Restenosis

Reports describing long-term follow-up indicate that restenosis >50% occurs:
- in 6-37% of patients after CEA

- Diagnosis
- Indication to treatment
- Treatment options

A potential source of error in using US after CAS is that reduced compliance in the stented artery may result in elevated velocity relative to the native artery.
CORRECT DIAGNOSIS OF IN-STENT RESTENOSIS

<table>
<thead>
<tr>
<th>No.</th>
<th>Stenosis (%)</th>
<th>PSV (cm/s)</th>
<th>EDV (cm/s)</th>
<th>ICA/CCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>[&lt;30]</td>
<td>&gt;104</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>[30-50]</td>
<td>105 – 174</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>[50-70]</td>
<td>175 - 299</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>[&gt;70]</td>
<td>&gt;300</td>
<td>&gt;140</td>
<td>&gt;3.8</td>
<td></td>
</tr>
</tbody>
</table>

*receiver operator characteristic (ROC) curve

Stroke - JOURNAL OF THE AMERICAN HEART ASSOCIATION

**Setacci et al. Stroke 2008;39:1189-96**

Result from CREST

Restenosis rate after CAS and CEA is similar with a threshold of 3 m/s


**Carotid restenosis after CAS & CEA**

How to deal with it:

- **Diagnosis**
- **Indication to treatment**
- **Treatment options**

**Clinical relevance**

Accompanying neurological events have been reported in only 1-10% of patients with restenosis, raising doubt as to the benefit of treating asymptomatic restenosis.

- Bonati et al. Cochrane Review 2012

**Restenosis after CAS or CEA**

Guidelines

“Restenosis is generally benign and does not require revascularization except when it leads to:

- recurrent ischemic symptoms
- or progresses to preocclusive severity”

“Under these circumstances, it may be justifiable to repeat revascularization, either by CEA in the hands of an experienced surgeon or by CAS”.

**Restenosis after CAS or CEA**

Indication for treatment of carotid restenosis

- symptomatic pts (>50%)
- but
- asymptomatic pts (>80%)
Carotid restenosis after CAS & CEA

How to deal with it:

- Diagnosis

- Indication to treatment

- Treatment options

Treatment options for restenoses following CEA or CAS

Endovascular treatment

- PTA
- Cutting balloon angioplasty
- Re-stenting (primary/after PTA, CBA)
- DES
- DEB

Surgical treatment (stent removal)

- CEA
- bypass

BIC registry

Annual rate

expected number of events per year per 100 event-free patients

<table>
<thead>
<tr>
<th>Complication</th>
<th>Annual rate</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause mortality</td>
<td>3.43</td>
<td>(3.3-3.9)</td>
</tr>
<tr>
<td>Stroke-related mortality</td>
<td>1.31</td>
<td>(1.1-1.6)</td>
</tr>
<tr>
<td>Fatal/disabling stroke</td>
<td>1.70</td>
<td>(1.4-2.1)</td>
</tr>
<tr>
<td>All neurological complications</td>
<td>3.45</td>
<td>(3.3-3.9)</td>
</tr>
<tr>
<td>In-stent restenosis (&gt;50%)</td>
<td>1.49</td>
<td>(1.2-1.8)</td>
</tr>
<tr>
<td>Reintervention</td>
<td>1.08</td>
<td>(0.6-1.4)</td>
</tr>
</tbody>
</table>

184 patients with ISR

Conclusion

- Several treatment with acceptable short-term results
- Limited quality of the currently available data (variability of results and study designs)
- No recommendation can be made for any specific therapy.

RESULTS

Reintervention

(64 cases)

- 4 stent removals (2 acute thrombosis)
- 60 further endovascular approaches

23 PTA

14 PTA + stenting

8 cutting balloon + stenting

15 cutting balloon

Uni- and multivariate analysis for Reintervention

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Hazard ratios</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stent design (stainless vs nitinol)</td>
<td>0.98</td>
<td>(0.6-1.7)</td>
<td>0.95 NS</td>
</tr>
<tr>
<td>Free cell area (mm²)</td>
<td>1</td>
<td></td>
<td>0.86* NS</td>
</tr>
<tr>
<td>&lt;2.5</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5-5</td>
<td>0.48</td>
<td>(0.1-3.5)</td>
<td>0.47 NS</td>
</tr>
<tr>
<td>5-7.5</td>
<td>1.00</td>
<td>(0.4-2.3)</td>
<td>0.99 NS</td>
</tr>
<tr>
<td>&gt;7.5</td>
<td>1.16</td>
<td>(0.6-2.3)</td>
<td>0.68 NS</td>
</tr>
</tbody>
</table>

*p-value of global test for association between free cell area and time to in-stent restenosis.

stent design material and free cell areas are not significantly associated with the incidence of ISR and incidence of reintervention.
Univariate e multivariate analysis: results

- prior surgical carotid restenosis (p=0.039)
- + postoperative fever (OR = 5.3)
- + need of pre-dilatation (OR = 3.9)
- + presence of concomitant malignancy or autoimmune disease (OR = 3.4)

**In-stent restenosis – treatment option**

PTA: 5.5/20 mm balloon

**In-stent restenosis by OCT**

**OCT after PTA for in-stent restenosis**

Good angiographic result after simple PTA, but ……

**LESSON LEARNED:**
PTA alone is no more a good option!!

**Better re-stenting !**

**Disadvantages**
- Increase arterial stiffness
- Kink or bend in the distal ICA
- major hyperplastic reaction at the distal end of the second stent (?)

**Advantage**
- Plaque containment
Restenosis after CAS

CEA with removal of the plaque and stent is a viable option for management of ISR in selected patients when distal control can be obtained beyond the stented segment.

CONCLUSIONS
Restenosis after CEA or CAS

- Correct diagnosis (dedicated US velocity criteria)
- Clinical relevance is low, indications are debated.
- Redo endovascular therapy is the most common treatment for ISR (re-stenting better than re-PTA), even though surgical options seems acceptable in selected cases.