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Recognition and Management of Perioperative Stroke in Hospitalized Patients

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Abstract

We sought to characterize stroke management and outcomes in a postoperative population. Using electronic medical records we identified 39 patients suffering perioperative stroke after noncardiac and non-neurosurgical procedures for whom documentation of management and outcomes was available. Thirty-three strokes occurred during admission while 6 occurred after discharge and were recognized upon return to the hospital. Perioperative stroke was associated with delayed recognition, infrequent intervention, and significant rates of morbidity and mortality, suggesting the need for improved screening and more rapid treatment. There may be disparities in care and outcomes between in-hospital and out-of hospital stroke patients, though further study is warranted.

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The authors declare no conflicts of interest.

Introduction

It has recently been reported that patients with in-hospital stroke have worse outcomes compared to community-onset stroke; in this cohort nearly 50% of the inpatient strokes were perioperative.[1] Given that surgery increases the risk of stroke,[2,3] and stroke recognition and management are more complicated in the perioperative period, surgical patients may be at particular risk for poor stroke outcomes. In a low-risk surgical patient population, we sought to further characterize stroke management and outcomes in patients suffering perioperative stroke. We classified cases according to whether stroke happened while patients were still hospitalized ("in-hospital strokes") or discharged and returning to the emergency department (ED) for treatment ("out-of hospital strokes").

Consent for Publication

Patients were a de-identified cohort and events studied occurred more than 3 years ago. IRB approval was obtained for the study and no consent was required at time of patient identification.

Methods

The study was approved by the University of Michigan Medical School IRB, and the requirement for written informed consent was waived. Electronic records of all patients undergoing noncardiac and non-neurosurgical procedures between 2003 and 2009 at the University of Michigan were screened for postoperative head computed tomography or brain magnetic resonance imaging. We previously published stroke incidence and risk factor data for this large cohort.[4] From these stroke cases, a subset with available detailed clinical data (2006–2009) was hand-reviewed for stroke recognition and treatment patterns. Demographic information, details of infarct timing and distribution, as well as outcomes data were collected. Perioperative stroke was defined as stroke occurring within 30 days of surgery.

Results

Thirty-nine patients suffering perioperative stroke were identified; 33 strokes (33/39, 85%) were identified in the hospital (in-hospital) and the remaining 6 (6/39, 15%) were associated with symptoms after discharge and were diagnosed upon return to the ED (out-of-hospital). Four patients (4/39, 10%) emerged from anesthesia with a new deficit and 44% (17/39) of strokes were recognized on postoperative days 0 or 1. The majority of strokes (30/39, 77%) occurred within the first 4 days after surgery. Six patients (6/39, 15%) presented with changes in mental status only, no focal sensorimotor deficits were noted in medical documentation. Only 15% (5/33) of in-hospital stroke patients had an imaging study within 6 hours of when they were last known to be at their neurological baseline. As such, at least 85% of patients did not receive neuroimaging within the 3-hour timeframe for tissue plasminogen activator eligibility per 2005 guidelines (study period was from 2006 – 2009).[5] Once neurologic symptoms were recognized, only 39% (13/33) of inpatients had an imaging study within 6 hours. For out-of-hospital stroke patients returning to the ED, only 17% (1/6) presented within 6 hours of when they were last known to be neurologically intact.

Compared to in-hospital patients, however, all (6/6, 100%) out-of hospital patients received neuroimaging within 6 hours of symptom onset. Thus, there was an apparent delay in neuroimaging after symptom recognition in the in-hospital cohort (Table 1). With the exception of one patient, all patients (38/39, 97%) were evaluated by neurology. For the entire cohort, only one (1/39, 3%) patient received intra-arterial tissue plasminogen activator. Although small numbers limit formal statistical analysis, there was no mortality in the out-of hospital subset and all of these patients were discharged to home. In contrast, mortality for the in-hospital stroke patients was 36% (12/33) and only 13 of this subset (13/33, 39%) were discharged home (Table 1).

Discussion

In this small observational study with a diverse surgical population, 44% of strokes occurred in the immediate perioperative period (postoperative days 0 and 1). Despite routine clinical assessment of these hospitalized patients, recognition of neurologic deficits was frequently delayed beyond the period of eligibility for acute intervention. In fact, acute intervention for stroke was infrequently documented as a clinical option. Of note, 15% of patients presented with mental status changes only with no appreciable focal deficits, a clinical presentation which may have hindered stroke recognition in the setting of anesthetic recovery and analgesic therapy. Patients suffering out-of-hospital stroke were seemingly evaluated more rapidly upon return to the ED and tended to have better outcomes. However, many confounders could be present that may have impacted these apparent differences. For example, National Institutes of Health Stroke Scale data were not available for the majority of patients, and thus, initial stroke severity could not be determined. Detailed physiological data were also not available around the time of index stroke. A larger sample size would also be required to control for confounds such as lower baseline morbidity.

Ultimately, this series provides evidence that surgical patients suffering perioperative stroke may not be recognized during the window of eligibility for acute intervention. Anesthesiologists should be aware of the risk factors for stroke (Table 2) and ensure that surgical teams are aware of patients at high risk for this devastating complication. Our findings, in conjunction with the recent work of Saltman et al.,[1] highlight the need for improved perioperative and inpatient stroke recognition and treatment. Anesthesiologists can play a vital role in this process.

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Table 1

Perioperative Stroke Management

Management Characteristics	Hospitalized (n = 33)	Discharged and Returning to ED[a] (n = 6)
NIHSS[b] Recorded (%)	2/33 (6.0)	0/6 (0)
Time LKW[c] to neuroimaging[d]		
Within 6 hours (%)	5/33 (15)	1/6 (17)
Within 8 hours (%)	6/33 (18)	1/6 (17)
Symptom recognition to neuroimaging[d]		
Within 6 hours (%)	13/33 (39.4)	6/6 (100)
Within 8 hours (%)	16/33 (48.5)	6/6 (100)
Documented thrombolysis discussion (%)	5/33 (15.2)	3/6 (50)
Thrombolysis (%)	1/33 (3.0)	0/6 (0)
Mortality[e] (%)	12/33 (36.4)	0/6 (0)
Disposition		
Home (%)	13/33 (39.4)	6/6 (100)
Care Facility (%)	8/33 (24.2)	0/6 (0)

[a] ED = Emergency Department;

[b] NIHSS = National Institutes of Health Stroke Scale;

[c] LKW = Last Known Well;

[d] Categorization within 6 hours and 8 hours based on available data in medical documentation;

[e] Defined as death during admission for index stroke

Table 2

Commonly Identified Risk Factors for Perioperative Stroke – Noncardiac, Nonneurologic Surgery

Perioperative Stroke Risk Factors	Adjusted OR[a] (95% CI[b])
Age[c]	**3.9** (3.0 – 5.0)[6]
	1.43 (1.35 – 1.51)[7]
	1.02 (1.01 – 1.04)[8]
History of cerebrovascular disease[d]	**7.1** (4.6 – 11.0)[9]
	2.9 (2.3 – 3.8)[6]
	1.72 (1.29 – 2.30)[8]
	1.64 (1.25 – 2.14)[7]
Atrial fibrillation	**5.5** (2.8 – 10.9)[9]
	1.95 (1.69 – 2.26)[7]
Cardiac disease[e]	**3.8** (2.4 – 6.0)[6]
	1.44 (1.21 – 1.70)[7]
	1.42 (1.07 – 1.87)[8]
Acute renal failure	**3.6** (2.3 – 5.8)[6]
	2.03 (1.39 – 2.97)[8]

[a] OR = Odds Ratio;

[b] CI = Confidence Interval;

[c] defined as > 62 years old in Mashour et al.[6], age per 10 years in Bateman et al.[7], and 1 year increase in age in Sharifpour et al.[8];

[d] further defined as previous stroke in Mashour et al.[6] and Bateman et al.[7], defined as history of stroke, transient ischemic attack, or existing hemiplegia in Sharifpour et al.[8];

[e] defined in Mashour et al.[6] as myocardial infarction within 6 months, defined in Bateman et al.[7] as congestive heart failure, and defined in Sharifpour et al.[8] as myocardial infarction within 6 months, history of cardiac revascularization, or congestive heart failure within 30 days;

[f] this reflects patients requiring preoperative dialysis.