

Temporal Trends in Use and Outcomes of Endovascular Intra-arterial Therapy for Acute Ischemic Stroke:

National Inpatient Sample Analysis, 2004-2012

Srikanth Boddu MD; Xingwen Sun; Thomas W Link MD; Ning Lin MD

Department of Neurological Surgery, Weill Cornell Medicine

Weill Cornell Brain and Spine Center

Introduction

Given progressive advances in devices and technique, we aimed to investigate nationwide, temporal trends in the use and outcomes of endovascular intra-arterial therapy (IAT) for stroke with respect to technological changes.

Methods

Patients with hospital discharge diagnoses of acute ischemic stroke from 2004-2012 were identified from the Nationwide Inpatient Sample (NIS). The rates of endovascular IAT and in-hospital mortality over three time periods: 2004-2007 (post-MERCI), 2008-2011 (post-Penumbra), and 2012 (post-Solitaire), were evaluated stratified by hospital and patient characteristics.

Results

Patient Characteristics. From 2004 to 2012, 6,633,799 patients with diagnoses for acute ischemic stroke (AIS) were identified from the NIS database, among whom 141,765 (2.1%) were treated with intravenous thrombolysis only and 40,022 (0.6%) were treated with intra-arterial therapy. Demographic and hospital-related characteristics of patients are summarized in Table 1.

Utilization Data. Utilization rates of intra-arterial therapy for stroke have increased steadily over time ($p < 0.001$ for trend) (Figure-1A). Approximately 0.05% of stroke patients underwent intra-arterial therapy in 2004, whereas 1.57% did in 2012, a >30-fold increase. The expansion of utility was more noticeable and significant ($p = 0.009$) between teaching vs. non-teaching hospitals (Figure-1B) and large vs. small/medium size hospitals ($p < 0.001$; Figure-1C).

Table 1. Demographics and hospital characteristics of study population

	Endovascular therapy (n=11960)
Age (years)	
Mean (\pm SD)	63.1 (\pm 15.4)
Sex	
Female	18321(45.8)
Male	21701(54.2)
Race	
White	23225(58.0)
Black	4684(11.7)
Others*	5599(14.0)
Unknown	6514(16.3)
Income Quartile (%)	
<25,000	10256(25.6)
25,000-34,999	8965(22.4)
35,000-44,999	10486(26.2)
\geq 45,000	10326(25.8)
Healthcare Coverage (%)	
Public (Medicare or Medicaid)	23493(58.7)
Private Insurance	12887(32.2)
Self-pay	2201(5.5)
Charlson Co-morbidity Score	
Mean (\pm SD)	1.9(\pm 1.6)
Hospital Location (%)	
Northeast	7324(18.3)
Midwest	9765(24.4)
South	12847(32.1)
West	10046(25.1)
Hospital Size	
Small	2521(6.3)
Medium	9085(22.7)
Large	28416(71.0)
Hospital Type	
Non-teaching	8004(20.0)
Teaching	32018(80.0)

*Hispanic, Asian, or Native American

Table 2. Change of endovascular treatment outcome over time

	2004-07	2008-11	2012	p value
Number of patients	5924	25483	8606	N/A
Age (year)				
Mean (\pm SD)	60.2 (\pm 15.8)	63.3 (\pm 15.5)	64.5 (\pm 14.5)	<0.001
Charlson Co-morbidity Score				
Mean (\pm SD)	5.2 (\pm 2.8)	5.6 (\pm 2.1)	5.9 (\pm 2.3)	<0.001
Overall Mortality, no. (%)	1496(25.3)	5087(20.1)	1502(17.1)	0.006
Elderly (\leq 65)	886/3691(24.0)	2367/13761(17.2)	775/4454(17.4)	0.07
Young ($>$ 65)	610/2233(27.3)	2720/11722(23.2)	727/4152(17.5)	<0.001
Intracranial hemorrhage, no. (%)	768(9.6)	2671(10.5)	830(9.6)	0.072
Pneumonia, no. (%)	438(7.4)	1596(6.3)	530(6.2)	0.051
Gastrostomy, no. (%)	751(12.7)	3470(13.6)	1315(15.3)	0.112
Tracheostomy, no. (%)	24(0.4)	1002(3.9)	355(4.1)	0.738
Length of stay (day)				
Mean (\pm SD)	12.44 (\pm 11.3)	10.8 (\pm 11.0)	10.8 (\pm 11.6)	0.250

Results (continued)

Outcome data. The overall in-hospital mortality in patients treated with endovascular IAT decreased significantly from 2004 (31.8%) to 2012 (17.1%) despite increases in the mean age ($p < 0.001$) and Charlson Comorbidity Index (CCI) of these patients ($p < 0.001$, Figure 2). The mortality decrease was significant from post-MERCI (25.3%), to post-Penumbra (20.1%), to post-Solitaire period (17.1%, Table 2). In subgroup analyses based on age, the mortality decrease from 3 periods of technological changes was significant for patients older than 65 (27.3% vs. 23.4% vs. 16.8%, $p < 0.001$), and trending towards significance for those younger than 65 (24.0% vs. 17.2% vs. 17.4%, $p = 0.07$).

Figure 2. Temporal trends in age, Comorbidity, and mortality rates in patients who underwent endovascular therapy

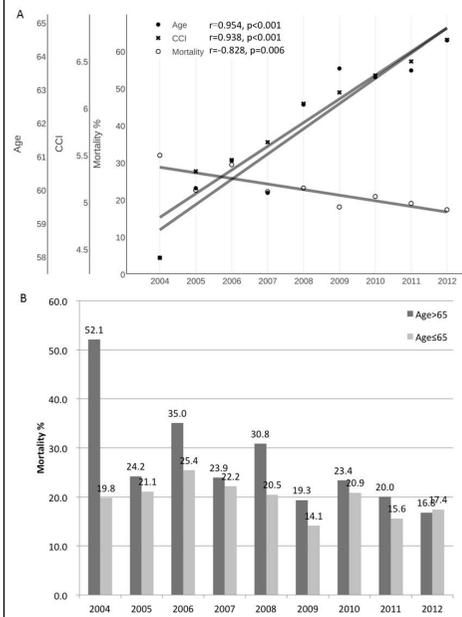
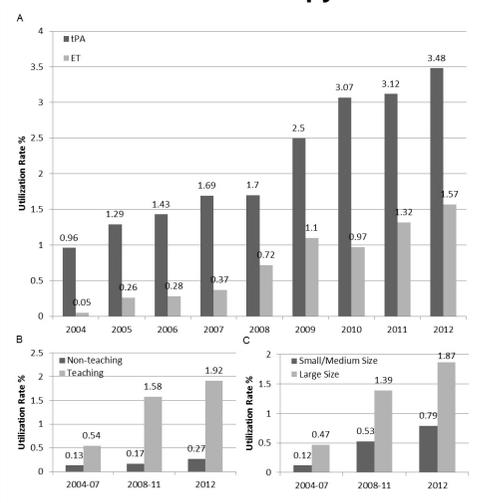


Figure 1. Utilization rates of IV tPA and endovascular therapy in stroke



Conclusions

Endovascular IAT utilization for acute ischemic stroke has increased significantly from 2004 to 2012. Despite significant increase in mean patient age and comorbidities, mortality associated with endovascular IAT has decreased from post-MERCI (2004-2007), post-Penumbra (2008-2011), to post-Solitaire (2012) era, significantly in patients between 65 and 80 years of age.