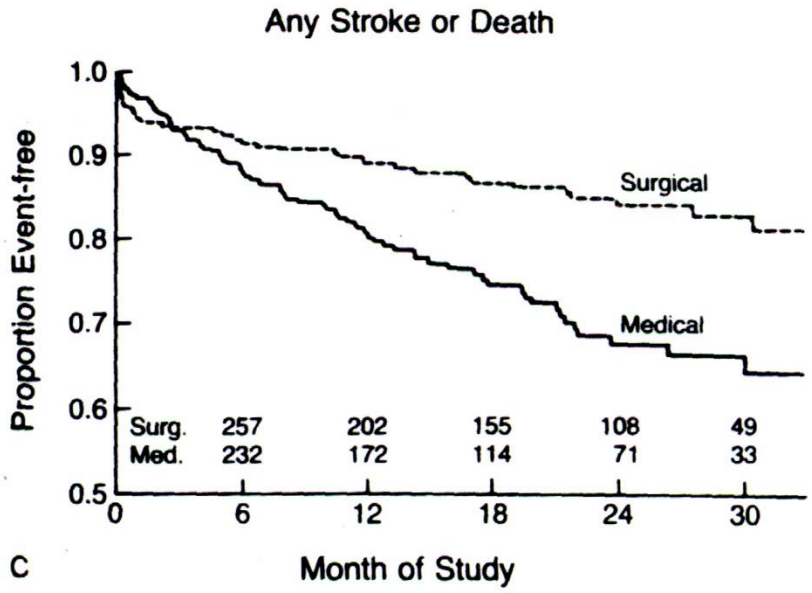
**Table 4. Incidence of Postoperative Stroke by Categories of Carotid Intervention**

| Intervention Type | No. of Patients | No. (%) of 9 Patients With Stroke |
|---|---|---|
| Combined CE and cardiac operation | 53 | 8 (15) |
| Staged CE, then cardiac operation | 16 | 0 |
| Carotid stenting, then cardiac operation | 5 | 1 (20) |
| Stenosis, nonocclusive, no intervention | | |
| ≥80% | 16 | 0 |
| ≥70% | 51 | 0 |

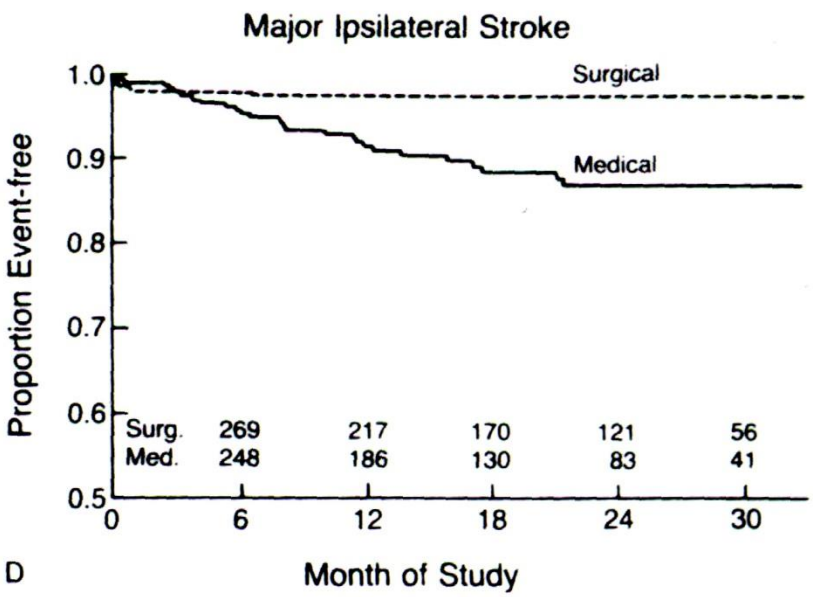
Abbreviation: CE, carotid endarterectomy.

**Figure Legend:**

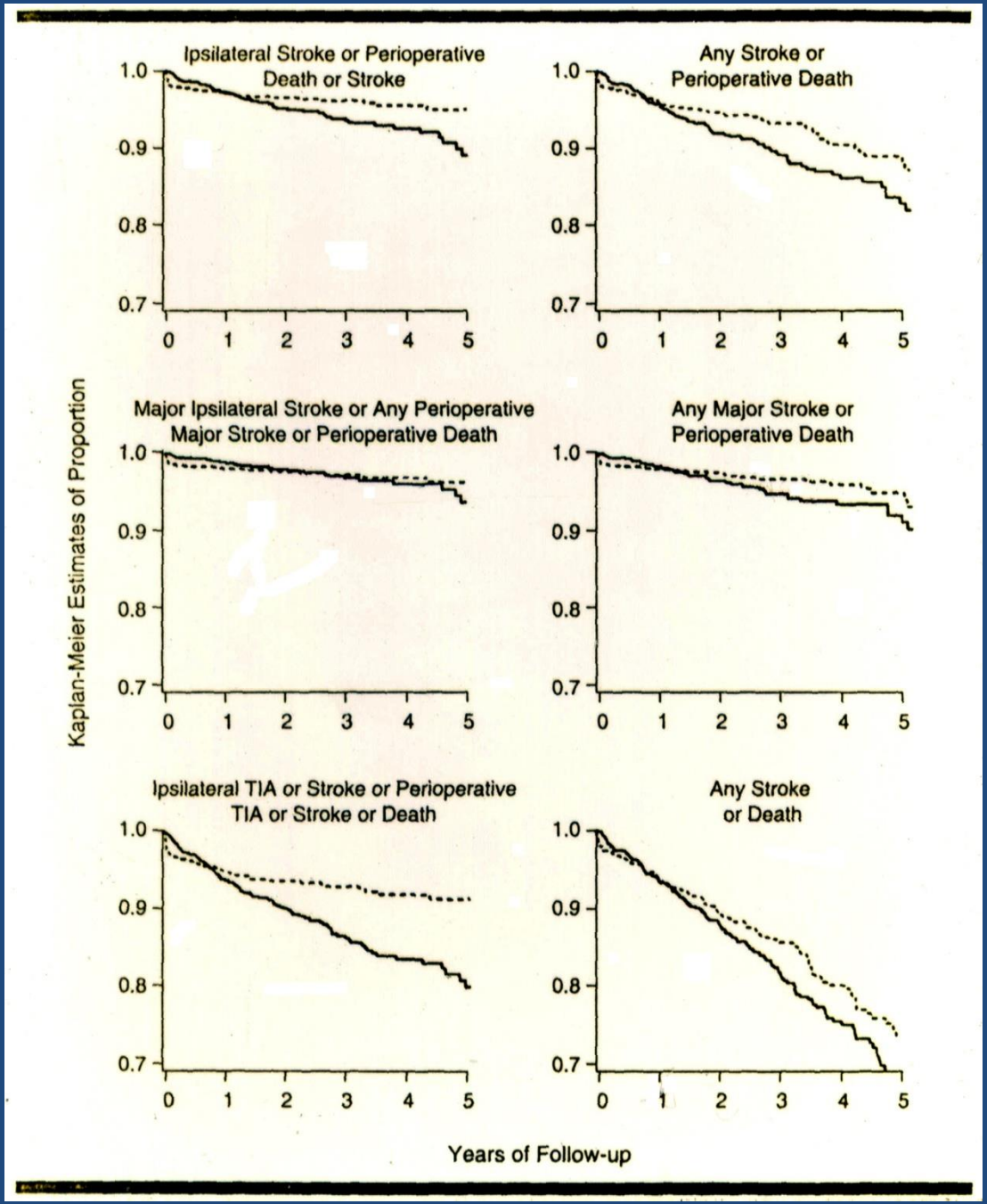
Incidence of Postoperative Stroke by Categories of Carotid Intervention


Any Stroke or Death
Proportion Event-free
1.0
0.9
0.8
0.7
0.6
0.5
Surgical
Medical
Surg. 257 202 155 108 49
Med. 232 172 114 71 33
0 6 12 18 24 30
Month of Study

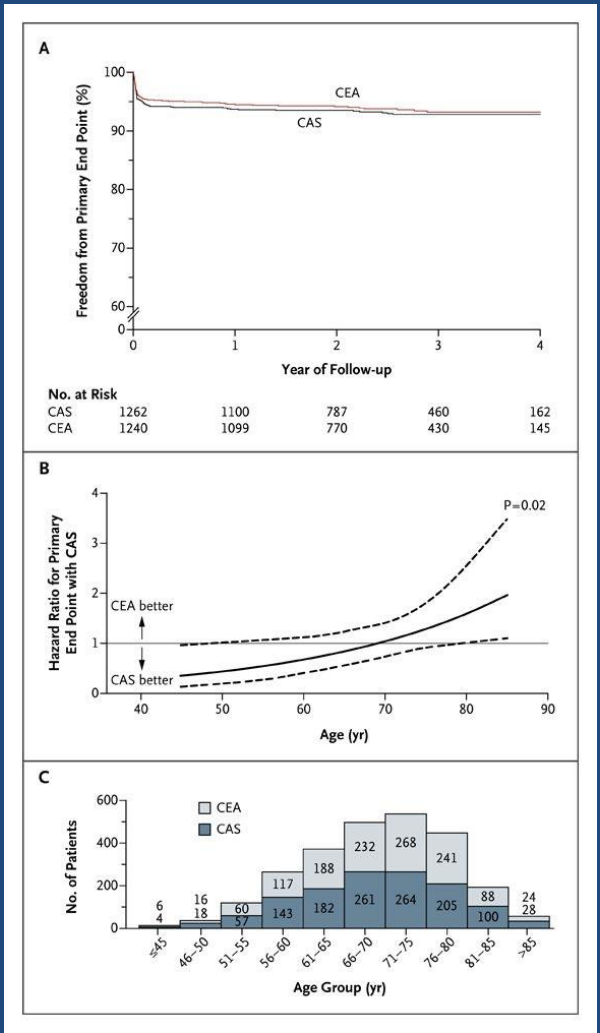
C


Major Ipsilateral Stroke
Proportion Event-free
1.0
0.9
0.8
0.7
0.6
0.5
Surgical
Medical
Surg. 269 217 170 121 56
Med. 248 186 130 83 41
0 6 12 18 24 30
Month of Study

D


Ipsilateral Stroke or Perioperative Death or Stroke
Any Stroke or Perioperative Death
Major Ipsilateral Stroke or Any Perioperative Major Stroke or Perioperative Death
Any Major Stroke or Perioperative Death
Ipsilateral TIA or Stroke or Perioperative TIA or Stroke or Death
Any Stroke or Death
Kaplan-Meier Estimates of Proportion
1.0
0.9
0.8
0.7
0
1
2
3
4
5
Years of Follow-up

# Primary End Point, According to Treatment Group




Brott TG et al. N Engl J Med 2010;363:11-23