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Atrial Fibrillation Associated Costs for Stroke Hospitalizations of Medicare Beneficiaries in the Stroke Belt of the United States

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Abstract

Purpose—To estimate atrial fibrillation (AF)–associated costs for stroke hospitalizations among Medicare beneficiaries aged ≥65 years in a 11-state region called stroke belt in the United States.

Methods—Using the 2010 Medicare Provider Analysis and Review File database, we analyzed costs of stroke hospitalizations conditional on presence of AF (n=226 289) after excluding those with subarachnoid hemorrhage, no information on race, or a length of stay [LOS] of 30 or more days. We employed regression analysis to estimate for defined subgroups the impact of AF on costs while controlling for major potential confounders.

Results—The average cost of all stroke hospitalizations was $27 915. The presence of AF increased this cost by $2711 (9.4%; P<0.001). AF-associated costs were $3159, $2610, and $2197 for patients aged 65–74, 75–84, and ≥85 years, respectively (all P<0.001). Among hospitalization with a length of stay (LOS) of 14–29 days, AF increased the costs by $5888 (P<0.001). AF was not associated with higher costs for hospitalizations involving intracerebral hemorrhage.

Conclusions—The costs of stroke hospitalizations are high, and they are even higher if the patient has AF. Further information is needed on the costs in patients with AF who are taking anticoagulants.

Introduction

Atrial fibrillation (AF) increases the risk of stroke, is associated with increased stroke severity, and is the main cause of stroke in elderly participants who receive Medicare.[1,2] Medical costs for AF and stroke have been estimated separately,[3–5] but there is little information on the costs associated with AF among stroke patients. While AF is relatively rare in the general population, it is much more common among patients hospitalized for stroke because of its powerful role as a risk factor. As such, AF-specific costs among the stroke population could play a substantial role influencing the overall costs of stroke care. Such costs would be critical for evaluating the cost-effectiveness of stroke interventions, especially those involving patients with AF, and thus we investigated hospitalization costs associated with AF for stroke patients in an elderly population.

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Disclosures

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Study Population

We used data from the 2010 Medicare Provider Analysis and Review File, which contains information on inpatient stays of current Medicare beneficiaries (aged ≥65 years), to identify all hospitalizations with a primary or secondary diagnosis of stroke (International Classification of Diseases, Ninth Revision [ICD-9] codes 431, 433, 434, 436, 437, 438, excluding subarachnoid hemorrhagic stroke) for patients residing in an 11-state region (the Stroke Belt) in the U.S. We also excluded hospitalizations that did not have information on race or that had a length of stay (LOS) of 30 or more days.

Among the stroke hospitalizations, we searched the data for AF including atrial flutter (ICD-9 427.31 and 427.32). The costs were total charges, including the charges for all services provided to the beneficiary for the stay regardless of Medicare coverage.

Statistical Analysis

We specified a multivariate regression model for the cost analysis. We ran the regression model for the total sample and subgroups formed by age, sex, race, LOS categories, initial admission (yes, no) and stroke diagnosis (primary, non-primary) status, and stroke type (intracerebral hemorrhage [ICH]; yes, no). We used the Charlson Comorbidity Index to control for health status.

We employed mixed-effects models to derive our estimates; these models incorporated repeated-measure approaches to account for the effects of possible multiple admissions for individual patients during the year. Statistical analyses were performed using SAS version 9.1.[6]

Results

We identified 226 289 stroke hospitalizations, with 42 557 (19.1%) having a diagnosis of AF (or atrial flutter) (Table 1). The proportion of hospitalizations having AF increased with age from 12.4% for those aged 65–74 years to 26.0% for those aged 85 or older. The proportions of AF among hospitalizations for women and white patients were higher than for their comparison groups. In contrast, the proportions were similar for initial admissions and readmissions, (18.8% for both). Overall, mean per-admission costs were $27 915 ($28 843 for AF admissions and $27 700 for admissions without AF).

After controlling for many potential confounders, AF increased the cost of hospitalization by $2711 (9.4%; P<0.001) (Table 2). Age was inversely associated with per-admission cost. AF increased the costs by $3159, $2610, and $2197 for patients aged 65–74, 75–84, and ≥85 years, respectively. Compared with women, men had a higher per-admission cost but a lower AF-associated cost ($2481 versus $2865). LOS was significantly and positively associated with per-admission costs, while for costs associated with AF increased with LOS up to $5888 for hospitalizations with an LOS of 14–29 days.

Initial hospitalizations cost $12 354 more than readmission, and AF increased the cost by $2844 for initial hospitalizations and $1735 for readmissions. Admissions in which the stroke was primary had a lower per-admission cost than those in which it was not primary,

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but the AF-associated cost was higher for primary than non-primary strokes. Per admission, intracerebral hemorrhage (ICH) cost $10 101 more than non-ICH, but the cost associated with AF was higher for non-ICH strokes ($2757) (AF did not significantly increase the cost for ICH stroke).

Discussion

Our study may be the one of the first describing the impact of AF on hospitalization costs among stroke patients using a large dataset. We found that AF increased the cost of stroke hospitalizations after controlling for health status and other potential confounders. This finding confirms the fact that stroke with AF is more severe than stroke without this disorder.[2]

Our findings that younger patients had both higher costs per stay and higher AF-associated costs than older patients and that men had a higher cost per hospitalization but that women had higher AF-associated costs should be useful for developing stroke prevention programs that incorporate the prevention or management of AF. Improved prevention of AF in younger patients and women might produce cost savings, although that would have to be formally tested. Our finding that AF-associated costs were higher for hospitalizations with longer LOS invites efforts to improve AF management for stroke patients with longer LOS while also perhaps achieving economic efficiencies.

The finding that both per-admission costs and AF-associated costs were higher for initial admissions than readmissions was a bit surprising, especially as an earlier investigation found that recurrent strokes had poorer outcomes on average than first strokes.[7] We also found that primary stroke cost less than non-primary stroke but had higher AF-associated costs. ICH had much higher costs than non-ICH stroke, but AF-associated costs for ICH patients did not differ significantly from those for such patients without AF, while such costs for non-ICH strokes were significantly greater. These findings suggest that evaluations of the cost-effectiveness of stroke programs should consider stroke admission type (initial or readmission), diagnosis status (primary, not primary), and event type (ICH or no-ICH) among AF patients.

Our study had several limitations including: 1) As with all studies that rely on medical records, the issue of coding error must be considered. Although misdiagnosis issues have been investigated in the literature, how this issue would affect the costs in our study is unknown. 2) Our study sample consisted entirely of Medicare beneficiaries, and thus the cost might be influenced by the Medicare reimbursement rate. 3) We did not incorporate the impact of anticoagulant therapy and in-hospital mortality in the cost analysis. Regardless of these limitations, however, the fact that we used a large sample and analyzed the costs from different angles suggests that our findings should have great utility and wide applicability.

Conclusions

This study indicated that the high costs of stroke hospitalizations can be expected to vary by demographic variables, admission status, LOS, and stroke type. Furthermore, we found that AF increases costs for a wide variety of patients. The detailed cost information on stroke

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patients presented here could be used in the development of cost-effective programs for stroke prevention, especially among AF patients. Further information is needed on the costs in patients with AF who are taking anticoagulants.

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Table 1

Patient Characteristics of Stroke Hospitalizations by Atrial Fibrillation Status, 2010 Medicare Provider Analysis and Review File Data

Characteristic	Total N (%) or Sample Statistics (n=226 289)	Hospitalizations with AF (n=42 557)	Hospitalizations without AF (n=183 372)
Age (years)			
65–74	77 993 (34.5)	9656 (12.4)	68 337 (87.6)
75–84	90 326 (39.9)	17 829 (19.7)	72 497 (80.3)
85 or older	57 970 (25.6)	15 072 (26.0)	42 898 (74.0)
Sex			
Male	98 117 (43.4)	17 323 (17.7)	80 794 (82.3)
Female	128 172 (56.6)	25 234 (19.7)	102 938 (80.3)
Race			
White	178 453 (78.9)	3829 (20.6)	141 624 (79.4)
Black	45 097 (19.9)	5260 (11.7)	39 837 (88.3)
Others	2739 (1.2)	468 (17.1)	2271 (82.9)
Average length of stay in days (SE)	7.05 (0.01)	6.93 (0.03)	7.08 (0.02)
Initial Admission			
Yes	157 441 (69.6)	29 628 (18.8)	127 813 (81.2)
No	68 848 (30.4)	12 929 (18.8)	55 919 (81.2)
Stroke as a Primary Diagnosis			
Yes	84 970 (37.5)	17 448 (20.5)	67 522 (79.5)
No	141 319 (62.5)	25 109 (17.8)	116210 (82.2)
Intracerebral Hemorrhage (ICH)			
Yes	8465 (3.7)	1827 (21.6)	6638 (78.4)
No	217 824 (96.3)	40 730 (18.7)	177 094 (81.3)
Mean total charge, in dollars (SE)	27 915 (65.8)	28 843 (148.1)	27 700 (73.4)

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Table 2

Coefficient Estimates of Costs of Stroke Hospitalizations for Patients Aged 65 Years or Older, 2010 Medicare Provider Analysis and Review File Data

Variables or SubGroups		Total Sample	Higher Cost Associated with AF from Subgroup Analysis
		CoEfficient [a]	Cost[a]
Atrial Fibrillation		2711	---
Age	65–74	10 163	3159
	75–84	5567	2610
	85 +	Referent	2197
Sex	Male	1774	2481
	Female	Referent	2865
Race	Black	−446	2829
	Non-black	Referent	2724
Length of Stay	1–6	−31 529	663
	7–13	−13 121	5145
	14–29	Referent	5888
Initial Versus Readmission	Initial admission	12 354	2844
	Readmission	Referent	1735
Primary Versus Non-Primary Stroke	Primary stroke	−876	2778
	Non-primary stroke	Referent	2521
Intracerebral Hemorrhage (ICH) Versus Infarction	ICH	10 101	1364
	Non-ICH stroke	Referent	2757
Charlson Comorbidity Index[b]		548	---

Note: All p≤0.001, except the higher cost associated with AF for ICH patients with a p-value of 0.17

[a] Coefficient and costs are in dollars,

[b] Charlson Index measures the likelihood of death or serious disability in the subsequent year by diagnosis codes for up to 18 different diseases