Urban-rural differences in mortality for atrial fibrillation hospitalizations in the United States

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BACKGROUND Cardiovascular outcomes vary between urban and rural hospitals, with worse outcomes in rural settings.

OBJECTIVE The purpose of this study was to examine whether in-hospital mortality for hospitalization for atrial fibrillation (AF) varied between urban and rural hospitals.

METHODS A cross-sectional examination of patients who were hospitalized for AF was performed in the National Inpatient Sample between 2012 and 2014 to compare in-hospital mortality in patients admitted to urban vs rural hospitals. Patients with a principal *International Classification of Diseases, Ninth Revision* discharge diagnosis of AF were included. Hospitals were classified as urban or rural on the basis of core-based statistical areas. *In-hospital mortality* was defined as death due to any cause during hospitalization.

RESULTS A total of 248,731 (mean age 69 years; 78% white; 48% women) admissions for AF were identified. Of these, 218,946 (88%) were from urban hospitals and 29,785 (12%) were from rural hospitals. Patients admitted to rural hospitals had a 17% increased risk of death as compared with those admitted to urban hospitals in a multivariable model, which accounted for differences in patient characteristics and potential confounders (odds ratio 1.17; 95% confidence interval 1.04–1.32). Similar results were obtained in a propensity score–matched analysis and in subgroup analyses by sex, race, and region.

CONCLUSION In-hospital mortality of AF is higher in rural hospitals than in urban hospitals. Further research is needed to understand this finding and to develop targeted strategies to reduce mortality in patients admitted for AF in rural hospitals.

KEYWORDS Atrial fibrillation; Hospitalization; In-hospital mortality; Outcomes; Rural

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Introduction

Atrial fibrillation (AF) is the most common arrhythmia encountered by the practicing clinician, with an estimated prevalence of 3%–6% in the United States.[1] A recent examination of national hospitalization rates for AF has shown that AF hospitalizations have increased exponentially in the United States from 2000 to 2010.[2] Despite the reported increases in AF hospitalizations, the in-hospital mortality in those admitted has decreased.[2]

Several reports have suggested that the quality of care, and subsequently the outcomes for patients admitted for cardiovascular diseases, varies between urban and rural hospitals.[3–8] Whether differences in in-hospital mortality also exist in patients admitted for AF is currently unknown. Less than optimal care of patients with AF has been reported in rural compared with urban areas,[9] which supports the possibility of poorer outcomes in patients with AF admitted to rural hospitals. Therefore, we examined the influence of rurality on in-hospital mortality in patients hospitalized for AF by using data from the National Inpatient Sample (NIS), a national all-payer administrative database.

Methods

Study design and cohort

The NIS is a database of a sample of discharged patients from US community hospitals. The NIS approximates a 20% stratified sample of all discharges and excludes rehabilitation and long-term acute care hospitals. NIS data are drawn from 44 states, plus the District of Columbia, representing more than 96% of the US population. Because of the complex study design, sampling weights are provided to compute national estimates. The NIS contains clinical and nonclinical

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data elements for each hospital stay, including the following: primary and secondary diagnoses and procedures; patient demographic data; hospital characteristics; expected payment source; total charges; discharge status; length of stay; and severity and comorbidity measures. Inpatient data are typically available from discharge abstracts. The NIS contains information on all patients, regardless of payer. Researchers and policymakers use the NIS to make national estimates of health care utilization, access, charges, quality, and outcomes, and data are available from 1988 through 2014. The database is maintained by the Agency for Healthcare Research and Quality (AHRQ). Annual data quality assessments of the NIS are routinely performed to guarantee the internal validity of the database.

This analysis was a cross-sectional examination of the NIS database of AF hospitalizations between 2012 and 2014 to determine whether admission to a rural hospital was associated with an increased risk of in-hospital mortality compared with admission to an urban hospital. Hospitalizations with a primary diagnosis code of AF were included, and we did not consider patients with secondary codes for AF. AF diagnoses were identified by *International Classification of Diseases, Ninth Revision* codes 427.31 and 427.32. We included all AF hospitalizations in patients 18 years and older. Patients with missing age, sex, or in-hospital mortality data were excluded. In addition, to obtain accurate in-hospitality mortality data for the hospital of admission, patients who were transferred to another acute care hospital at the time of discharge were excluded. This included transfer to a different acute care hospital or other health facility (eg, skilled nursing facility). This study was approved by the institutional review board at Emory University.

Hospital and patient characteristics

Patient data included age, sex, race (eg, white, black, and other), and insurance status (eg, Medicare, Medicaid, private, and self-pay or other). Urban-rural classification of hospitals was based on core-based statistical area (CBSA) codes. Hospitals located in counties with a CBSA type of metropolitan (areas that contain at least 1 urbanized area of 50,000 or more population) were considered urban, while hospitals with a CBSA type of micropolitan (at least 1 urban cluster that has a population of 10,000–50,000) or noncore (not metropolitan or mircopolitan) were classified as rural.[10] Hospitals were also classified according to census regions: Northeast; Midwest; South; and West. Comorbid conditions were identified using the AHRQ comorbidity database. The identification of these conditions is based on *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnoses and diagnosis-related group information listed on the discharge record. Using the standard logic of the Elixhauser Comorbidity Software,[11] coexisting medical conditions are identified that are not directly related to the principal diagnosis, or main reason for admission, and are likely to represent conditions that originated before admission. Comorbid conditions identified from administrative claims data generally agree with patient chart data for recording of comorbidities,[12] and similar methods were used by the Centers for Medicare and Medicaid Services for calculating their 30-day heart failure mortality measure.[13] The following comorbid conditions were included in this analysis: obesity, hypertension, diabetes, heart failure, chronic lung disease, peripheral vascular disease, renal failure, liver disease, hypothyroidism, depression, alcohol abuse, and anemia.

Outcomes

The main outcome of interest was *in-hospital mortality*, which was defined as death due to any cause during hospitalization. AF procedures during the same hospitalization were identified by *International Classification of Diseases, Ninth Revision* codes and included external electrical cardioversion (99.61) and catheter ablation (37.34). We also examined the 5 most common secondary diagnoses for patients hospitalized for AF. *International Classification of Diseases, Ninth Revision* codes were used to identify these diagnoses, and the following were identified in the overall AF cohort: heart failure (428.xx), hypertension (401.xx), hyperlipidemia (272.xx), diabetes (250.xx), and acute kidney injury (584.xx).

Statistics

Baseline characteristics were compared by urban-rural status. Survey-specific statements (SURVEYFREQ and SURVEYMEANS) were used to obtain descriptive statistics. Statistical significance was tested using the t test for continuous variables and the Rao-Scott χ^2 test for categorical variables. The frequencies of external electrical cardioversion and catheter ablation procedures were also compared in rural vs urban hospitals in the overall sample and in subgroups of sex (male vs female), race (white, black, and other), and region (Northwest, Midwest, South, and West). A multivariable logistic regression model for survey data (SURVEYLOGISTIC) was used to compute the multivariable risk of death in patients admitted for AF in rural vs urban hospitals, accounting for hospital-level clustering of patients and the sampling design using CLUSTER and STRATA statements, respectively. The multivariable model included the following covariates: age, sex, race, insurance, hospital region, obesity, hypertension, diabetes, heart failure, chronic lung disease, peripheral vascular disease, renal failure, liver disease, hypothyroidism, depression, alcohol abuse, and anemia. We also performed a propensity score–matched analysis using multivariable logistic regression to predict the probability of being seen in rural vs urban hospitals using the same covariates in the primary analysis, and a 1:1 matching was performed (n = 58,896). The primary analysis was then repeated in the propensity score–matched cohort. A sensitivity analysis was performed by excluding patients who underwent either external electrical cardioversion or catheter ablation because of the relatively low mortality rate associated with these procedures. Secondary analyses were performed to determine whether the in-hospital risk of death associated with AF varied by sex, race, or region by computing interaction terms. An additional analysis was also performed to determine whether the 5 most common secondary diagnoses identified in the total cohort varied by rural vs urban hospital status. Statistical significance,