Research Question

- What is the effect of carotid artery stenting on cognitive function in subjects with high grade carotid artery stenosis? See Figure 1

Methods

Design

- Prospective, non-randomized, single center study, conducted at Spectrum Health and West Michigan Heart
- Subjects with severe carotid artery stenosis were followed pre and post their clinically indicated carotid artery stenting (CAS) procedure
- A battery of standardized cognitive tests performed pre and post CAS were evaluated by a licensed psychologist
- Other study related data collected for statistical analysis included: medical history, anatomical and procedural information collected during CAS procedures and a neurological evaluation using the National Institute of Health Stroke Scale

Participants

- Convenience sampling method from the investigator’s practice
- Key Inclusion Criteria: asymptomatic 40-80 year olds, right hand dominance, >80% stenosis with a TIMI flow 1-3 and a baseline peak carotid velocity of 380cm/sec.
- Key Exclusion Criteria: history of major stroke, Alzheimer’s, dementia, cognitive impairment, planned intervention to contralateral carotid artery or any planned major surgery within 6 months, diabetes, right or left hemispheric lesions.

Procedures

- Approval of this project was granted by the Spectrum Health Institutional Review Board
- Pre procedure research data was captured within 14 days of each subject’s CAS procedure
- Post procedure research data was captured at subjects’ routine 1 month follow-up visit with the investigator at 40 +/- 14 days
- Additional research data was collected at the hospital just prior to CAS procedure, during CAS procedure and prior to discharge

Outcome Measures

- A series of standardized tests combined into an hour long testing session was performed pre and post CAS procedure
- Tests included: Digit Span and Coding subtests from the Wechsler Adult Intelligence Scale-3rd ed. (WAIS-3), FAS Verbal Fluency Test, Mental Control subtest from the Wechsler Memory Scale, Rey-Ostersmith Complex Figure Test, Trail Making Test parts A & B and the California Verbal Learning Test-2 (CVLT-2)

Data Analysis

- Wilcoxon Signed Rank tests were conducted to compare the pre and post cognitive test scores (α = 0.05).
- Bonferroni-Holm adjustment for multiple comparisons
- Fisher’s Exact Test was used to investigate if specific medical history variables were associated with pre and post test score differences (α = 0.05).
- Mann-Whitney U tests were used to compare verbal fluency and visual memory (via symbol recognition) for subjects identified with a right hemispheric and those with a left hemispheric lesion (α = 0.05).

Results

- Results indicated a significant median increase in scores of the Trials 1 to 5 portion of the California Verbal Learning Test-II (CVLT-II; p = 0.00019). On average, subjects were able to recall more words from the given list post CAS. This suggests an overall average improvement of short term memory. See Figure 2
- Evidence indicates that a subject’s degree of stenosis is significantly associated with their improved delayed (30 minutes) and immediate ability to recall a complex figure post CAS (p = 0.0005). This suggests that improvement in visual memory post CAS is impacted by the degree of vessel narrowing pre CAS.
- There is a significant association between diabetes mellitus and improved total recognition post CAS (p = 0.0305). Through the use of the Rey-Ostersmith Complex Figure Test, subjects were asked to reproduce a complex figure at different time intervals and were asked to identify individual portions of the complex figure from a set of random figures. The data suggests that improvement in visual memory post CAS is impacted by whether the subject has controlled, uncontrolled or no diabetes mellitus.
- Subjects with a right hemispheric lesion showed more improvement on measures of verbal fluency (COWAT) than those with a left hemispheric lesion, on average (p = 0.0029). See Figure 3
- Subjects with a left hemispheric lesion showed more improvement on measures of visual memory than those with a right hemispheric lesion, on average (p = 0.0354). See Figure 3

Conclusions

- Our results, as consistent with a number of previous studies, offer support for stable or improved cognitive functioning post CAS procedure.
- Clinically, this may have implications when considering the efficacy and utility of CAS in relation to other available and alternative treatments.
- Secondary analysis suggest trends in the areas of degree of stenosis, diabetic status and lesion location on potential neuro-cognitive outcomes. Further study with more robust sampling is required to better understand the degree of effect these mediating factors have on cognitive function.