# Initiation of a Neurosurgeon-Led Comprehensive Stroke Center: Review of Endovascular Stroke Therapy

Ethan A. Benardete MD PhD; Anil Karunakaran Nair MD
Department of Neuroscience, Kennedy Memorial Hospital, Sewell, NJ 08080 &
Department of Neurological Surgery
Thomas Jefferson University
Philadelphia, PA 19107

## Learning Objectives

Analyze the outcomes of a Community Hospital-based Comprehensive Stroke Center (CSC) in the start-up phase

## Introduction

The requirements for a comprehensive stroke center (CSC) include the ability to perform endovascular stroke therapy (EST)1. The processes and procedures required to effectively intervene in ischemic stroke patients are complex. We hypothesized that outcomes of EST would improve over time in the start-up phase of a new community-based CSC.

## Methods

We retrospectively reviewed demographic and outcome data from patients treated at a new CSC. Demographic data collected included (but was not limited to) age, sex, smoking history, hypertension, and prior stroke. Outcome data was divided into Year 1 and Year 2 subcategories and statistical analysis was applied to compare each group. For continuous data, students two-tailed t-test was used. Otherwise, one-way ANOVA or Fisher's exact test were applied.

### Table 1

| | | | *Year 1* | | *Year 2* | | *P* |
|---|---|---|---|---|---|---|---|
| Mean Age (yrs) | | | 78.4 | | 66.1 | | 0.03 |
| Min | Max | | 63 | 89 | 34 | 88 | |
| Mean NIHSS | | | 19 | | 14 | | 0.16 |
| Min | Max | | 8 | 25 | 6 | 21 | |
| Male:Female | | | 3:8 | | 4:3 | | 0.33 |
| % Prior Stroke | | | 0 (0/11) | | 14 (1/7) | | 0.39 |
| % Smoker | | | 9 (1/11) | | 29 (2/7) | | 0.53 |
| % HL | | | 64 (7/11) | | 85 (6/7) | | 0.60 |
| % Afib | | | 45 (5/11) | | 28 (2/7) | | 0.64 |
| % HTN | | | 82 (9/11) | | 71 (5/7) | | 1.00 |
| % IV rt-PA | | | 55 (6/11) | | 57 (4/7) | | 1.00 |

Table 1. Demographic Data for acute stroke patients treated with EST in years 1 and 2 at a new CSC. % Afib is the percentage of patients with atrial fibrillation; % HL is percentage of patients with hyperlipidemia; % HTN is percentage of patients with hypertension. % IV rt-PA is the percentage of patients that had received IV rt-PA prior to ET. Mean NIHSS is the mean NIH stroke scale on admission. Min and Max are the minimum and maximum values respectively. *P* value is the result of the Fisher's exact test (see Methods).

Demographic Data

## Results

Demographic data were similar between year 1 and year 2. There were statistically significant improvements in door-to-needle time for delivery of IV-rtPA and modified Rankin score at discharge between year 1 and year 2 ($P < 0.05$). Door-to-intervention time also decreased, but it was not statistically significant . There were trends in improved outcomes variables including decreased mortality (36% vs. 14%), decreased complication rates (27% vs. 14%), and Thrombosis in Cerebral Infarction (TICI) scores. ANOVA analysis also demonstrated that age was statistically associated with higher mortality, while improved NIHSS score was associated with better outcomes.

### Table 2

| | *Year 1* | *Year 2* | *P* |
|---|---|---|---|
| % Discharge mRS ≤ 2 | 9 (1/11) | 57 (4/7) | 0.05 |
| %TICI = 3 | 27 (3/11) | 57 (4/7) | 0.33 |
| % 30-day Mortality | 36 (4/11) | 14 (1/7) | 0.60 |
| % MCA | 90 (10/11) | 100 (7/7) | 1.00 |
| % Complication | 27 (3/11) | 14 (1/7) | 1.00 |
| % Stentriever | 73 (8/11) | 85 (6/7) | 1.00 |
| % TICI ≥ 2b | 64 (7/11) | 71 (5/7) | 1.00 |
| % IA medications | 36 (4/11) | 43 (3/7) | 1.00 |

Table 2. Comparison of outcome and procedure data on acute stroke patients treated with endovascular therapy at a new CSC in years 1 and 2 (Fisher's exact test). % Discharge mRS ≤ 2 is the percentage of patients at discharge who had a modified Rankin scale score less than or equal to 2 (independent). % TICI = 3 is the percentage of patients with complete revascularization on the TICI scale. % MCA is the percentage of patients with a middle cerebral artery occlusion on angiography. % Complication is the percentage of patients who had a procedural complication. % Stentreiver is the percentage of patients treated with a strentriever as the primary endovascular device. % TICI ≥ 2b is the percentage of patients with a revascularization score on the TICI scale 2b or higher. % IA medications is the percentage of patients that received intra-arterial rt-PA or abxicimab as an adjunct to their procedure. The fraction in parentheses is the number of patients with the characteristic over the total. *P* value is the result of Fisher's exact test.

Outcome Data

### Table 3

| | | *Year 1* | | *Year 2* | | *P* |
|---|---|---|---|---|---|---|
| Mean DTN (mins) | | 57.5 | | 36.3 | | 0.03 |
| Min | Max | 54 | 121 | 35 | 37 | |
| Mean Discharge mRS | | 4.4 | | 2.8 | | 0.18 |
| Min | Max | 2 | 6 | 1 | 6 | |
| Mean DTI (mins) | | 157 | | 136 | | 0.40 |
| Min | Max | 70 | 222 | 72 | 201 | |
| Mean Procedure Length (mins) | | 135 | | 117 | | 0.51 |
| Min | Max | 49 | 234 | 50 | 217 | |
| Mean NIHSS Δ | | 5 | | 6 | | 0.88 |
| Min | Max | -13 | 21 | 0 | 14 | |

Table 3. Comparison of procedure and outcome variables from year 1 and year 2 at a new CSC. Mean NIHSS Δ is the average change in NIHSS scale following the procedure at 24 hours post procedure. DTN is door-to-needle time. DTI is door-to-intervention time. *P* value is the result of significance testing as described in the text.

Procedural Metrics

### Table 4

| *Variable 1* | *Variable 2* | *P* |
|---|---|---|
| NIHSS Δ | 30-day Mortality | 0.01 |
| Age | 30-day Mortality | 0.06 |
| Door-to-Intervention Time | 30-day Mortality | 0.09 |
| Procedure Length | 30-day Mortality | 0.12 |
| Preop NIHSS | 30-day Mortality | 0.50 |
| NIHSS Δ | TICI ≥ 2b | 0.01 |
| DTI Time | TICI ≥ 2b | 0.14 |
| Procedure Length | TICI ≥ 2b | 0.32 |
| Age | TICI ≥ 2b | 0.72 |
| Preop NIHSS | TICI ≥ 2b | 0.76 |

Table 4. Results of one-way ANOVA on pooled data from years 1 and 2. NIHSS Δ is the change in NIHSS 24-hours following the procedure. DTI time is the door-to-intervention time. 30-day mortality and TICI ≥ 2b (TICI score greater than or equal to 2b) are categorical variables.

Outcome Analysis

## Conclusions

The initiation of a CSC is a complex undertaking that requires establishment of processes and protocols. At the same time, procedural techniques need improvement. All of these variables can affect outcome. Our data suggest that over time improvements do occur in both process and technical variables. However, even in the earliest stages, EST is safe in a neurosurgeon-driven CSC.

## References

1. Alberts MJ, Latchaw RE, Selman WR, Shephard T, Hadley MN, Brass LM et al. Recommendations for comprehensive stroke centers: A consensus state from the brain attack coalition. *Stroke: a journal of cerebral circulation*, 2005; 36:1597-1616.