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Hospital Readmission Rates among Mechanically Ventilated Stroke Patients

Shouri Lahiri, MD¹, Babak B. Navi, MD, MS^{2,3}, Stephan A. Mayer, MD⁴, Axel Rosengart, MD, PhD⁵, Alexander E. Merkler, MD^{2,6}, Jan Claassen, MD, PhD⁶, and Hooman Kamel, MD^{2,3}

¹Department of Neurology and Neurosurgery, Cedars-Sinai Medical Center

²Department of Neurology, Weill Cornell Medical College, New York, NY

³Feil Family Brain and Mind Research Institute, Weill Cornell Medical College, New York, NY

⁴Mount Sinai Health System, Icahn School of Medicine at Mount Sinai, New York, NY

⁵Department of Neurology, Neurosurgery, and Biomedical Sciences, Cedars Sinai Medical Center, Beverly Hills, LA

⁶Department of Neurology, Columbia College of Physicians and Surgeons, New York, NY

Abstract

Background and Purpose—Tracheostomy is frequently performed in patients with severe ischemic stroke, intracerebral hemorrhage, or subarachnoid hemorrhage. Little is known about readmission rates among stroke patients who undergo mechanical ventilation.

Methods—We used previously validated *ICD-9-CM* codes and data on all discharges from nonfederal acute care hospitals in three states. We compared readmission rates among mechanically ventilated stroke patients who were discharged with or without a tracheostomy.

Results—Among 39,881 patients who underwent mechanical ventilation during the index stroke hospitalization and survived to discharge, 10,690 (26.8%; 95% confidence interval [CI], 26.4–27.2%) underwent tracheostomy. During a mean follow-up period of 3.4 (\pm 2.0) years, the overall incidence rate of readmissions was 4.25 (95% CI, 4.22–4.28) per 100 patients per 30 days. The rate of any readmissions within 30-days was 26.9% among patients with tracheostomy compared to 22.5% among those without a tracheostomy (absolute risk difference, 4.4%; 95% CI, 3.5–5.4%; $P < 0.001$). After adjustment for potentially confounding variables, tracheostomy was associated with a slightly increased readmission rate (incidence rate ratio [IRR], 1.07; 95% CI, 1.03–1.11).

Conclusions—Approximately one-quarter of mechanically ventilated stroke patients who survive to discharge are readmitted to the hospital within 30 days. Readmission rates are significantly higher in stroke patients who undergo tracheostomy, but the difference is not clinically meaningful. Thirty-day readmission rates among mechanically ventilated stroke patients are similar to Medicare beneficiaries hospitalized with major medical diseases like pneumonia.

Correspondence to: Shouri Lahiri, MD, AHSP Suite A6600, 127 S. San Vicente Blvd, Los Angeles, CA 90048, shouri.lahiri@cshs.org, Telephone: 310-423-0814, Fax: 310-967-8739.

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Keywords

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Ischemic stroke (IS), intracerebral hemorrhage (ICH), and subarachnoid hemorrhage (SAH) often cause respiratory failure due to injury to vital structures responsible for respiration, arousal, and airway protection [1]. After initial endotracheal intubation, tracheostomy may be performed for long-term management of respiratory and airway failure. We have shown that 12.5% of all patients with stroke receive mechanical ventilation (MV) and 16.3% of these patients undergo tracheostomy [2], which is considered a hallmark of chronic critical illness [3].

Hospital readmissions for patients with chronic critical illness are common and increasingly recognized as a major cause of morbidity and health care spending in the United States [4]. Prior studies on readmission rates have been largely limited to medical and surgical intensive care populations [5]. Little is known about readmission rates of patients with stroke who require MV. In this study, we used statewide administrative claims data to examine population-based readmission rates for patients with stroke who received MV, stratified by whether tracheostomy was performed.

Methods

Design

We used statewide administrative claims data collected by California, Florida, and New York and provided to the Agency for Healthcare Research and Quality as part of the Healthcare Cost and Utilization Project [6] (see the Methods Supplement). Our study was approved by the Weill Cornell Medical College institutional review board.

Patient population

A previously validated *International Classification of Diseases, 9th Edition, Clinical Modification (ICD-9-CM)* code algorithm was used to identify patients discharged with a first-recorded diagnosis of IS (433.x1, 434.x1, and 436), ICH (431), and SAH (430) (see the Methods supplement) [7]. We included only patients who underwent MV during the index hospitalization for stroke and were discharged alive. MV was identified using *ICD-9-CM* procedure codes that have been previously validated as 86% sensitive and 98% specific [8]. Once identified, index stroke patients were followed throughout the study period for inpatient readmissions and death.

Measurements

Our key predictor variable was tracheostomy, identified using *ICD-9-CM* codes that have been previously validated as 100% sensitive and 96% specific to detect incident tracheostomy placement [2]. We adjusted for several covariates that may confound the relationship between tracheostomy status and the risk of readmission (see Methods supplement for full list of variables). To explore reasons for readmission, we tabulated the most common primary diagnoses upon readmission.

Statistical Analysis

Descriptive statistics with exact confidence intervals [CI] were used to report rates of any readmission within 30-days. The χ^2 -test was used to compare proportions while the t-test or rank-sum test were used to compare continuous variables. We used survival statistics to report incidence rates of hospital readmission, and Poisson regression analyses with robust standard errors to determine the adjusted incidence rate ratio (IRR) for tracheostomy versus no tracheostomy in relation to readmission. The proportional hazards assumption was confirmed by visual inspection of log-log plots. Since we lacked data on out-of-hospital deaths, we performed sensitivity analyses in which we censored patients at the time of their last hospitalization rather than assuming that they were alive throughout the entire period for which we had data. In subgroup analyses, we compared the association between tracheostomy and readmission rates among individual stroke subtypes.

Results

Among 39,881 patients with stroke who received MV during the index hospitalization and survived to discharge, 10,690 (26.8%; 95% CI, 26.4–27.2%) received a tracheostomy. See Supplemental Table I of the Data supplement for baseline and demographic characteristics. Among the 29,191 patients who did not receive a tracheostomy during the index hospitalization, the cumulative rate during follow-up of tracheostomy placement at a subsequent readmission was 0.7% (95% CI, 0.6–0.8%).

During a mean follow-up period of 3.4 (± 2.0) years, the overall incidence rate of readmissions was 4.25 (95% CI, 4.22–4.28) per 100 patients per 30 days. This rate was somewhat higher among those who underwent tracheostomy (4.70; 95% CI, 4.64–4.77) compared to those without tracheostomy (4.08; 95% CI, 4.05–4.12). The rate of any readmission within 30-days was 26.9% among patients with tracheostomy compared to 22.5% among those without a tracheostomy (absolute risk difference, 4.4%; 95% CI, 3.5–5.4%; $P < 0.001$).

After adjustment for potentially confounding variables such as stroke type, demographic characteristics, vascular risk factors, and Elixhauser comorbidities (see Methods supplement for full list), tracheostomy was associated with a slightly increased readmission rate throughout follow-up (IRR, 1.07; 95% CI 1.02–1.11). This association was somewhat stronger in a sensitivity analysis limited to the follow-up period during which patients were known with certainty to be alive (IRR, 1.17; 95% CI, 1.13–1.21).

The most common primary diagnoses at the time of readmission were sepsis (12.7%), pneumonia (4.6%), congestive heart failure (4.1%), and device-related complication (4.0%).

Discussion

We found that approximately one-quarter of patients with stroke who received MV were readmitted within 30 days of discharge. After adjusting for demographic characteristics, vascular comorbidities, and markers of stroke severity, we found a slight association

between tracheostomy and the risk of readmission. This held true in sensitivity analyses accounting for the possibility of unrecorded out-of-hospital deaths.

In this study of patients with severe enough stroke to require MV, readmissions occurred frequently due to sepsis, various infections, and complications directly related to tracheostomy itself. Although we expected a clinically significant increase in readmission with tracheostomy, the rate of any readmission at 30-days was similar to that of Medicare beneficiaries hospitalized for medical illnesses such as pneumonia [4] and the readmission rate reported in a study of general intensive care unit patients [5]. Our findings are in contrast to the conventional wisdom, which holds that placing a tracheostomy after stroke consigns patients to a very high rate of subsequent readmissions.

Our study has important limitations that should be considered. First, we did not have data on deaths occurring outside of the hospital setting. However, this would not have affected the rate of any readmission within 30-days, which were performed in keeping with the methods of other studies [4]. Furthermore, our results were not substantially changed in sensitivity analyses. Second, since we relied on administrative data, we did not have detailed clinical information on important factors—such as stroke severity, size, location, and mechanism—that may have affected both the decision to perform a tracheostomy and readmission rates. Third, we did not have data on federal hospitals, although these account for a very small minority of hospitals in the states that we studied.

In summary, we found that readmission rates in stroke patients after tracheostomy are similar to rates in Medicare beneficiaries hospitalized with major medical diseases like pneumonia. Future studies are indicated to explore reasons for the continued high mortality among stroke patients after MV, as well as to elucidate strategies to optimize cost-effectiveness and outcomes after tracheostomy placement in these patients.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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