

# Comparative Cost Effectiveness for Carotid Interventions

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## Disclosures

No Financial Disclosures

### Revolution in Carotid Revascularization: CEA to CAS to TCAR

- Carotid endarterectomy (CEA) has been the gold standard for carotid revascularization
- Transfemoral carotid angioplasty stenting (CAS) challenged this when it was approved by FDA
  - Many studies have suggested that CAS has worse neurological outcomes
- Transcarotid artery revascularization (TCAR) was introduced as an alternative

#### Transcarotid Artery Revascularization (TCAR) vs. Carotid Endarterectomy (CEA)

Subacute, retrospective, propensity matched controlled study (500 TCARs, 262 CEAs)

|                       |      |      |
|-----------------------|------|------|
| 30 day Stroke & Death | 1.4% | 1.0% |
| 1 year Stroke & Death | 4.0% | 6.7% |
| Cranial nerve injury  | 0.3% | 3.1% |

*Kashyap et al. J Vasc Surg July 2019*

#### Trans-Carotid (TCAR) vs. Trans-Femoral (TFCAS) Carotid Artery Stenting

SYS VQI TCAR Surveillance Project (538 TCARs vs. 10356 TFCAS)

|                              |      |      |
|------------------------------|------|------|
| Stroke/TIA                   | 1.9% | 3.3% |
| In hospital stroke/TIA death | 2.2% | 3.8% |

*Malas et al. J Vasc Surg January 2019*

### CEA vs. CAS: "Costs"- Initial Observations

- Outcomes were worse for CAS
- CEA was less costly
- CEA was "more cost effective"

*Estlini MH et al. National Trends in Utilization and Post-procedure Outcomes for Carotid Artery Revascularization. J Vasc Surgery 2011; 53:807-15*

### Introduction: Mathematical Models and Economic Analyses

- Ideally a rigorous t-Test would be used to answer all statistical questions which is often not possible
- Researches are trying to gap the missing data by a creating mathematical model is needed:
  - Decision tree model
  - Markov model
  - Monte Carlo model
- Sensitivity Analyses are to be performed to find out which variables in the model drive the results
  - What are the most important variables and how they affect the data?
- Identifying the "dominant" treatment

\*\*\*Meltzer MA. Introduction to health economics for physicians. The LANCET 2001; 358: 993-98

### CEA vs. CAS: CEA is More Costs Effectiveness

Using CREST data: The probability that CEA was "economically attractive" at this threshold (\$50,000/QALY) was 54.4%.  
**CEA was dominant in 34.2%**  
**CAS was dominant in only 6.2%**

*\*CAS was dominant in only 5.4% symptomatic theoretical probabilistic analyses vs. 37.6% for CEA*

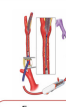
- The study used lower than average cost outside of the study
- Centers were chosen for their excellence i.e. results may not be replicated outside of the trials

Costs and Cost Effectiveness of Carotid Stenting versus Endarterectomy for Patients at Standard Surgical Risk. Results from the Carotid Revascularization Endarterectomy versus Stenting Trial (CREST). J Vasc Med Biol 2011; 23(4): 211-21. doi:10.1177/1049649111411111

### TCAR vs. CEA


#### Cost-Effectiveness of TransCarotid Artery Revascularization (TCAR) versus Carotid Endarterectomy (CEA)

Multicenter prospective study using a Markov microsimulation model for symptomatic carotid patients



**TCAR**

5-year cost: \$19,154  
for 2.92 Quality Adjusted Life Years (QALY)



**CEA**

5-year cost: \$7,821  
for 2.85 Quality Adjusted Life Years (QALY)

- 5-year costs for TCAR were greater, but it afforded **greater QALY**.
- ICER (Incremental Cost Effectiveness Ratio) was **\$152,229/QALY** for TCAR compared to CEA.
- TCAR was cost effective in 49% and became cost-effective at 6 years.

Study suggested CEA to be more cost-effective in the first 5 years after follow-up; TCAR becomes more cost-effective at 6 years.

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Cui et al. *J Vasc Surg* December 2021  
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### TCAR vs. CEA vs. CAS\*

|       | Total cost | Total QALY | ICER (\$/QALY) |
|-------|------------|------------|----------------|
| CEA   | 228,933    | 9.79       | -              |
| TCAR  | 233,763    | 9.82       | +160,642       |
| TFCAS | 234,373    | 9.80       | Dominated      |

TCAR cost \$160,642/QALY gained > our willingness to pay threshold (\$100,000/QALY)

Carotid endarterectomy remains cost-effective for the surgical management of carotid stenosis. Natalie D. Sridharan, MD, MS,\* Rabih A. Chaer, MD, MS,\* Kenneth Smith, MD, MS,\* and Mohammad H. Estemi, MD,\* Pittsburgh, Pa  
J Vasc Surg 2022;75:1304-10

### TCAR vs. CEA vs. CAS\*

| Parameter                             | Base Value |
|---------------------------------------|------------|
| Risk of perioperative stroke for TCAR | 1.4%       |
| Risk of perioperative stroke for CAS  | 2.4%       |
| Procedural cost of TCAR               | \$15,182   |

CEA is favored

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### TCAR vs. CEA vs. CAS\*

| Parameter                             | Base Value | Threshold Value |
|---------------------------------------|------------|-----------------|
| Risk of perioperative stroke for TCAR | 1.4%       | 0.9%            |
| Risk of perioperative stroke for CAS  | 2.4%       | 1.1%            |
| Procedural cost of TCAR               | \$15,182   | \$12,996        |

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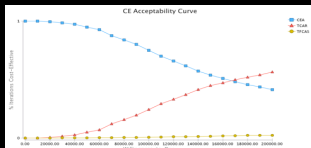
### TCAR vs. CEA vs. CAS\*

| Parameter                             | Base Value | Threshold Value | New Favored Strategy |
|---------------------------------------|------------|-----------------|----------------------|
| Risk of perioperative stroke for TCAR | 1.4%       | 0.9%            | TCAR                 |
| Risk of perioperative stroke for CAS  | 2.4%       | 1.1%            | TFCAS                |
| Procedural cost of TCAR               | \$15,182   | \$12,996        | TCAR                 |

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### TCAR vs. CEA vs. CAS\*

#### Results – Probabilistic Sensitivity Analysis



CEA was favored in 75.6% of model iterations at \$100,000/QALY, with TCAR favored in 23.9%; CAS in <1%

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## Conclusions

- Carotid endarterectomy remains the most cost-effective strategy for carotid revascularization
- TCAR *does not* meet a *traditional* cost-effectiveness threshold (\$100,000/QALY) to replace CEA as the primary treatment modality for carotid stenosis
  - *TCAR can become economically more cost-effective if*
    - *Equipment cost is reduced,*
    - *Its 30-day outcomes become significantly better than CEA*

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