

Stroke Prevention: The Best Outcome after a Transient Ischemic Attack. Results from the Minnesota Stroke Registry and Opportunities to Improve Care

Abstract

A transient ischemic attack (TIA) is an opportunity for stroke prevention. We examined the care of 708 TIA patients entered into the Minnesota Stroke Registry (MSR) and analyzed the extent to which they were discharged on appropriate guideline-recommended secondary prevention treatments. We calculated the overall number of strokes prevented by multiple risk factor modifying treatments. Of the 708 TIA patients, 533 (75%) were discharged on antihypertensive treatment. Of 208 patients with an LDL-Cholesterol greater than 100 mg / dl, 131 (63%) patients were prescribed lipid-lowering medications. Anticoagulation treatment was prescribed in 76% (82 of 108) of patients diagnosed with atrial fibrillation during hospitalization. Anti-thrombotic therapy was prescribed in 94% (563 of 600) TIA patients without atrial fibrillation. We estimated that 104 strokes will be prevented over 5 years due to combining multiple treatments assuming a baseline stroke risk of 60% in atrial fibrillation patients and 17% in non-atrial fibrillation patients over 5 years.

Keywords: Transient ischemic attack

Journal of Vascular and Interventional Neurology 2008;1(4):118-121

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A transient ischemic attack (TIA) is a medical emergency and an opportunity for stroke prevention. American Heart Association recommendations for prevention of vascular events after TIA include antihypertensive treatment beyond the hyperacute period for patients with or without a history of hypertension; glucose control with aggressive hypertension treatment and lipid management in diabetic individuals; life-style modification, dietary guidelines and treatment with cholesterol lowering agents for those with elevated cholesterol, comorbid coronary artery disease or symptomatic atherosclerotic disease. The target for lipid management in this population is a low-density lipoprotein cholesterol (LDL-C) level of <100 mg/dL with a recommended LDL-C <70 mg/dL for very high-risk persons with multiple risk factors. Antiplatelet agents are recommended for preventing recurrent stroke and other cardiovascular events. In those with a high-risk source of cardioembolism long-term anticoagulation is recommended.¹⁻³ Herein, we examine the care of patients discharged with a clinical diagnosis of TIA using data from the Minnesota Stroke Registry. Our aim is to determine whether patients hospitalized after TIA in Minnesota are discharged with evidence-based secondary prevention treatments in place, and identify opportunities for stroke prevention.

Data and Methods

The Minnesota Stroke Registry (MSR), part of the Paul Coverdell National Acute Stroke Registry (PCNASR), collects quality of care information on acute stroke and TIA patients and aims to facilitate the implementation of interventions to improve the quality of stroke care in Minnesota hospitals. Hospital participation is voluntary. Trained abstractors from participating hospitals enter data via a web-based interface concurrent with or soon after patient care using standard data definitions provided by the Centers for Disease Control.

We examined the care of patients discharged with a clinical diagnosis of TIA from January 1, 2008 to December 31, 2008. We calculated the expected number of strokes prevented due to each treatment in a five year period using the best available evidence on recurrent stroke prevention by treatment/modification of risk factors such as hypertension,⁴ dyslipidemia,⁵ atrial fibrillation (AF)⁶ and anti-thrombotic therapy.⁷ We converted cumulative incidence and incidence rates reported in literature to 5-year cumulative incidence assuming a linear relationship. Patients with contraindications were included in the calculation of stroke prevented.

The specific measures examined were:

1) Patients discharged on anti-hypertensive medication.

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- 2) Patients with LDL-C >100mg/dL discharged on any lipid lowering medication.
- 3) Patients with AF detected or documented during hospitalization and discharged on anticoagulant medication.
- 4) Patients without AF discharged on antithrombotic medication.

Table 1. Demographics and risk factors from Minnesota Stroke Registry TIA population

TIA Patient Characteristics (N=708)	Patients
Mean age ± SD, years	72±15
Women	398 (56%)
Arrival Mode to emergency room	
Emergency medical service ambulance	341 (48%)
Private transportation	335 (47%)
Not documented	32 (5%)
Ethnicity	
White	557 (79%)
Hispanic or Latino	9 (1%)
Risk factors by history	
Hypertension	551 (78%)
Dyslipidemia	361 (51%)
Diabetes mellitus	179 (25%)
Coronary artery disease	175 (25%)
Atrial fibrillation	107 (15%)
Lipid profile evaluated (LDL-C)	484 (68%)
Discharge Medications	
Antihypertensives	533 (75%)
Antithrombotics	668 (94%)
Cholesterol reducing medication	429 (61%)
Able to ambulate independently prior to TIA	624 (88%)
Able to ambulate independently at discharge	550 (78%)

Table 2. Best evidence for risk factors treatment in patients with Transient Ischemic

Evidence	Design	Total patients	Treatment events (rate)	Placebo events (rate)	Follow-up Duration	Primary outcome
PROGRESS (4)	Perindopril and indapamide versus placebo in stroke or TIA patients in the last 5 years	6105	307 (10%)	420 (14%)	4 years cumulative incidence	Fatal or non-fatal stroke
SPARCL (5)	Atorvastatin versus placebo in Stroke or TIA patients without CAD within the previous 6 months	4731	265 (11.2%)	311 (13.1%)	4.9 years cumulative incidence	Fatal or non-fatal stroke
EAFT (6)	Open anticoagulation vs. double-blind treatment aspirin or placebo in IS or TIA	1007	20 (4%)	50 (12%)	Annual rate	All strokes (first event only).
Antiplatelet Trialists' Collaboration (7)	Antiplatelet therapy vs. control in Stroke or TIA	10,000	479 (8.2%)	600 (10.2%)	3 years	Non-fatal stroke

Abbreviations used:

PROGRESS: The perindopril protection against recurrent stroke study

SPARCL: (Stroke Prevention by Aggressive Reduction in Cholesterol Levels) Study

EAFT : (European ATRial Fibrillation Trial) Study Group.

Antiplatelet Trialists' Collaboration: Collaborative overview of randomized trials of Antiplatelet therapy Prevention of death, myocardial infarction, and stroke by prolonged antiplatelet therapy in various category of patients.

We calculated the overall number of strokes prevented by multiple risk factor modification using the method proposed by Yusuf et al.^{8,9} We estimated the cumulative risk reduction (RRR) assuming that the effect estimates of each treatment were independent ($RRR = [1 - RR_1 \times RR_2 \times RR_3] \times 100$). RR refers to relative risk in the above equation. The absolute reduction (ARR) over 5 years was calculated as: $ARR = RRR \times$ baseline risk; and the number of strokes prevented as: number of patients \times ARR. We divided patients into two sets: atrial fibrillation and non-atrial fibrillation patients. Baseline risk for atrial fibrillation patients was taken from the European Atrial Fibrillation Trial⁶ and for non-atrial fibrillation patients from the pooled results of the Antiplatelet Trialists Collaboration.⁷ The effect estimate for lipid lowering medication was applied to all patients, whether they had a LDL-C >100mg/dL or not.

Results

A total of 708 TIA hospital discharges were entered into the MSR by 13 participating hospitals during 2008. The mean age was 72 years, and 56% were women. Many patients arrived at hospital emergency department using emergency medical service ambulances (48%) or private transportation (47%). Transportation modality was undocumented in the remainder. The proportion of whites was 79%, and only 1% was Hispanic or Latino. The following risk factors were identified: hypertension (78%), dyslipidemia (51%), diabetes mellitus (25%), and Coronary Artery Disease (25%). Almost 70% of TIA patients had LDL-C levels examined. On discharge, 75% were prescribed antihypertensive medications, 94% were prescribed antithrombotic treatment, and of 208 patients with LDL-C >100 mg/dL, 63% were prescribed a cholesterol lowering agent. AF was detected in 108 patients, i.e. 15% of all TIA patients. Of these 108 patients, 90 (83%) had a history of TIA as well. Also, 76% of in-hospital

AF patients were discharged on anticoagulant medication. Antithrombotic therapy was prescribed in 94% (563 of 600) TIA patients without AF. Related to patient outcomes, while all the 708 patients were classified as having a clinical diagnosis of TIA on discharge, some of them were less mobile at discharge than prior to admission. I.e., 90% of the patients were able to ambulate independently prior to the TIA admission; at discharge only 80% were able to ambulate independently (Table 1). We chose the best evidence for risk factor modification in patients with ischemic stroke and TIA to calculate outcome

gains (Table 2). Based on event rates of fatal or non-fatal stroke reported in PROGRESS,⁴ SPARCL,⁵ EAFT,⁶ and Antiplatelet Trialists' Collaboration⁷ trials, we estimated that we will prevent the following over the next 5 years: 27 strokes due to antihypertensive drugs, 3 strokes due to lipid-lowering drugs, 40 strokes due to antithrombotic drugs in atrial fibrillation patients, and 19 strokes in non-atrial fibrillation patients (Table 3). We estimated that 104 strokes will be prevented over 5 years by treatments addressing multiple risk factors assuming a 5 years baseline risk of 60% in atrial fi-

Table 3. Secondary Prevention in MN Registry TIA population

	Patients eligible for treatment	Number treated (%)	Strokes prevented due to treatment over 5 years	Number not treated (%)	Strokes that could have been prevented in 5 years
Hypertension	708	533 (75%)	27	175 (25%)	9
Not on medication at admission	208	58 (28%)		150 (72%)	
Dyslipidemia LDL-C >100 mg/dL	208	131 (63%)	3	59 (28%) 18 (9%) ci*	1
Not on medication at admission	161	87 (54%)		57 (35%) 17 (10%) ci	
No LDL evaluation	224	117 (52%)		85 (38%) 22 (10%) ci	
Atrial Fibrillation detected in hospital	108	82 (76%)	40	9 (8%) 17 (16%) ci*	4
Not on medication at admission	15	12 (80%)		1 (7%) 2 (13%) ci	
Non-atrial fibrillation patients	600	563 (94%)	19	19 (3%) 18 (3%) ci*	1
Not on antithrombotic medication at admission	214	188 (88%)		16 (7%) 10 (5%) ci	

Abbreviations used: ci: contraindication, for dyslipidemia ci includes family/patient refusing treatment; *patients with contraindications were included in the calculation of strokes prevented

brillation patients and 17% in non-atrial fibrillation patients.

Discussion

A substantial proportion of patients hospitalized for TIA in the MSR received anti-hypertensive medications on discharge, a rate higher than that reported in other studies such as the California Acute Stroke Prototype Registry (CASPR) which reported a treatment rate 63% in TIA patients.¹⁰ Lipid profiles were evaluated in 68% of TIA discharges in our registry and lipid-lowering drugs were prescribed to 131 patients with LDL-C >100mg/dL (63%). This is again higher compared to prior reports from the PCNASR of TIA patients with TIA and stroke (40% had a lipid profile)¹¹ and CASPR (36% had a lipid profile evaluated and 34% were given a lipid lowering

agent).¹² Because lipid-lowering agents were also prescribed in patients whose LDL-C was not examined, we may have slightly underestimated the number of stroke prevented. The use of antithrombotic medication prescribed at discharge in TIA patients without atrial fibrillation was high (94%). The rate of anticoagulation in TIA patients diagnosed with atrial fibrillation was 76%, similar to rates reported in PCNASR.¹¹ Among atrial fibrillation patients, 16% had documented contraindications for anticoagulant therapy. The estimated number of strokes prevented over 5 years in hospitals participating in the MSR was 104, representing 15% of TIA patients. These results suggest that physicians are practicing effective stroke prevention.

There are several limitations in this work. Despite the use of standardized data definitions, there may have been varia-

tions in the clinical diagnosis of TIA. Data accuracy is obviously limited by the quality and completeness of the medical records. We do not have the data to stratify TIA patients by risk of early stroke recurrence, nor do we have information on other risk reducing interventions such as carotid endarterectomies. The fact that some patients were discharged with a diagnosis of TIA but were less independent than they were at admission in terms of ambulation raises the question as to whether these patients were TIAs or were in fact minor strokes.

In conclusion, the rates of appropriate TIA treatment in the MSR are encouraging. A substantial number of strokes may have been prevented due to the secondary preventative treatments instituted on discharge.

Disclosure/Acknowledgements

Kamakshi Lakshminarayan was supported by an NINDS/NIH career development award K23NS051377 during this work. This study was supported by a co-operative agreement, U58DP000857 from the Centers for Disease Control. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC. The authors thank participating Minnesota hospitals for their commitment to the care of stroke patients in the community.

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