41319: Easily Screenable Characteristics Associated with Cognitive Improvement and Dysfunction After Carotid Endarterectomy

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Disclosures

There are no disclosures for this study or abstract.
Background:

- Carotid endarterectomy (CEA) has been shown to be an effective treatment for the prevention of stroke in asymptomatic or symptomatic patients with high grade carotid artery stenosis. Many early studies of cognitive performance were directed at demonstrating improvement in cognitive performance after CEA. Our previous studies, however, demonstrated that patients may develop cognitive changes associated with CEA, either dysfunction or improvement.

- The factors that contribute to cognitive dysfunction and cognitive improvement have been presented in previous publications by other authors. However, these cohorts have been small and in-depth analysis has been limited.

- In the present study, we aim to determine the incidence of both early cognitive dysfunction (eCD) and early cognitive improvement (eCI) defined as cognitive performance within 24 hours of surgery in a large cohort of patients using a battery of neuropsychometric tests and the risk factors associated with each.
Methods

• This is a retrospective review of a prospective observational study. 585 patients were tested with a battery of neuropsychometric tests immediately before surgery and again within 24 hours following surgery. A cohort of 155 patients undergoing “simple” spine surgery were used as a reference group to account for the trauma of surgery, effects of general anesthesia, and practice effect.

• To minimize the effects of differing tests on overall performance, we arranged the test results into four different cognitive domains: (1) Memory, (2) Executive Function, (3) Visuo-spatial Reasoning, and (4) Motor Function. The memory domain includes total recall and percent total retention scores from the Hopkins Verbal Learning Test, the immediate recall portion of the Rey-Ostrich Complex Figure (ROCF), and the CLTR and LTR components of the SRT. The executive domain is composed of the COWAT and Trails B tests. The visuo-spatial domain is composed of the copy portion of the ROCF and the motor domain is determined by the grooved pegboard and finger tapping test.
Methods

- We used the neuropsychometric performance of the reference group to generate Z-scores of patients in the CEA group, where we subtracted the mean score change in the reference group and divided the standard deviation of the score change in the reference group. Patients in the CEA group are considered to have early cognitive dysfunction (eCD) if: patients had Z-scores ≤ -2 in two or more cognitive domains or patients had mean Z-scores across all 4 domains ≤ -1.5. Patients are considered to have early cognitive improvement (eCI) if: they had Z-scores ≥ 2 in two or more cognitive domains or they had mean Z-scores across all 4 domains ≥ 1.5. All other patients’ cognitive performance was considered “no change”.

- We compared patient characteristics using Pearson’s chi-squared test for categorical variables and two-sample t-test for continuous variables. We used the proportional odds model to model the associations between the ordinal categorical cognitive performance outcomes (three levels eCD, “no change”, and eCI) and explanatory variables of interests. A p-value ≤ .05 was considered statistically significant. Statistical analysis was performed using the JMP® 10 Statistical Discovery from SAS (Cary, NC).
Results

- Of the 585 subjects, 24% had eCD, 6% had eCI, and 70% had “no change”

- Patients who had eCD were more likely to be statin naïve (OR=1.23 [1.03:1.48], p=0.02) or women (OR=1.27 [1.06:1.53], p=0.01).

- Those with eCI were less likely to have less formal education (OR=0.76 [0.57:0.99], p=0.04) and less likely to have diabetes mellitus (OR=0.8 [0.65:0.99], p=0.04).

<table>
<thead>
<tr>
<th>Patient Characteristic</th>
<th>Coefficient</th>
<th>OR</th>
<th>95% CI</th>
<th>p value</th>
<th>Δ CP*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.0122</td>
<td>1.01</td>
<td>0.99 : 1.03</td>
<td>0.24</td>
<td></td>
</tr>
<tr>
<td>Years of Education†</td>
<td>-0.281</td>
<td>0.76</td>
<td>0.57 : 0.99</td>
<td>0.04</td>
<td>eCI</td>
</tr>
<tr>
<td>No Diabetes Mellitus</td>
<td>-0.2178</td>
<td>0.8</td>
<td>0.65 : 0.99</td>
<td>0.04</td>
<td>eCI</td>
</tr>
<tr>
<td>No Hypertension</td>
<td>-0.097</td>
<td>0.91</td>
<td>0.76 : 1.08</td>
<td>0.29</td>
<td></td>
</tr>
<tr>
<td>No Statin Use</td>
<td>0.208</td>
<td>1.23</td>
<td>1.03 : 1.48</td>
<td>0.02</td>
<td>eCD</td>
</tr>
<tr>
<td>Female</td>
<td>0.2412</td>
<td>1.27</td>
<td>1.06 : 1.53</td>
<td>0.01</td>
<td>eCD</td>
</tr>
<tr>
<td>No Peripheral Vascular Disease</td>
<td>0.0863</td>
<td>1.09</td>
<td>0.90 : 1.32</td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td>No Aspirin</td>
<td>0.1945</td>
<td>1.21</td>
<td>0.97 : 1.52</td>
<td>0.09</td>
<td></td>
</tr>
</tbody>
</table>

*: Cognitive Performance; †: Year of Education: per 5-year increment.
Discussion

• Consistent with our previous findings, non-diabetics and those on statin therapy were shown to have decreased incidence of cognitive dysfunction. Patients who were both non-diabetic and on statins were also more likely to have cognitive improvement. Education and sex play significant roles in the development of cognitive change after CEA. In univariate analysis, every 5 years of education accounted for 24% increased odds that the patient would have some cognitive improvement after the surgery. One theory is that education is a surrogate for cognitive reserve which allows patients to accommodate for some cognitive impairment with some form of cognitive compensation. Sex also had a predictive effect on CD. Women fared much worse than their male counterparts in terms of likelihood of developing eCD. All of the women in this cohort were post-menopausal. It is believed that reduced estrogen production by post-menopausal women increases their risk for metabolic dysregulation and inflammation. While we did not measure circulating estrogen, we speculate that this post-menopausal inflammatory state may be responsible for the discordant rates of post-CEA eCD between men and women.
Summary

- Patients having CEA may develop eCD or eCI within the first 24 hours after surgery.
- The risk factors associated with development of eCD or eCI within the first 24 hours after CEA surgery depend on the medications that the patient is taking as well as patient characteristics including genetic factors.
- In general, women are more likely to develop eCD.
- More years of education decreases the incidence of eCD and increases the incidence of eCI.
- The only medications likely to decrease eCD are statins and aspirin. Both are correlated most strongly in asymptomatic patients.
- Women may suffer more cognitively from surgery than men, but more robust sex-specific studies are needed.