

Antiplatelet and Anticoagulation Therapy before an Ischemic Stroke Neither Precludes nor Complicates Intravenous Thrombolysis.

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Objectives: To ascertain the effect of baseline antiplatelet (AP), anticoagulation (AC), or dual antithrombotic (AP+AC) therapy on the likelihood of receiving intravenous thrombolysis with recombinant tissue plasminogen activator (tPA) after acute ischemic stroke and on subsequent hemorrhage rates.

Methods: We queried the Colorado Stroke Registry, a shared database of 38 Colorado hospitals. Patients with complete records of outpatient ischemic stroke seen within 180 minutes of onset were included in the analysis. The CSA database tracks standard contraindications to tPA, including INR > 1.7.

Results: Of 15,625 records, 1,322 (8.5%) met inclusion criteria. The table shows INR and NIHSS values for all patients in the groups of interest and for those without contraindications for tPA. Of the 777 patients (59%) without contraindications, 55% received tPA. AP patients were no more likely than controls (patients not previously on antithrombotics) to have tPA contraindications (39% vs. 40%, $p = 0.67$), and eligible patients were as likely to receive tPA (58% vs. 54%, $p = 0.33$). AC patients were more likely than controls to have tPA contraindications (66% vs. 40%, $p < 0.0001$), but eligible patients were as likely to receive tPA (70% vs. 54%, $p = 0.14$). AP+AC patients were as likely as controls to have tPA contraindications (50% vs. 40%, $p = 0.19$), and eligible patients were as likely to receive tPA (43% vs. 54%, $p = 0.33$). AP, AC or AP+AC therapy did not increase the risk of symptomatic intracerebral hemorrhage (SICH), serious systemic hemorrhage (SSH), or other serious complication (OSC), as seen in the table.

Conclusions: Pre-stroke AP, AC, or AP+AC therapy does not decrease the likelihood of tPA treatment in the absence of published contraindications. In contrast to some reports, eligible patients on AP, AC, or AP+AC therapy who receive IV tPA do not appear to have an increased risk of serious complications. We recognize, however, that numbers are small in some subgroups. A type-II statistical error cannot be excluded.

	All Patients				
	<u>Control</u>	<u>AP</u>	<u>AC</u>	<u>AP+AC</u>	<u>P</u>
N (%)	903 (68)	309 (23)	68 (5)	42 (3)	
INR mean (SD)	1.1 (0.5)	1.1 (0.5)	1.7 (0.9)	1.6 (0.7)	<0.0001
NIHSS mean (SD)	8.9 (7.6)	8.8 (7.6)	10.4 (8.4)	8.8 (7.4)	0.648
	Patients with no contraindications to tPA				
N (%)	543 (70)	190 (24)	23 (3)	21 (3)	
INR mean (SD)	1.1 (0.6)	1.1 (0.6)	1.3 (0.3)	1.2 (0.4)	<0.0001
NIHSS mean (SD)	9.7 (7.9)	9.3 (7.7)	9.8 (7.3)	9.6 (7.7)	0.905
	Outcomes after tPA treatment				
SICH: Y/N (%Y)	15/284 (5)	7/104 (6.3)	0/16 (0)	0/9 (0)	0.638
SSH: Y/N (%Y)	2/297 (0.7)	1/110 (0.9)	0/16 (0)	0/9 (0)	0.970
OSC: Y/N (%Y)	4/295 (1.3)	4/107 (3.6)	1/15 (6.3)	0/9 (0)	0.302

Return Home: A Practical Measure of IV-tPA Efficacy

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Introduction/Hypothesis: Years after regulatory approval, debate lingers about the effectiveness of intravenous tissue plasminogen activator (tPA) for acute ischemic stroke, perhaps because standard outcome measures (clinical outcomes at 3 months) are logistically & economically challenging. Alternative outcomes may be useful in monitoring tPA's effectiveness.

Methods: We queried the >8,700 ischemic strokes in the Colorado Stroke Registry (CSR), to see whether tPA affects the likelihood of home discharge (DC-Home). Selected patients arrived from the scene by EMS or private means, had onset in a community setting between 1/1/06 and 5/31/10, and had data on DC & tPA status. We excluded transfers between other hospitals and intra-arterial or research treatments. We used recursive partitioning to select cut points for variables in a logistic model of DC-Home.

Results: 5,550 patients met inclusion/exclusion criteria. Our model included: age, National Institutes of Health Stroke Scale (NIHSS), arrival by private means rather than by EMS, and whether tPA was given. Data were missing in at least one field (almost exclusively NIHSS) in 49 % of records. These were excluded from multivariate analysis. No values were imputed or assigned. The analysis was based on complete data from 2,812 patients. Of them, 415 (14.7%) received IV-tPA & 1443 (51.3%) were DC-Home. The model's discrimination was good (AUC; 95% CI = 0.81; 0.795-0.825). In unadjusted analysis, tPA was negatively associated with DC-Home: OR; 95% CI = 0.71; 0.59-0.85. However, in the multivariate model it was positively associated: OR; 95% CI = 2.03; 1.54-2.67. This gives a risk ratio (95% CI) of 1.36 (1.2-1.48), increasing the probability of DC-Home from 52.4% to 71.4%. The number-needed-to-treat (NNT) is 5.3.

Conclusions: Standard measures of tPA effectiveness are often unavailable. DC information is more readily available, and calling DC-Home a "good outcome" is reasonable, when the alternatives are rehabilitation, nursing facility, hospice or death. Thrombolysis is more likely to be administered to severe strokes. These are less likely to allow DC-Home, but when data are adjusted for age and stroke severity, the NNT for DC-Home is similar to the value for 3-month clinical outcomes, suggesting DC-Home may be a practical measure of tPA efficacy. Our conclusions are tempered by recognition of limitations that include the observational nature of our data and the incidence of missing data for NIHSS (particularly in non-treated patients). Additional analysis does not indicate that missing NIHSS values would alter our conclusions, but we cannot exclude the possibility. Finally, ours is a less-than-perfect model. There may be other determinants of DC-Home that would alter our results. We encourage others to attempt to replicate our findings with independent data.

Why Hospital Mortality is Not a Good Quality Indicator for Stroke

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Introduction/Hypothesis: Consumer-oriented hospital ratings are meant to improve health care by giving consumers the power to make quality-based choices. A key assumption is that there is a strong link between quality of care and the factors on which the ratings are based. A readily available and unambiguous outcome, hospital mortality (HM), is a commonly used metric of the quality of stroke care. To make fair comparisons among hospitals, cases are risk-adjusted based on administrative data, but this may not provide a reliable measure of quality. The most important determinants of HM may be variables (such as initial stroke severity) that are missing from administrative data sets -- and that are unalterable by either hospitals or care providers.

Methods: From the >8,700 ischemic strokes in the Colorado Stroke Registry (CSR) we constructed a predictive model of HM for stroke in order to understand the role of non-modifiable factors in HM. We used recursive partitioning to select factors for multivariate logistic models, which were assessed for their predictive value of HM.

Results: A total of 5,550 records from 29 hospitals met inclusion/exclusion criteria designed to identify ischemic strokes, occurring in a community setting, between 1/1/06 and 5/31/10, arriving by EMS or private transport, and having a known discharge status that excluded transfers to another hospital. In univariate analysis HM was correlated with such care-related issues as the occurrence of pneumonia, venous thromboembolism, and the use of tissue plasminogen activator. At eight hospitals the odds of HM were significantly greater than at the median-value hospital. The risk ratio for hospitals in the highest quartile was 6.8-fold greater than in the lowest quartile ($P < 0.0001$). However, when adjustment was made for admission National Institutes of Health Stroke Scale (NIHSS), a measure of stroke severity not found in administrative data sets, no hospital was significantly worse than the median for HM. A multivariate model (consisting of NIHSS, Arrival-by-EMS, Ability-to-Ambulate-at-Admission, and being Marked-as-Comfort-Care) showed an area under the receiver operator characteristic curve of 93.6%, with 96.9% of cases correctly classified.

Conclusions: Outcomes for stroke patients are strongly dependent on the severity of the stroke, as indicated by the initial NIHSS score. This variable is not found in administrative data, and it cannot be changed by hospital treatment. When adjusted for the initial NIHSS, not one of the 29 hospitals showed a HM that was significantly greater than the median value, although eight had significantly greater values before the adjustment. It is possible to account for most of the variation in HM by factors that are unaffected by the care provided. For this reason, we suggest that HM, unadjusted for initial stroke severity, is not a good measure of hospital quality-of-care for stroke.

Hospital Patient Volume Correlates with the Likelihood, but not the Promptness or Risk of tPA

Don B Smith, Paul Murphy, William Jones

Introduction/Hypothesis: A positive relationship between hospital patient-volume (HV) and outcomes is widely acknowledged. We asked whether this relationship holds between the HV for ischemic stroke and variables such as the likelihood, promptness, and risks of IV tissue plasminogen activator treatment (tPA).

Methods: We used the Colorado Stroke Registry, a prospective database shared by 38 hospitals, to identify patients meeting these criteria: ischemic stroke with onset in a community setting and arrival to hospital from the scene by EMS or private means within 180 minutes. Transfers between hospitals were excluded. We explored the relationship of HV (the # of included records from each hospital) with the hospital-specific relative risks for: receiving tPA, receiving tPA within one hour, having a listed contraindication to tPA, and having symptomatic intracerebral hemorrhage (SICH) after tPA. We also compared HV to median arrival-to-CT and median arrival-to-tPA times. Statistical comparisons were made by linear regression, Chi-Square, t-test, and Kruskal-Wallis, as appropriate.

Results: From >8,700 ischemic strokes we identified 2,136 patients meeting inclusion criteria. HV ranged from 1 to 289 patients across 32 hospitals with data. The median HV was 31, with an interquartile range of 4.5-127. HV was not significantly correlated with: median age, gender, median NIHSS, median onset-to-arrival-time, or mode of arrival. HV was strongly correlated with the likelihood of receiving tPA, which was 3 times more likely in hospitals above the HV median as compared to those below (24% vs. 8%, $p = 0.0002$). HV was not correlated with: tPA-in-1-hour, median arrival-to-CT-time, median arrival-to-tPA-time, listed contraindications to tPA, or SICH.

Conclusions: Our data show that the number of ischemic strokes recorded by hospitals correlates positively with the likelihood of receiving tPA. It does not, however, correlate with the promptness of either CT scanning or tPA administration. Neither does it correlate with the risk of SICH following tPA. As a caveat, we acknowledge limitations in our conclusions: our data are observational in nature and based on self-reporting from hospitals. Nevertheless, this analysis suggests that “practice does not make perfect” for tPA use in ischemic stroke. This is surprising since a positive correlation between volume and outcome is seen in skill-dependent procedures such as heart surgery. In comparison, administration of tPA is a relatively low skill procedure (although one requiring considerable clinical judgment). Lower volume hospitals appear to be capable of giving tPA as quickly and as safely as higher volume hospitals, but they are significantly less likely to use tPA at all. These findings, if confirmed by other investigators, may have relevance in planning and improving stroke systems of care.