Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

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Circulation 1999;99;370-376
Circulation is published by the American Heart Association. 7272 Greenville Avenue, Dallas, TX 72514
 Print ISSN: 0009-7322. Online ISSN: 1524-4539

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Background**—**Stroke occurs concurrently with myocardial infarction (MI) in ≈30 000 US patients each year. This number is expected to rise with the increasing use of thrombolytic therapy for MI. However, no data exist for the economic effect of stroke in the setting of acute MI (AMI). The purpose of this prospective study was to assess the effect of stroke on medical resource use and costs in AMI patients in the United States.

Methods and Results**—**Medical resource use and cost data were prospectively collected for 2566 randomly selected US GUSTO I patients (from 23 105 patients) and for the 321 US GUSTO I patients who developed non–bypass surgery–related stroke during the baseline hospitalization. Follow-up was for 1 year. All costs are expressed in 1993 US dollars. During the baseline hospitalization, stroke was associated with a reduction in cardiac procedure rates and an increase in length of stay, despite a hospital mortality rate of 37%. Together with stroke-related procedural costs of $2220 per patient, the baseline medical costs increased by 44% ($29 242 versus $20 301, $P<0.0001$). Follow-up medical costs were substantially higher for stroke survivors ($22 400 versus $5282, $P<0.0001$), dominated by the cost of institutional care. The main determinant for institutional care was discharge disability status. The cumulative 1-year medical costs for stroke patients were $15 092 higher than for no-stroke patients. Hemorrhagic stroke patients had a much higher hospital mortality rate than non–hemorrhagic stroke patients (53% versus 15%, $P<0.001$), which was associated with ≈$7200 lower mean baseline hospitalization cost. At discharge, hemorrhagic stroke patients were more likely to be disabled (68% versus 46%, $P=0.002$).

Conclusions**—**In this first large prospective economic study of stroke in AMI patients, we found that strokes were associated with a 60% ($15 092) increase in cumulative 1-year medical costs. Baseline hospitalization costs were 44% higher because of longer mean lengths of stay. Stroke type was a key determinant of baseline cost. Follow-up costs were more than quadrupled for stroke survivors because of the need for institutional care. Disability level was the main determinant of institutional care and thus of follow-up costs. **(*Circulation*. 1999;99:370-376.)**

Key Words: stroke ■ myocardial infarction ■ cost-benefit analysis

Each year, 550 000 Americans develop stroke, and 1.5 million have an acute myocardial infarction (AMI).[1] Approximately 30 000 strokes occur in the setting of AMI. In conformity with evidence-based practice guidelines, more AMI patients are receiving thrombolytic therapy, which has been associated with a small but significant increase in primary intracranial hemorrhage.[2,3] Accordingly, more AMI patients are likely to develop stroke. However, despite the substantial contribution of stroke care to the overall economic impact of atherosclerotic disease, surprisingly little has been done to investigate the costs associated with stroke and their determinants. Furthermore, no economic data exist for AMI patients who develop stroke.

As part of the Economics and Quality of Life (EQOL) substudy for the *G*lobal *U*tilization of *S*treptokinase and *T*issue Plasminogen Activator for *O*ccluded Coronary Arteries Study (GUSTO I), we prospectively collected, by structured interview, detailed resource use information on North American AMI patients who developed a stroke during their baseline hospitalization. Only US patients were included in this economic analysis. To evaluate the effect of stroke on resource use and costs, strokes due to bypass surgery were excluded. The purpose of this study is to describe the effects of stroke on medical resource use and costs for AMI patients in the United States.

Methods

Study Population

The GUSTO I EQOL substudy included 3000 patients randomly selected from 26 003 North American GUSTO I patients.[4,5] For this

Received April 9, 1998; revision received September 30, 1998; accepted October 9, 1998.

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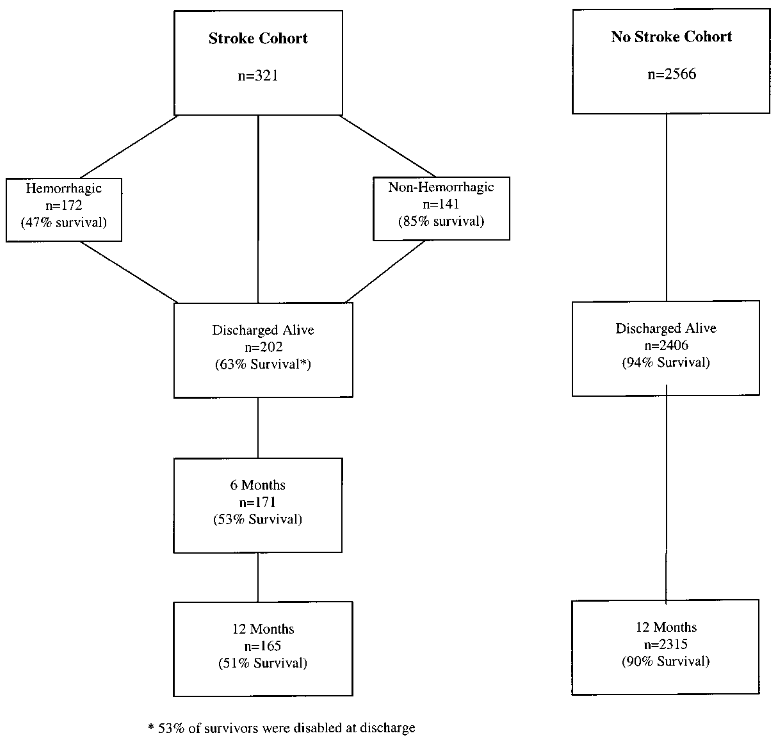

Clinical outcomes of stroke versus no-stroke cohort.

study, the 2566 US patients in the EQOL substudy served as the no-stroke cohort. There were 352 US stroke patients in GUSTO I. Thirty-one CABG-related strokes (diagnosed within 3 days of CABG) were excluded. Therefore, the final stroke cohort consisted of 321 patients (1.4% of the 23 105 US GUSTO I patients). Efforts were made to collect economic and quality-of-life data prospectively on all GUSTO I patients who suffered a stroke during their baseline hospitalization. Of the US stroke patients, 202 (63%) survived to discharge, 171 survived to 6 months, and 165 survived to 1 year (Figure).

Demographic/Clinical Data

Baseline clinical and demographic variables collected on the GUSTO clinical case report form included age, sex, cardiovascular risk factors, prior MI, prior angina, prior revascularization, cerebrovascular disease, myocardial infarct location, and Killip class.[6]

At hospital discharge, patients were prospectively classified by the site investigator as "disabled" if they had a moderate (substantial limitation of activity and capability) or severe (inability to live independently or work) deficit from their stroke.[3]

Reporting and Classification of Strokes

As previously described, suspected strokes were reported by investigators to Duke Coordinating Center, and selected stroke-related data were collected on an ancillary case report form.[3] Stroke was defined as an "acute new neurological deficit resulting in death or lasting for more than 24 hours, as classified by a physician, with supporting information including brain images and neurological/neurosurgical evaluation."[3] All suspected stroke patients were advised to have either CT or MRI. Among the stroke cohort, 97% had at least 1 neuroimaging study. A stroke review committee reviewed all adverse neurological events. Details regarding the adjudication process have been reported previously.[3]

Strokes were divided into 4 main categories: primary intracranial hemorrhage, nonhemorrhagic infarct, hemorrhagic conversion of infarct, and unknown. The specific criteria used to make these distinctions have been published.[3] For the present study, primary intracranial hemorrhage and hemorrhagic conversion are considered "hemorrhagic strokes."

Stroke Data Collected

For the present analysis, we extracted stroke-related resource utilization from the stroke ancillary form. Stroke specific resource use included neurology and/or neurosurgery consultations, head CTs/MRIs, echocardiograms, electroencephalograms, carotid duplex studies, carotid arteriograms, and neurosurgical procedures.

Medical Resource and Cost Data

Data on medical resource consumption during the baseline hospitalization were collected on the case report form. To collect follow-up resource consumption data, we conducted telephone interviews at 30 days, 6 months, and 1 year with stroke survivors.[4] If the patient was unable to participate, brief proxy interviews were conducted with a family or household member (36% of 30-day interviews and 32% of 1-year interviews). In each interview, patients were asked about medical care between interviews, including rehospitalization, cardiac catheterization, PTCA, CABG, AMI, institutional care, and 11 types of outpatient visits. All patient-reported cardiac procedures were verified with the facility that provided medical care. For those patients without baseline stroke-related procedural cost data, cost was computed on the basis of existing patient data stratified by stroke type (hemorrhagic or nonhemorrhagic). For this study cohort, resource units were converted to medical costs (1993 US dollars) by use of the methodology of the GUSTO I cost-effectiveness analysis.[5] For the baseline hospitalization, cost weights for each major resource consumed were developed from the Duke Transition System I cost accounting system. For each follow-up admission, costs were based on Medicare Diagnostic Related Group reimbursement rates. Physician fees and outpatient visits were assigned costs according to the Medicare Fee Schedule. Nursing home costs and rehabilitation hospital costs were assigned by use of per diems obtained from institutions that provided care for GUSTO I patients.

Data Analysis

In this study, all 4 thrombolytic treatment groups in GUSTO were combined. To describe the characteristics of the study population, we used means and SDs for continuous variables, and medians, percentages, and interquartile ranges (25th to 75th percentiles) for discrete variables. Univariate tests were performed with standard contin-

TABLE 1. Baseline Medical Characteristics of Stroke Versus No-Stroke Cohorts

	Stroke (n=321)	No Stroke (n=2566)	P
Age, y	69±10	60±12	0.0001
Male	61	71	0.001
White	88	91	0.08
Weight, kg	75±16	82±17	0.0001
Hypertension	53	41	<0.001
Diabetes	20	15	0.02
Current smoker	30	43	<0.001
Family history of CAD	35	50	<0.001
Hyperlipidemia	34	38	0.22
Previous angina	46	35	<0.001
Previous MI	22	17	0.03
Previous PTCA	4	6	0.19
Previous CABG	7	6	0.45
Anterior MI	39	38	0.13
Initial Killip class >I	20	14	0.09
Initial systolic BP	132±25	126±23	0.0001
Initial heart rate (bpm)	78±19	75±17	0.005
Comorbidity (self-reported)			
COPD	11	10	0.79
CHF	7	4	0.17
Renal failure	2	1	0.51
Depression	13	9	0.13

CAD indicates coronary artery disease; BP, blood pressure; COPD, chronic obstructive pulmonary disease; and CHF, congestive heart failure. Values are mean±SD or percent.

gency table χ^2 tests for categorical variables and the Wilcoxon rank-sum test or nonparametric ANOVA for continuous variables. To examine the predictors and correlates of medical cost, we used multivariable linear regression analyses with logarithmic transformation of the baseline hospitalization, follow-up, and cumulative 1-year costs.

Results

Study Population

Of our stroke cohort, 63% (202) survived to discharge versus 94% for the no-stroke cohort. Comparison of the baseline medical characteristics of the stroke and the no-stroke cohorts revealed that stroke patients were older, weighed less, and were more likely to be female (Table 1). In terms of cardiac risk factors, stroke patients had more hypertension and diabetes but were less likely to be current smokers. Stroke patients had more prior angina and history of AMI and higher presenting heart rate. There were no significant differences in other comorbid conditions between the 2 groups (Table 1).

Of the 321 strokes, 172 (53%) were hemorrhagic, 141 (44%) were nonhemorrhagic, and 8 (2%) were unclassified. Of the 172 hemorrhagic strokes, 152 were primary intracranial hemorrhages. The hospital mortality rates were 53% for hemorrhagic stroke and 15% for nonhemorrhagic stroke. Among the stroke survivors, hemorrhagic and nonhemorrhagic stroke patients had similar 1-year survival rates (79% versus 83%, P=NS), although hemorrhagic stroke patients were more likely to be disabled than nonhemorrhagic patients at discharge (68% versus 46%, P=0.002).

Effects of Stroke on Medical Resource Consumption and Costs

During the baseline hospitalization, the stroke cohort had a much lower rate of cardiac catheterization (40% versus 72%, $P<0.001$), PTCA (16% versus 30%, $P<0.001$), and CABG (5% versus 13%, $P<0.001$) than the no-stroke cohort (Table 2). Conversely, stroke increased the length of stay, by 1.6 days in the intensive care unit (ICU) ($P<0.0001$) and 2.6 days on the non-ICU ($P<0.0001$) wards. Stroke-related procedures added an average of \$2220 to the baseline hospitalization cost. These shifts in medical resource use resulted in a 44% increase (\$29 242 versus \$20 301, $P<0.0001$) in the average cost of the baseline hospitalization for the stroke versus the no-stroke cohort (Table 2).

During follow-up, the medical costs of the stroke survivors were more than quadruple those of the no-stroke cohort (\$22 400 versus \$5282, $P<0.0001$). The total numbers of hospitalizations and total incremental costs for hospital care were approximately equal (Table 3). There were no differences in outpatient costs. Stroke patients continued to have lower rates of cardiac catheterization (13% versus 20%, P=0.02) and PTCA (5% versus 12%, P=0.001) than the no-stroke cohort. The higher follow-up costs were entirely a result of the greater need for institutional care among the stroke survivors (37% versus 2%, $P<0.0001$).

Cumulative 1-year costs were 60% higher for stroke patients (\$40 192 versus \$25 098, $P<0.0001$). Overall, the 321 patients in the stroke cohort increased the cumulative 1-year medical costs of the 23 105 US GUSTO I patients by \$4.85 million, representing an average increase in direct costs of \$210 per AMI patient. The greater cost occurred despite a much higher 1-year mortality rate (49% versus 9.8%) and lower rates of all cardiac procedures: cardiac catheterization (44% versus 79%, $P<0.001$), PTCA (19% versus 37%, $P<0.001$), and CABG (9% versus 19%, $P<0.001$).

Linear multivariable regression cost models were constructed to identify the major predictors of the baseline hospitalization, follow-up, and cumulative 1-year costs. Demographics, cardiac risk factors, baseline medical characteristics, and stroke-specific variables (stroke occurrence, stroke type, and discharge disability level) were analyzed. For baseline costs, stroke occurrence and stroke type were the main predictors of baseline hospitalization cost. The main predictor of follow-up costs was discharge disability level. As for cumulative 1-year costs, the main determinants were stroke occurrence, stroke type, prior angina, and diabetes (Table 4).

Effects of Stroke Type on Medical Resource Consumption and Costs

Hemorrhagic strokes were associated with a much higher (53% versus 15%, $P<0.001$) and earlier (50% by day 3) hospital mortality rate than nonhemorrhagic strokes. As a result, the average length of stay for hemorrhagic stroke patients was 5 days shorter ($P<0.01$). Hemorrhagic stroke

TABLE 2. Baseline Medical Resource Use and Costs in Stroke Versus No-Stroke Cohorts

	Stroke (n=296)	No Stroke (n=2475)	*P*
Medical resources			
Cardiac catheterization	40	72	<0.001
PTCA	16	30	<0.001
CABG	5	13	<0.001
ICU LOS	6.1±5.8	4.5±3.4	0.0001
	4.5 (3–7.5)	3.5 (2.5–5.5)	
Total LOS	14±12.6	9.8±6.6	0.0001
	12 (4–19)	8 (6–12)	
Medical costs, $			
Hospital	24 646±19 795	17 032±13 027	0.0001
	20 226 (11 878–31 058)	13 800 (8075–21 640)	
Physician	4595±3199	3269±2350	0.0001
	3808 (2185–5966)	2619 (1573–4158)	
Stroke procedures	2220±1140	...	...
	1876 (1427–2767)		
Total	29 242±22 808	20 301±15 217	0.0001
	24 012 (14 303–37 429)	16 485 (9770–26 145)	

ICU indicates intensive care unit; LOS, length of stay. Values are mean±SD or percent.

patients also had sharply lower rates of invasive cardiac procedures than nonhemorrhagic stroke patients, who had rates of invasive cardiac procedures similar to those of the no-stroke cohort (Table 5). Compared with no-stroke patients, baseline medical costs for nonhemorrhagic stroke patients were $13 498 higher and costs for hemorrhagic stroke patients were $6318 higher (Table 5). For stroke patients who survived to discharge, there were no significant differences between hemorrhagic stroke and nonhemorrhagic stroke survivors in mean length of stay or cost.

Effects of Disability Level on Medical Resource Use and Costs in Stroke Survivors

Of the stroke survivors, 55% were disabled at discharge. During follow-up, institutional care was necessary for 64% of the disabled patients versus 7% of the nondisabled patients. No significant differences in the rate of cardiac procedures or hospitalizations between the 2 groups were observed. The higher follow-up costs of the disabled patients ($37 190 versus $6640, $P<0.0001$) were accounted for by their greater need for institutional care (Table 6).

Discussion

This is the first detailed prospective evaluation of the economic consequences of stroke in the setting of AMI. Unlike most prior stroke cost studies, which used claims data to determine the diagnosis of stroke, this study applied a rigorous prospective methodology to confirm and classify the stroke type.[7,8] Costs were estimated from carefully collected resource use data, including hospitalization, cardiac and stroke-related procedure data, rehospitalization, institutional care, and outpatient visits. To isolate the effect of stroke on costs, we excluded strokes due to CABG. Finally, because GUSTO I involved nearly 600 US sites ranging from community hospitals to tertiary academic referral centers, our resource use data should have broad generalizability. It should be emphasized, however, that our results describe the costs and resource use patterns associated with stroke in the setting of AMI and therefore do not necessarily relate to stroke costs in the absence of cardiovascular disease.

Major Findings

Strokes increased the average 1-year medical costs of AMI by 60% ($40 192 versus $25 098), despite a high early mortality rate and much lower rates of cardiac procedures in the stroke cohort. The drivers of the cost increase were longer lengths of stay in stroke survivors, stroke-related procedural costs at baseline, and greater need for institutional care for stroke survivors during follow-up.

Among the stroke cohort, the main determinant of baseline hospitalization cost was the stroke type, with the hemorrhagic strokes averaging $26 619 and nonhemorrhagic strokes averaging $33 799. The lower costs associated with hemorrhagic strokes were due to the high hospital mortality rate (53%), which led to shorter lengths of stay and fewer invasive cardiac procedures. For hemorrhagic stroke survivors, the length of stay and baseline hospitalization costs were similar to those of nonhemorrhagic stroke patients. The only previous literature on stroke costs discusses patients with isolated strokes, in whom the stroke type (subarachnoid hemorrhage, intracerebral hemorrhage, and ischemic stroke) was the major determinant of cost.[7,8] Holloway and colleagues compared the baseline hospital costs for all stroke patients seen during 1992 at 5 academic medical centers.[8] Using ICD-9 cerebrovascular subgroups, they found the mean hospital costs were $21 535 for intracerebral hemorrhage and $9882 for ischemic stroke. Demographic factors, such as age, were not significant determinants of baseline hospitalization cost. Postdischarge

TABLE 3. Multivariate Regression Models of Medical Costs*

	Regression Coefficient	95% CI	*P*
Baseline costs			
Stroke occurrence	0.56	0.44, 0.69	0.0001
Stroke type	−0.41	−0.57, −0.25	0.0001
Prior angina	0.10	0.05, 0.16	0.0001
Current smoker	−0.06	−0.11, −0.01	0.02
Diabetes	0.07	0.002, 0.15	0.05
Follow-up costs			
Disabling stroke	1.42	0.99, 1.84	0.0001
Prior angina	0.17	0.02, 0.32	0.0005
Diabetes	0.22	0.03, 0.42	0.002
Heart rate	0.005	0.001, 0.009	0.007
Stroke type	0.65	0.16, 1.14	0.009
Sex	0.19	0.04, 0.35	0.01
Prior MI	0.21	0.02, 0.41	0.02
Family history of CAD	0.45	0.025, 0.87	0.03
Total 1-year costs			
Stroke occurrence	0.51	0.38, 0.64	0.0001
Stroke type	−0.42	−0.59, −0.25	0.0001
Prior angina	0.10	0.44, 0.16	0.0004
Diabetes	0.13	0.05, 0.20	0.001

CAD indicates coronary artery disease.
*Costs were natural log–transformed.

costs were not examined. Thus, in contrast to our results, these studies found that hemorrhagic strokes were associated with higher costs than nonhemorrhagic (ischemic) strokes. The explanation for the divergent results resides in the higher and earlier mortality rate of AMI patients treated with thrombolytics who develop hemorrhagic strokes compared with isolated hemorrhagic strokes (53% versus 21%).[8] Consequently, AMI patients with strokes had shorter lengths of stay and consumed fewer resources.

During follow-up, the main predictor of cost was not stroke type. The higher cost for stroke survivors was driven by the cost of institutional care, the need for which was determined largely by the discharge disability level. Stroke patients who were disabled at discharge had $37 190 in subsequent costs out to 12 months, compared with $6640 for nondisabled stroke patients. Taylor and coworkers[7] used Medicare claims and other national data sources to construct an epidemiological model of the lifetime costs of incident strokes occurring in 1990. In their study, stroke type and age were the main drivers of follow-up cost. However, like other cost studies of patients with isolated stroke, they did not evaluate global disability level as a determinant of cost.

Given the differences in demographics and cardiac risk factors between the stroke and no-stroke groups, one hypothesis for the higher medical costs of stroke patients was that they were older, "sicker" patients. However, multivariable regression models of cost revealed that demographic factors such as age were not significant cost predictors. The strongest predictors of cumulative 1-year costs were stroke occurrence and stroke type, and only prior angina and diabetes were independent clinical predictors of 1-year costs.

Implications of Findings

Extrapolation of our results to the estimated 30 000 Americans who develop strokes while hospitalized for an AMI[1] shows that such strokes increase the annual national costs for AMI care by ≈$458 million during the year after stroke. Consequently, new therapeutic strategies that significantly alter the stroke rate may have important economic consequences at a national or health care system–wide level that are independent of their effects on other outcomes. Hillegass and colleagues[9] previously showed that a more effective reperfusion strategy that also increased the stroke rate over current thrombolytic therapy rates can still yield an acceptable risk-to-benefit ratio. However, several recent clinical trials have been stopped because of increased hemorrhagic stroke rates,[10,11] and it seems quite unlikely that clinicians will accept a more effective thrombolytic regimen in exchange for an increased stroke rate. Current AMI clinical trials are evaluating combination fibrinolytic, antiplatelet, and antithrombin regimens at reduced doses, which may improve coronary reperfusion at a lower stroke risk. Our data suggest that these regimens have the potential to produce important cost savings in AMI care.

TABLE 4. Follow-Up Medical Resources Use and Costs in Stroke Versus No-Stroke Patients*

	Stroke (n=185)	No Stroke (n=2352)	*P*
Resources			
Cardiac procedures			
Cardiac catheterization	13	20	0.02
PTCA	5	12	0.001
CABG	5	7	0.29
Rehospitalization			0.37
0	53	58	
1	29	26	
>1	18	16	
Hospital days	8.5±18.3	3.8±8.7	0.02
Outpatient visits	10.3±7.3	9.7±7.4	0.16
Institutional care	37	2	0.0001
Institutional care days	28±67	0.7±8	0.0001
Costs, $			
Hospitalizations			
Cardiac	1523±4227	2606±5464	0.003
Noncardiac	2106±3377	1258±2916	0.0001
Physician fees	699±1255	615±1122	0.23
Total (hospital+physician)	4329±6617	4479±7541	0.41
Outpatient visits	512±333	486±335	0.14
Institutional care	17 617±46 993	319±3723	0.0001
Total incremental costs	22 400±48 477	5282±8476	0.0001

Values are mean±SD or percent.
*From discharge to 12 months.

TABLE 5. Baseline Medical Costs: Hemorrhagic Stroke, Nonhemorrhagic Stroke, and No-Stroke Patients

	Hemorrhagic (n=160)	Nonhemorrhagic (n=128)	No Stroke (n=2475)
Medical resources			
Cardiac catheterization	24*	63	72
PTCA	11*	24	30
CABG	2*	10	12
ICU LOS	5.8±6.4	6.6±5	4.5±3.4
	4 (2–7)	5 (3.5–8)	3.5 (2.5–5.5)
Total LOS	12±13	17±12*	9.8±6.6
	9 (2–17)	15 (10–22)	8 (6–12)
Medical costs, $			
Hospital	22 387±21 174*	28 528±17 498*	17 032±13 027
	15 908 (7330–28 092)	23 463 (16 252–36 252)	13 800 (8075–21 640)
Physician	4232±3202	5271±3072*	3269±2350
	3141 (1806–5512)	4450 (3121–6780)	2619 (1573–4158)
Total	26 619±24 221*	33 799±20 324*	20 301±15 217
	19 376 (9074–34 133)	27 931 (19 468–43 248)	16 485 (9770–26 145)

Abbreviations as in previous tables. Values are mean±SD or percent.
*$P<0.01$ vs the no-stroke cohort.

Strokes were associated with significant shifts in medical resource use, particularly cardiac resource use. The rates of invasive cardiac procedures for the stroke cohort were nearly half those of the no-stroke cohort. Most of the reduction in cardiac procedures occurred at the baseline hospitalization. However, this effect extended into follow-up, with both disabled and nondisabled stroke patients having lower rates of cardiac catheterization and PTCA than the no-stroke

TABLE 6. Follow-Up Medical Resources and Costs in Disabled Versus Nondisabled Stroke Survivors

	Disabled (n=122)	Not Disabled (n=90)	*P*
Resources			
Cardiac procedures			
Cardiac catheterization	13	14	0.77
PTCA	3	7	0.23
CABG	5	5	0.86
Rehospitalization			0.61
0	50	55	
1	32	26	
>1	18	20	
Hospital days	11±22	5.9±12	0.44
Outpatient visits	9.4±7.5	11±6.9	0.06
Institutional care	64	7	<0.0001
Institutional care days	52±85	3±20	0.0001
Costs			
Hospitalization			
Cardiac hospital	1525±4250	1574±4290	0.75
Noncardiac hospital	2306±3579	1957±3186	0.61
Physician fees	814±1407	595±1073	0.53
Total (hospital and physician)	4645±6694	4127±6624	0.54
Outpatient visits	470±346	559±313	0.06
Institutional care	32 154±60 397	1974±14 399	0.0001
Total incremental costs	37 190±62 165	6640±15 912	0.0001

Values are mean±SD or percent.

cohort. Given the low rates of cardiac procedures at baseline hospitalization, one would expect a “catch-up” phenomenon during follow-up, which was absent even among the nondisabled stroke patients. This effect of stroke in the management of coronary disease is likely to alter the long-term prognosis of these coronary disease patients.

Contrary to prior studies, age was not a significant predictor of cost in stroke patients. However, because the effect of stroke on AMI costs is directly related to the incidence of stroke, any factor that substantially increases the stroke rate has significant cost consequences. AMI studies on thrombolytics have demonstrated that with increasing age, there is greater stroke risk and less survival benefit.[3,12] The meta-analysis by the Fibrinolytic Therapy Trialists’ Collaboration Group indicated that the use of thrombolytics in AMI patients >75 years old results in 10 lives saved per 1000 patients, compared with 27 lives saved per 1000 patients 65 to 74 years old.[13] The combination of lower efficacy and the higher stroke rate in patients >75 years old calls into question whether alternative reperfusion strategies that have lower stroke rates (such as primary angioplasty) would be preferred in the elderly.

Limitations

Several caveats should be considered with regard to our study. First, costs for the baseline hospitalization were estimated from the Duke cost accounting system,[5] not directly at each participating institution. Thus, the absolute magnitude of baseline cost differences observed in this study may not represent costs at other medical centers. Second, the available follow-up in GUSTO I extends only to 1 year. Therefore, our study provides an incomplete picture of the lifetime economic consequences of strokes in AMI patients. Finally, neuroimaging studies were performed in a number of AMI patients without stroke to “rule out” a stroke. Data on these resources were not collected and are not accounted for in the analysis.

Conclusions

This prospective study measured the effect of stroke on cost and medical resource use in AMI and examined the main determinants of cost. Overall, compared with the no-stroke cohort, stroke increased the average 1-year medical costs by 60% ($15 094). The early economic effects were due to a high early mortality rate, which decreased invasive cardiac procedure use after stroke (more pronounced in patients with hemorrhagic strokes, who had the highest mortality rate) and longer length of stay among the stroke survivors. After discharge, disability level was the principal determinant of cost, with highest institutional care need and lowest cardiac procedure rates in patients with major disability.

Acknowledgments

This study was supported in part by research grants HS-06503 from the Agency for Health Care Policy and Research; HL-36857, HL-17670, and National Research Service Award 2 T32 HL-07101-21A from the National Heart, Lung, and Blood Institute; and by grants from Searle, Chicago, Ill; Genentech, South San Francisco, Calif; and the Robert Wood Johnson Foundation. We are indebted to Tracey Simons, MA, for her assistance in editing the manuscript and Linda Davidson-Ray, BA, and Patricia Cowper, PhD, for their assistance in developing the cost data.

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