Large, randomized, controlled trials have shown that carotid endarterectomy is beneficial for selected patients with recently symptomatic stenosis. However, surgery carries a risk of stroke and death. Most perioperative strokes are ipsilateral carotid territory infarcts, some possibly resulting from the interruption of blood flow that occurs while the carotid artery is clamped. The duration of interrupted blood flow can be minimized by use of a shunt. Potential disadvantages of shunting include complications such as air and plaque embolism and carotid artery dissection. We performed a systematic review of randomized, controlled trials to determine the effect of a policy of routine or selective shunting on the risk of perioperative stroke, death, and other operative complications. We also tried to identify if any one method of selecting which patients undergoing endarterectomy, under general anesthetic, require a shunt is better than any other.

**Methods**

Similar search strategies and inclusion criteria were used in the original (up to 2000) and this updated review (2000 to 2008). Trials were included if they compared any of the following policies: routine shunting versus avoiding a shunt; selective shunting versus routine shunting; selective shunting versus avoiding a shunt; or if they examined different methods for determining the need for a shunt. Recorded end points were all strokes, ipsilateral strokes, all strokes and deaths, wound hemorrhage, wound infection, and ipsilateral cranial nerve injuries. The time periods examined were intraoperative, within 24 hours of surgery, within 30 days of surgery, and during the whole follow-up period. If available, the number of shunts inserted in trials comparing one method of monitoring with another was also recorded. The analyses of surgical complications (including ipsilateral stroke) were based on all arteries randomized, whereas overall stroke and death rates were calculated per patient.

**Results**

Four trials fulfilled the inclusion criteria. Three (686 patients) compared routine shunting with no shunting.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Shunt Event/Cases</th>
<th>Not Shunt Event/Cases</th>
<th>OR</th>
<th>95 % CI</th>
<th>I², %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>3/321</td>
<td>7/334</td>
<td>0.45</td>
<td>0.13–1.59</td>
<td>60</td>
</tr>
<tr>
<td>Stroke</td>
<td>11/321</td>
<td>15/334</td>
<td>0.77</td>
<td>0.35–1.69</td>
<td>59</td>
</tr>
<tr>
<td>Stroke or death</td>
<td>12/321</td>
<td>20/334</td>
<td>0.62</td>
<td>0.31–1.27</td>
<td>0</td>
</tr>
<tr>
<td>Local hematoma</td>
<td>1/313</td>
<td>1/328</td>
<td>1.19</td>
<td>0.07–19.47</td>
<td>NA</td>
</tr>
<tr>
<td>Cranial nerve injury</td>
<td>3/63</td>
<td>2/75</td>
<td>1.81</td>
<td>0.30–10.82</td>
<td>NA</td>
</tr>
<tr>
<td>Infection</td>
<td>0/313</td>
<td>1/328</td>
<td>0.16</td>
<td>0.00–8.12</td>
<td>NA</td>
</tr>
</tbody>
</table>

*Allocation was adequately concealed in one trial, unclear in one, and quasirandomized in the other. There were crossovers between treatment arms in 2 of the trials, but neither trial excluded patients after randomization, and analysis was by intention to treat. The treatment groups were comparable in 2 trials, but no baseline data were available in the other trial. There were no losses to follow-up in any trial, but the duration was only 30 days. The Table shows the pooled estimates of the risks and the ORs between shunted and nonshunted operations for each complication studied. The overall 30-day stroke and death rate was 4.9%, and the overall risk of death was 1.5%. No significant differences were seen in any of the recorded outcomes for shunted versus nonshunted patients.*
within 24 hours of surgery versus 2 of 70 in the stump pressure alone group (OR=1.47, 95% CI=0.25 to 8.68, \(P=0.7\)). There were no significant differences in wound hemorrhage or nerve palsy, but combined monitoring resulted in the use of fewer shunts.

Discussion and Implications for Future Research
There is still insufficient evidence from randomized, controlled trials to support or refute the use of routine or selective shunting during carotid endarterectomy or to support the use of one form of monitoring over another in selecting patients requiring a shunt. Larger randomized, controlled trials are required.

Disclosures
None.

References

Key Words: carotid endarterectomy ■ monitoring ■ shunting ■ stroke
Routine or Selective Carotid Artery Shunting for Carotid Endarterectomy and Different Methods of Monitoring in Selective Shunting
Kittipan Rerkasem and Peter M. Rothwell

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