Elderly patients are at higher risk of procedural complications. Surgical revascularization has been performed successfully in selected octogenarians. Nevertheless, it is widely believed that percutaneous approaches are safer in the elderly. Indeed, percutaneous coronary intervention is now successfully being performed even in selected nonagenarians. Thus, it is tempting to presume that carotid revascularization in the elderly might be safer if done via endovascular means.

The data to date, however, have been conflicting, with several reports demonstrating very high rates of stroke or death with carotid stenting in octogenarians. Furthermore, although carotid stenting with embolic protection has been shown to be noninferior to carotid endarterectomy in patients at high surgical risk, whether carotid stenting is equivalent to carotid endarterectomy remains an open question in patients at low surgical risk. Additionally, especially for asymptomatic patients, the question arises whether a patient will live long enough to derive potential benefit from any procedure. This question becomes more pressing as the elderly population expands and the definition of elderly creeps upward, and also as clinical trials continue to underenroll the elderly. The cut point where appropriate clinical caution turns instead into preconceived notions and age-related bias is difficult to define.

In this issue of *Circulation*, Chiam et al report on 142 consecutive patients aged 80 years or older who underwent carotid stenting. This series of patients has previously been reported, with the current article adding observations related to intermediate-term survival. Of these 142 patients, 72% were asymptomatic. The 30-day rate of stroke or death was 3.3% (5.1% in symptomatic patients and 2.6% in asymptomatic patients); the 30-day major stroke or death rate was only 2%, with no myocardial infarctions or intracranial hemorrhages. Interestingly, at 6 months, all 4 patients who suffered a periprocedural stroke were still alive. These short-term results are superb and fall within the American Heart Association guideline benchmarks of ≤3% 30-day risk for asymptomatic patients. The perioperative risk of stroke or death was ≈3% in the Asymptomatic Carotid Atherosclerosis Study (ACAS) and the Asymptomatic Carotid Surgery Trial (ACST), and though not directly comparable, it is reassuring that the rate in the series by Chiam et al was not higher.

At 1-year follow-up, the survival rate was 90%. The estimated survival at 2 years was 85% and at 3 years was 76%. The authors thus calculate a mortality rate of ≈9% per year. Thus, in this carefully selected population, patients had reasonably good intermediate-term survival. Longer-term follow-up of the cohort studied by Chiam et al will be useful.

Independent predictors of mortality in the analysis by Chiam et al consisted of the usual culprits: previous stroke or transient ischemic attack 6 months or more prior, current or previous smoking, or diminished preprocedural creatinine clearance. A trend was found for lower preprocedural hemoglobin to be an independent predictor of mortality. Importantly, neither gender nor symptomatic status independently predicted mortality. Future studies may help refine what the predictors are for long-term success after carotid stenting in the elderly.

Several questions remain about the appropriate role for carotid stenting in the elderly. These excellent results from a single experienced center with seasoned operators may not be easily reproducible in the community setting. These patients represent a highly selected group of octogenarians with rigid exclusion criteria based on decreased cerebral reserve (defined as prior large stroke, multiple lacunar infarcts, intracranial microangiopathy, or dementia, vessel tortuosity, or arterial calcification). It would be of great interest to know what percentage of octogenarians was denied intervention by the authors on the basis of these criteria. Can we expect all clinicians to demonstrate the same discipline and judgment in patient selection and the technical expertise during stent deployment? Outcomes achieved from procedures performed at academic tertiary care centers do not always translate into typical clinical practice. This phenomenon had been clearly demonstrated in the carotid endarterectomy literature. Also, the average age in this series was 83.3±3.1 years (range 80 to 95 years), and only 42 patients (27.5%) were over 84 years of age. Thus, the very elderly were not well represented.

The case for carotid stenting in symptomatic octogenarians is provocative. In the North American Symptomatic Endarterectomy Trial (NASCET), elderly patients with symptomatic carotid stenosis were demonstrated to derive the greatest relative stroke reduction from carotid endarterectomy versus medical therapy (28.9% for patients >75 years of age). If other investigators can confirm that these excellent results may be achieved with carotid stenting, the procedure may prove advantageous in these highly selected octogenarians.
The argument for carotid stenting in asymptomatic octogenarians is much more complex. The older ACAS and the more recently published ACST both found that carotid endarterectomy reduced risks of stroke or death over a 5-year horizon in a younger population. These large trials of carefully monitored patients with asymptomatic carotid disease have identified stroke risks of 11% (ipsilateral strokes in ACAS) and 11.8% (total strokes in ACST) at 5 years, demonstrating an annual stroke risk of 2.5%/year. On the basis of these trials, it has been calculated that 18 carotid endarterectomies need to be performed to prevent 1 stroke over 5 years of follow-up. Given the reduced long-term survival in the elderly, how many additional carotid stents would need to be performed to prevent 1 stroke in asymptomatic octogenarians? A previous Markov analysis based on outcomes from the ACAS demonstrated that carotid endarterectomy in asymptomatic patients 79 years of age was in the cost-ineffective range of >$100 000 per quality life year (with $50 000/quality life year considered cost effective). Similar questions must be asked about the cost-effectiveness of carotid stenting in asymptomatic octogenarians.

Since these studies have been completed, medical therapy has advanced and offers the potential for even lower stroke rates with nonprocedural approaches, including intensive statin therapy. The 76% 3-year survival in this series by Chiam et al is higher than has been reported by some other series and likely reflects the careful selection criteria applied. Yuo et al, for example, reported only a 55% 3-year survival in octogenarians after carotid stenting. Should we as clinicians be comfortable with the observation that roughly 50% to 60% of octogenarians would be projected to survive the necessary 5 years to derive significant benefit from the intervention so that their stroke risk can be reduced below 2.5%/year for their remaining years of life? An old aphorism passed down through generations of surgeons states, “A procedure not worth doing, is not worth doing well.” Of course, the same fundamental questions pertain to carotid endarterectomy in asymptomatic octogenarians.

We congratulate the authors on their excellent results, but the incremental value of carotid revascularization in octogenarians remains uncertain. Hopefully ongoing and future trials (Table) will shed more light on the impact of newer medical therapies on the stroke-free survival of octogenarians with asymptomatic carotid stenosis. Perhaps other factors such as systemic markers of inflammation, the rate of plaque progression on serial ultrasounds, or nuances of plaque morphology will emerge as important markers for stroke risk. Ultimately, randomized trials comparing carotid intervention (both endarterectomy and stenting) against advanced medical therapy will be necessary. Only then will we be able to

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**Table. Large Ongoing Randomized Trials of Carotid Stenting Versus Carotid Endarterectomy**

<table>
<thead>
<tr>
<th>Trial</th>
<th>Treatment Groups</th>
<th>Number of Patients</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREST</td>
<td>CAS vs CEA</td>
<td>~2500</td>
<td>Symptomatic and asymptomatic</td>
</tr>
<tr>
<td>ACT 1</td>
<td>CAS vs CEA</td>
<td>~1700</td>
<td>Asymptomatic patients</td>
</tr>
<tr>
<td>ACST 2</td>
<td>CAS vs CEA</td>
<td>~5000</td>
<td>Asymptomatic patients</td>
</tr>
<tr>
<td>ICSS/CAVATAS 2</td>
<td>CAS vs CEA</td>
<td>~1500</td>
<td>Symptomatic patients</td>
</tr>
<tr>
<td>TACIT</td>
<td>CAS vs CEA</td>
<td>&gt;2500</td>
<td>Asymptomatic patients</td>
</tr>
</tbody>
</table>

CREST indicates Carotid Revascularization Endarterectomy Versus Stenting Trial; ACT 1, the Asymptomatic Carotid Trial 1; ACST 2, the Asymptomatic Carotid Surgery Trial 2; ICSS/CAVATAS 2, the International Carotid Stent Study/Carotid Artery and Vertebral Artery Transluminal Angioplasty Study 2; TACIT, the Transatlantic Asymptomatic Carotid Intervention Trial; CAS, carotid artery stenting; CEA, carotid endarterectomy; and BMT, best medical therapy.

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**Figure.** Angiography before (A) and after (B) a right carotid artery stent in an 81-year-old man with amaurosis fugax.
determine with certainty if 80 is indeed the new 60 in asymptomatic patients undergoing carotid revascularization.

Disclosures
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References

Key Words: Editorials ■ carotid arteries ■ stenosis