Disclosures

• No financial disclosures
• Willing to consider any and all offers
The amount written about a subject is inversely proportional to what is actually known about that subject.
“JUST THE FACTS”
What do we know about carotid endarterectomy?
Carotid Endarterectomy

- Robb and Eastcott
- DeBakey
Reconstruction of internal carotid artery in a patient with intermittent attacks of hemiplegia

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In 1914 Ramsey Hunt described the syndrome of internal carotid occlusion and prefaced his paper with the following observations:

“The object of the present study is to emphasise the importance of obstructive lesions of the main arteries of the neck, in the causation of softening of the brain, and more especially to urge the routine examination of these vessels in all cases presenting cerebral symptoms of vascular origin. In other words, the writer would advocate the same attitude of mind towards this group of cases as towards intermittent claudication, gangrene, and other vascular symptoms of the extremities, and never omit a detailed examination of the main arterial stem.”
Cerebral Arterial Insufficiency:
One to 11-Year Results Following Arterial
Reconstructive Operation

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Cerebrovascular insufficiency constitutes a problem of considerable magnitude
in terms of both death and disability. At least two million people now alive in the
United States are victims of this condition and that it ranks third as a cause of death in
this country. Studies of the natural course of the disease in patients in whom the diag-
nosis was made clinically without arteriography reveal that death occurs within 5
years after onset in 50 per cent of the patients, with 21 per cent dying during the
initial attack. \(^1\) Survival studies of patients with extracranial carotid artery occlusion
proved by arteriography suggest a similarly grave prognosis. \(^4\) Reports of collabora-
tive studies of patients randomized into a control group receiving no treatment and a
group receiving treatment with anticoagulants indicate that the latter form of therapy
does not significantly alter the course of the disease, particularly as it affects sur-
vival. \(^5\)

During the past decade—and as a consequence of surgical experience, more fre-
cuent use of arteriography and more intensive investigations—a much better understand-
ing of this problem has been obtained. It is now known, for example, that

\(^*\) Presented at the Southern Surgical Association, Dec. 8-9, 1964, Boca Raton, Fla.
Supported in part by PHS Grants HE-03127,
HE-04763 and HE-05435.

the disease tends to assume certain characteristic and recognizable pathologic, anat-
one and clinical patterns of involvement. Most frequent are those resulting from well
localized occlusive lesions in the extracranial arterial bed which are amenable to
surgical treatment. About three fourths of patients with extracranial occlusions have
forewarning symptoms. Early recognition of these manifestations—along with precise
diagnosis by means of arteriography demonstrating the presence of an occlusive les-
ion in the extracranial arterial bed, followed by application of surgical treatment
—may not only relieve the symptoms of cerebral ischemia but also prevent the de-
development of a subsequent stroke. It is thus apparent that surgical therapy constitutes
an effective approach to this problem in a significantly high proportion of these
patients.

Clinical Material

Our own experience with this surgical approach, beginning with the performance of
our first operation for correction of an extracranial arterial occlusion causing cere-
brovascular insufficiency on August 7, 1953, now extends for more than 11 years. During
this period we have employed some form of arterial reconstructive operation in the
treatment of 1,155 patients with cerebrovascular insufficiency produced by extra-
Carotid Endarterectomy (NASCET, 1991)

- Level 1 evidence
- Unequivocal benefit of surgery over best medical management in patients with >70% stenosis of the carotid artery (definition of best medical care)
- Symptomatic
NASCET

Stroke rate w/o CEA  Stroke rate w/ CEA

26%  9%
<table>
<thead>
<tr>
<th></th>
<th>w/o CEA</th>
<th>w/CEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major stroke and death</td>
<td>13.1%</td>
<td>2.5%</td>
</tr>
</tbody>
</table>
Carotid Endarterectomy (ACAS)

- Level 1 evidence
- Unequivocal (but small) benefit of carotid endarterectomy over best medical therapy in patients with >60% carotid stenosis
- Asymptomatic patients
ACAS

• Risk of stroke without surgery – 2%/year

• Risk of stroke with surgery – 1%/year
Advantages of CEA

• Predictable results
• “Permanent” treatment
• Less risk of perioperative neurologic events
• Less incidence of recurrent stenosis
Disadvantages of CEA

• Incision and scar
• Cranial nerve injuries
• Medical limitations
• Anatomic limitations
Risks of CEA

- Infection
- Bleeding
- Injury to the cranial nerves
- Change in voice
- Stroke
- Death
What do we know about carotid artery stenting?
• More after CREST I
• Still not alot
Carotid Embolic Protection Device and Stent Deployment
CAS

- First performed in the 1980’s
- All but one of the studies and trials sponsored by industry
- Conflicting and confusing data from studies completed (What is high risk?)
  (true incidence of neurologic event, major and minor strokes)
Advantages of CAS

- Less invasive (but still invasive)
- Decrease incidence of cranial nerve injury
- Cosmetic benefits
- Treatment of medically compromised patients
Disadvantages of CAS

• Increased incidence of post procedure neurologic complications
• Increased incidence of recurrent stenosis
• Cardiac complications
• Presently no comparisons to medical therapy alone
Criteria for carotid stenosis

- PSV > 250 cm/s = > 70% stenosis
- ICA/CCA = >3.5 - 4
Criteria for recurrent in-stent stenosis

- PSV > 350 cm/s = > 70% stenosis
- ICA/CCA = > 4.75
Disadvantages of CAS

- Anatomic limitations
- Operator biases
How to evaluate trials and studies

- Symptomatic versus asymptomatic
- Patients greater than 80 years of age
- Size of study
  - excess of 1000 patients
  - to show 1% improvement in a device would need over 5,000 patients
How to evaluate trials and studies

• Prospective versus retrospective
• Standardization of training and experience of interventionalists participating in study
• Independent neurologic evaluation of patients in the study
• Use of cerebral protection devices
CREST I

• Prospective randomized equivalency trial
• Only NIH sponsored trial
Study Design

- Prospective, multicenter, randomized, controlled trial with blinded endpoint adjudication

- Comparing CEA and CAS in participants with symptomatic and asymptomatic stenosis

- 108 US and 9 Canadian sites

- Team included neurologist, interventionalist, surgeon, and research coordinator at each center
Primary Endpoint

- Peri-procedural
  a composite of:
  - any Clinical Stroke
  - Myocardial infarction
  - Death

- Post-procedural
  - Ipsilateral stroke up to 4 years
Myocardial Infarction (MI)

- Combination
  - Elevation of cardiac enzymes (CK-MB or troponin) to a value 2 or more times the individual clinical center's laboratory upper limit of normal. **Plus**
  - Chest pain or equivalent symptoms consistent with myocardial ischemia, or, ECG evidence of ischemia including new ST segment depression or elevation > 1mm in 2 or more contiguous leads

- Not enzyme-only

- Adjudicated by two cardiologists blinded to treatment
# Peri-procedural Stroke and MI

## Comparison of CAS vs. CEA

<table>
<thead>
<tr>
<th></th>
<th>Hazard Ratio 95% CI</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stroke</strong></td>
<td>HR = 1.79; 95% CI: 1.14-2.82</td>
<td>0.01</td>
</tr>
<tr>
<td>CAS</td>
<td>4.1% vs. 2.3%</td>
<td></td>
</tr>
<tr>
<td><strong>MI</strong></td>
<td>HR = 0.50; 95% CI: 0.26-0.94</td>
<td>0.03</td>
</tr>
<tr>
<td>CEA</td>
<td>1.1% vs. 2.3%</td>
<td></td>
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</table>
CREST–2 Parallel Study Design

(n = 1,240 in each trial)

CAS + Medical
n = 620

Medical
n = 620

CEA + Medical
n = 620

Medical
n = 620

Endpoint

Endpoint = all stroke & death in first 30 days and ipsilateral stroke thereafter up to 4 years.
Primary Aims

- In patients with ≥70% asymptomatic stenosis, to assess:
  - The treatment differences between medical management and CEA
  - The treatment differences between medical management and CAS
Secondary Aims

To assess:

- Differences in cognitive function in patients randomized to intensive medical management compared to those randomized to CEA or CAS at 4 years of follow-up.

- Differences in major stroke events at 4-years.

- Differences in primary outcomes affected by age, sex, severity of carotid stenosis, risk factor level, and duration of asymptomatic period.
≥70% Stenosis

- PSV* ≥ 230 cm/second on DUS
  
  plus one of the following 4 criteria:
  
  • EDV** ≥ 100 cm/second on DUS or
  
  • IC / CC PSV*** ≥ 4.0 on DUS or
  
  • ≥ 70% stenosis on MR angiogram or
  
  • ≥ 70% stenosis on CT angiogram

*peak systolic velocity
**end diastolic velocity
***internal carotid / common carotid artery peak systolic velocity
Question is not whether patient should have CEA or stent but rather whether patient should have any intervention at all.
• Trying to disprove the only thing that the cardiologists, neuroradiologists, and vascular surgeons agree upon
• These patients should have some type of intervention
• The role of CEA in treating symptomatic carotid artery occlusive is well established for symptomatic disease.

• The role of CEA in treating asymptomatic patients will be reassessed in CREST II
Is there a role for CAS in the treatment of carotid stenosis?

YES
As technology advances, CAS will improve.
• Avoid shortcuts in evaluating the efficacy of CAS
• Maintain strict indications for CAS
• Avoid relegating CAS to a technical procedure alone
CAS should be a tool in every vascular specialists tool kit
Must better define indications for use of CAS
Indications must be based upon level 1 data
NOT the ease of performance
Or
Ready availability of the procedure and those performing it