Redefinition of Transient Ischemic Attack Improves Prognosis of Transient Ischemic Attack and Ischemic Stroke
An Example of the Will Rogers Phenomenon

Michael T. Mullen, MD; Brett L. Cucchiara, MD

Background and Purpose—The recent redefinition of transient ischemic attack (TIA) reclassifies patients with acute infarction on magnetic resonance imaging as ischemic stroke. Redefinition will improve the prognosis of both TIA and ischemic stroke, an epidemiological paradox known as the Will Rogers phenomenon. We sought to quantify the impact of this phenomenon.

Methods—Incidence of TIA, risk of death/disability after stroke, rate of acute infarction on magnetic resonance imaging after TIA, and 90-day stroke risk after TIA with and without infarction on magnetic resonance imaging were determined based on published data. The impact on poststroke disability in the redefined cohort of patients with ischemic stroke was computed. A sensitivity analysis was performed to account for uncertainty in input variables.

Results—Using the new TIA definition, the 90-day risk of stroke following TIA is 1%. In the United States, redefinition will increase annual ischemic stroke incidence from 691 650 to 747 755 and result in a 3.4% absolute reduction in poststroke disability. In a sensitivity analysis, this risk reduction varies from 1.5 to 6.5%, and is most dependent on the incidence of TIA.

Conclusions—Redefinition of TIA reduces stroke risk after TIA to approximately 1% at 90 days, and reduces the rate of poststroke disability by approximately 3.4%. (Stroke. 2011;42:3612-3613.)

Key Words: TIA • definitions • prognosis • epidemiology

In 2009, the American Heart Association endorsed a change in the definition of transient ischemic attack (TIA) from a clinical, time-based definition to a tissue-based definition.1 The revised TIA definition requires transient neurological dysfunction due to a vascular cause without evidence of acute infarction. If infarction is present, then the event is reclassified as an ischemic stroke. The impact of reclassification on the incidence of stroke and TIA has been estimated; however, the impact of reclassification on the prognosis of stroke has not been quantified.2 Individuals with classically defined TIA with evidence of acute infarction on magnetic resonance imaging (DWI+) are at dramatically higher risk of subsequent stroke than are those without infarction (DWI−).3 Therefore, redefinition improves the prognosis of TIA substantially. Reclassifying DWI+ TIA patients as having had an ischemic stroke will reduce the percentage of stroke patients with disability. A change in diagnostic criteria that appears to improve the prognosis of two disease states without altering prognosis at the individual level has been termed the Will Rogers phenomenon, after an aphorism made by the social commentator: “When the Okies left Oklahoma and moved to California, they raised the average intelligence level in both states.”4 We sought to quantify this phenomenon related to redefinition of TIA.

Methods

TIA incidence rates have been estimated previously.2 We updated this estimate using the same search strategy and criteria as previously reported.2 Extrapolation from TIA incidence rates to absolute number of TIA patients was performed using the total United States population from the 2010 census.5 We performed a literature search in MEDLINE (1985–present) to determine the risk of death or disability after stroke, defined by a modified Rankin scale ≥3. Search terms included stroke, disability, prognosis, outcome, epidemiology, population, and Rankin. Inclusion criteria were: United States population-based, unselected stroke population (all subtypes and severities included). Studies that included intracranial hemorrhages or did not account for fatal strokes were excluded. A 90-day outcome was selected because TIA prognosis is frequently measured at 90 days, and 90-day stroke outcome correlates well with long-term disability.6 The annual incidence of classically defined ischemic stroke was extracted from the 2010 American Heart Association Heart Disease and Stroke Statistics.7 The rate of DWI+ TIA and subsequent stroke risk after TIA with and without infarction were determined from a collaborative study, which combined data from 12 independent centers and incorporated a systematic review with previously unpublished data.3,8 This represents the most comprehensive analysis of TIA stratified by DWI available. Poststroke death/
Disability was assumed to be equivalent in primary strokes and stroke following TIA.

**Results**

The annual incidence of ischemic stroke is 691,650. The annual incidence of TIA ranges from 113,960 to 338,800, with a median of 203,280 (Supplemental Table S1, http://stroke.ahajournals.org). In the United States, redefinition will increase annual ischemic stroke incidence from 691,650 to 747,755. Only 1 study reporting the risk of disability after stroke met all inclusion/exclusion criteria. This study reported a death/disability rate of 48.6% at 90 days after stroke. It is estimated that 27.6% of TIA patients will have a DWI lesion on magnetic resonance imaging. The rate of stroke at 90 days after DWI+ TIA is 7.7%, and after DWI− TIA is 1.0%. Redefinition will reduce the proportion of patients disabled after stroke by 3.4%. A sensitivity analysis was performed over a range of assumptions (Table). In this analysis, the absolute reduction in disability is largely dependent on TIA incidence and varied from 1.5% to 6.5%.

**Discussion**

Our analysis quantifies the effect of the Will Rogers phenomenon related to redefinition of TIA. Using this definition, only DWI− patients would be classified as TIA. A recent study suggests that the 90-day risk of stroke in this population is 1.0%, and is consistently low regardless of ABCD2 score. Redefining TIA thus transforms it into a relatively benign, low-risk condition. Similarly, but to a lesser degree, the prognosis of ischemic stroke is also improved by redefinition.

Estimates of TIA incidence, average poststroke disability, and the rate of subsequent stroke in patients with DWI+TIA are imprecise. Our base case estimate of poststroke disability comes from a single study; however, disability rates reported in other countries are similar, ranging approximately from 40% to 55%. The estimate of subsequent stroke in DWI+ patients may be biased by the patient population included and center-based treatment effects, but the absolute risk reduction is relatively insensitive to changes in the risk of stroke after DWI+ TIA. Our analysis assumes that all TIA patients receive an magnetic resonance imaging. In practice, magnetic resonance imaging utilization is likely to be significantly lower, reducing the overall impact of the Will Rogers phenomenon.

Reclassifying DWI+ TIA as ischemic stroke increases the incidence of stroke and reduces the percentage of stroke patients dead or disabled at 90 days. Redefinition does not alter the total number of people disabled by stroke, nor does it alter risk at the individual level. Our analysis emphasizes that estimates of recurrent stroke after TIA, stroke incidence, and poststroke disability using the revised definitions should not be compared with historical estimates using classical definitions.

**Disclosures**

None.

**References**

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http://stroke.ahajournals.org/content/42/12/3612

Data Supplement (unedited) at:
http://stroke.ahajournals.org/content/suppl/2011/09/20/STROKEAHA.111.627877.DC1

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Supplemental Material

Supplemental Table 1. TIA Incidence

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<th>Population</th>
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<th>Annual TIA per 100,000 population</th>
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*Based on total population from 2010 Census, 309 million