Carotid endarterectomy in octogenarians
Shaw-Hua Kueh, Vicki Livingstone, Ian A Thomson

Abstract

Aim This study compared the postoperative complication rate between patients age 80 or older to those younger than 80 to determine if older patients were associated with higher risk of complication following carotid endarterectomy.

Method Patients who received carotid endarterectomy between January 1997 and December 2005 were identified using the New Zealand Vascular Surgical Audit Registry. Patients were recruited into the two predetermined age groups. Baseline demographics and the complication rates between the two groups were analysed and compared using Chi-squared test. Confounding factors were adjusted using logistic regression.

Results 1682 patients were identified, of which 243 patients (14%) were age 80 or older. Younger patients were more likely to be male (P=0.002) and diabetics (P=0.047) and more patients in the older age group were symptomatic from the carotid stenosis (P=0.014). The overall complication rate was 17.2% and there was no significant difference between the two groups (P=0.268). The overall combined postoperative death, TIAS and stroke rate was 3.3%. The cardiac complication rate was low but higher in octogenarians at 4.5% compared to 2.2% (P=0.035).

Conclusions Older age does not appear to be associated with higher perioperative complications in carotid endarterectomy.

Carotid endarterectomy (CEA) was first described by Eastcott and colleagues in 1954 to treat carotid artery stenosis with the intention to reduce the risk of stroke and death. The benefit of CEA in patients who are symptomatic with severe carotid stenosis has been well established in large multi-centred randomised trials. In the Northern American Symptomatic Carotid Endarterectomy Trial (NASCET) a 17% absolute risk reduction of stroke at 2 years was reported when comparing CEA to medical therapy in patients with severe symptomatic carotid stenosis of 70–99%. The European Carotid Surgery Trial (ECST) was also in agreement, demonstrating a 9.6% reduction in stroke risk at 3 years follow up.

CEA used to carry a significant perioperative risk of stroke and death of 6.5% to 7.5%. Octogenarians were thought to have an even higher complication rate and were therefore excluded from several major trials. However with an aging population seen worldwide and the argument that these are the patients most at risk of stroke and would therefore benefit most from CEA, there has been an increasing interest to evaluate if CEA can be performed safely on older patients.

Retrospective studies from tertiary hospitals in Europe and America have demonstrated no difference between the older and younger patients in terms of mortality and stroke rates. This was further supported by meta-analysis of 46 studies between 2000 and 2010 with 2963 octogenarian included. On the contrary, a recent multi-centred retrospective study
involving 10 countries across Europe and Australasia reported a higher rate of mortality among those older than 75.11

We evaluated the complication rates of carotid endarterectomy in New Zealand to determine if CEA was performed safely on octogenarians.

**Method**

Carotid endarterectomies (CEAs) were performed by 17 experienced vascular surgeons who were members of the New Zealand Society of Vascular Surgery (NZSVS) in 6 mainly tertiary hospitals across New Zealand. These centres were Auckland, Wellington, Christchurch, Dunedin, Hamilton and Nelson. CEAs performed were registered in the New Zealand Vascular Surgical Audit Registry.

The Registry was developed by the Clinical Audit Research Unit at the Department of Surgery in Dunedin School of Medicine, University of Otago, New Zealand. The study was approved by the New Zealand Society of Vascular Surgery.

Patients were categorised into two predetermined age groups of ≥ 80 and those < 80 years old at the time of surgery. Baseline characteristics between the two groups were analysed using the Chi-squared (χ²) test.

Postoperative period was defined as within 30 days after surgery. Complications were further classified as follows:

- Neurological complications included Transient Ischaemic Attack (TIA), stroke and peripheral nerve injury related to either anaesthesia or surgery. TIA was defined as neurological deficit lasting less than 24 hours.
- Cardiac complications include cardiac ischaemia, arrhythmia and cardiac complications otherwise not specified.
- Wound complications include wound infection and wound haematoma.

The complication rates were compared between the two study groups. All statistical analyses were conducted using statistical Package for Social Sciences (SPSS) version 13.0 software (SPSS Inc., Chicago, IL, USA). Potential confounders were adjusted using logistic regression. A P-value of less than 0.05 was considered significant.

External validation of the data collection of the registry was analysed and over the period of 1997 to 2005 47% of CEAs performed in New Zealand were reported in the registry when compared with data from Ministry of Health, New Zealand. The proportion of octogenarians was comparable with 13.9% identified in the Ministry of Health data and 14.9% identified in the vascular registry.

**Results**

A total of 1682 CEAs were performed on 1682 patients between January 1997 and December 2005. The baseline demographics are summarised in Table 1. There was male predominance in both age groups and more symptomatic patients were found in the older age group.

American Society of Anesthesiologists (ASA) score was used as a measure of patients’ preoperative physical status to undergo surgery. These were missing in 14% (243) of the cases and majority of patients had ASA score of 2 or 3 (Table 3).

The ASA score and the proportion of those with missing data were not significantly different between the 2 age groups. The majority of the patients had elective CEA and there was no difference in the urgency of the surgery between the two age groups. Nearly half of all patients received patched closure (805 patients, 48%).

357 complications were documented in 290 patients. The overall postoperative complication rate in New Zealand was 17.2% (290/1682). Younger patients had a postoperative complication rate of 17.7% (255/1439) and older patients had 14.4% (35/243). This was not statistically significant, P=0.268. The odds of octogenarians developing perioperative
complication was 21% less than younger patients after adjusting for confounders; however this did not reach statistical significance (Table 2).

Table 1. Baseline demographics

<table>
<thead>
<tr>
<th>Variables</th>
<th>&lt;80 years (n=1439)</th>
<th>≥80 years (n=243)</th>
<th>Chi-squared</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
<td></td>
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<tr>
<td>Median age</td>
<td>70 (5.5)</td>
<td>6 (2.5)</td>
<td>0.047*</td>
<td></td>
</tr>
<tr>
<td>Age range</td>
<td>41–79</td>
<td>80–99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>933 (64.8)</td>
<td>133 (54.7)</td>
<td>0.002*</td>
<td></td>
</tr>
<tr>
<td>Comorbidities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>79 (5.5)</td>
<td>30 (12.3)</td>
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<td></td>
</tr>
<tr>
<td>Smoking</td>
<td>246 (17.1)</td>
<td>21 (8.6)</td>
<td></td>
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</tr>
<tr>
<td>Dyslipidaemia</td>
<td>181 (12.6)</td>
<td>5 (2.1)</td>
<td>0.081</td>
<td></td>
</tr>
<tr>
<td>Cardiac events</td>
<td>38 (2.6)</td>
<td>38 (12.3)</td>
<td>0.594</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>398 (27.7)</td>
<td>71 (29.2)</td>
<td>0.616</td>
<td></td>
</tr>
<tr>
<td>Urgency of operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency</td>
<td>9 (0.6)</td>
<td>4 (1.6)</td>
<td>0.193</td>
<td></td>
</tr>
<tr>
<td>Urgent</td>
<td>249 (17.3)</td>
<td>46 (18.9)</td>
<td></td>
<td></td>
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<tr>
<td>Elective</td>
<td>1181 (82.1)</td>
<td>193 (79.4)</td>
<td></td>
<td></td>
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<tr>
<td>Symptomatic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIA</td>
<td>630 (43.7)</td>
<td>127 (52)</td>
<td>0.014 *</td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>483 (33.6)</td>
<td>98 (40.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASA score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>40 (2.8%)</td>
<td>3 (1.2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>644 (44.8%)</td>
<td>102 (42.0%)</td>
<td>0.429</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>496 (34.5%)</td>
<td>97 (39.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>46 (3.2%)</td>
<td>8 (3.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>210 (14.6%)</td>
<td>33 (13.6%)</td>
<td></td>
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</tbody>
</table>
* Statistical significance. TIA=transient ischaemic attack.

Table 2. Logistic regression of odds ratio (OR) for the overall complication rate between the two age groups

<table>
<thead>
<tr>
<th>Age</th>
<th>Crude OR (95% CI)</th>
<th>OR adjusted for gender (95% CI)</th>
<th>OR adjusted for gender &amp; comorbidities (95% CI)</th>
<th>OR adjusted for gender &amp; comorbidities &amp; symptoms (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;80 years</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>≥80 years</td>
<td>0.81 (0.55–1.18)</td>
<td>0.82 (0.56–1.20)</td>
<td>0.80 (0.54–1.16)</td>
<td>0.79 (0.54–1.16)</td>
</tr>
</tbody>
</table>

The complication rates are shown in Table 3. Due to the infrequent rate of TIA, stroke and death, statistical analyses were unable to be performed reliably. Four deaths (0.3%) were reported during the perioperative period in the younger age group. Two patients died from cardiac causes—one from myocardial infarction 5 days postoperatively and another from unspecified cardiac death. One patient died from a major stroke 7 days after the operation and one patient died of unspecified death. No deaths were reported in the older age group.
Cardiac complications were more frequently seen in older patients compared to their younger counterpart at 4.5% and 2.2% respectively (P=0.035) but were at a low level. Cardiac ischaemia more than doubled in the older age group at 2.5% compared to 0.9%, and cardiac arrhythmia more than four times higher at 1.6% compared to 0.3%.

Postoperatively, the median duration of hospital stay was 4 days for both age groups, with an interquartile range (IQR) of 3 to 5 days amongst younger patients and 3 to 6 days amongst older patients. The median duration of operation was 90.0 minutes for both age groups with IQR of 74 to 120 in younger patients and 70 to 120 in older patients.

**Discussion**

In this study the overall complication rate following CEA was 17.2% and no difference was found between those older than 80 years of age and those younger than 80.

Subanalysis revealed our combined rate of TIA, stroke and death was 3.3% and no difference was found between the 2 age groups. However octogenarians were more likely to suffer from cardiac complications compared to their younger counterparts.

The stroke and mortality complication rate was significantly lower than those previously reported in major trials. External validation of the registry showed that only 47% of CEA performed in New Zealand were registered which may subject our study to selection bias as it is possible that only those with good surgical outcomes were reported in our registry.

Although the data suggest significant under-reporting of the CEAs performed, we noted that octogenarians accounted for 13.9% of the data from Ministry of Health, New Zealand. This was comparable to those found in our registry at 14.4%.

Our registry can therefore be considered to be a representative sample of the New Zealand CEA population. There may also be an inherent selection bias in that younger patients are treated more aggressively despite significant comorbidities compared to older patients in whom surgery would only be considered if they have less comorbidities and were symptomatic. Baseline demographics did suggest this, with older patients being less likely to be diabetics and more likely to be symptomatic with carotid stenosis.

When adjusted for comorbidities, the odds of older patients developing perioperative complications was no different to younger patients (Table 2). Furthermore, we utilised ASA score in our study as a marker of patients’ preoperative physical state and no difference was
found between the 2 age groups with approximately 80% in both age groups having an ASA score of 2 or 3. Therefore it appears that comorbidities and preoperative physical state did not significantly impact on the overall complication rate in our study.

Internationally, there have been a number of reports supporting the role of CEA in the elderly population, contrary to the conventional idea that age is associated with increased risk of complication. O’Hara et al. reported a retrospective study conducted in Cleveland clinic of 182 CEA performed on 167 patients age 80 and older, were not associated with increased risk of complications.\(^5\)

Eighty-five percent of patients had 80% to 99% stenosis. The postoperative stroke and mortality rates were 1.6% and 1.8% respectively. These were indistinguishable from that of younger patients of 2.2% and 1.1% respectively. The 5 years stroke-free survival rate was 42% (95% CI, 30%–53%).

In the University of North Carolina, 2398 CEA were performed on 1970 patients;218 CEAs were performed on 187 patients age 80 and older.\(^2\) Older patients were less likely to be male, diabetic, smoker or have a history of vascular surgery. These differences were considered by the author to be the result of selection bias, thereby favouring a better postoperative outcome for older patients. The mortality and stroke rates were similar between the two age groups.

In Italy, Ballotta et al reported a retrospective study of 1260 carotid endarterectomy, of which 115 were performed on 112 patients age 80 and older.\(^9\) Their data closely resembles ours with mortality of 0.3% in younger patients and none in older patients. Stroke rates were lower compared to ours at 0.8% in younger patients and none in older patients. Older patients were less likely to be diabetic and hypertensive. Cardiac complications were similar between the two study groups.

Most recently, an international, multi-centred study with combined analysis of 8 national and 2 regional databases across Europe and Australasia showed a 0.2% increased risk of stroke and death in those over 75 years of age.\(^11\) The database included 48035 carotid endarterectomy performed in 383 centres. The type of anaesthesia did not affect the mortality or stroke but CEAs without patch was associated with increased risk of non-fatal stroke. No comparisons were made of other characteristics between the 2 age groups.

In conclusion, our retrospective audit over a 9 year period demonstrated that octogenarians did not have a significantly increased risk of neurological events or deaths following carotid endarterectomy compared to their younger counterparts, however, non-fatal cardiac complications occurred more frequently amongst octogenarians. This is in agreement with a number of previous reports.

We acknowledge that in our database, there was significant under-reporting and possibly subjects our study to a significant selection bias. This study could be further improved with better compliance with data collection and further evaluation of perioperative complication rates based on symptom as well as age.
Competing interests: None known.

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References: