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ORIGINAL RESEARCH

Incidence and Long-Term Outcomes of Stroke in Patients Presenting With ST-Segment Elevation–Myocardial Infarction: Insights From the Midwest STEMI Consortium

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BACKGROUND: Contemporary real-world data on stroke in patients presenting with ST-segment–elevation myocardial infarction (STEMI) are scarce.

METHODS AND RESULTS: We evaluated the incidence, trends, cause, and predictors of stroke from 2003 to 2019 in 4 large regional STEMI programs in the upper Midwest that use similar transfer and treatment protocols. We also evaluated the long-term impact of stroke on 5-year mortality. Multivariate logistic and Cox regression analysis was used to identify variables independently associated with stroke in patients presenting with STEMI and identify variables associated with 5-year mortality. A total of 12 868 patients presented with STEMI during the study period. Stroke occurred in 98 patients (0.76%). The incidence of stroke remained stable over time (0.5% in 2003, 1.2% in 2019; *P*-trend=0.22). Most (75%) of strokes were ischemic, with a median time to stroke symptoms of 14 hours after primary percutaneous coronary intervention (interquartile range, 4–72 hours), which led to a small minority (3%) receiving endovascular treatment and high in-hospital mortality (18%). On multivariate regression analysis, age (increment of 10 years) (odds ratio [OR], 1.32; 95% CI, 1.10–1.58; *P*-value=0.003) and preintervention cardiogenic shock (OR, 2.03; (95% CI, 1.03–3.78; *P*=0.032)) were associated with a higher risk of in-hospital stroke. In-hospital stroke was independently associated with increased risk of 5-year mortality (hazard ratio, 2.01; 95% CI, 1.13–3.57; *P*=0.02).

CONCLUSIONS: In patients presenting with STEMI, the risk of stroke is low (0.76%). A stroke in patients presenting with STEMI is associated with significantly higher in-hospital (18%) and long-term mortality (35% at 5 years). Stroke was associated with double the risk of 5-year death.

Key Words: stroke ■ stroke management ■ stroke prevention ■ ST-segment deviation ■ ST-segment–elevation myocardial infarction

In the current era, most patients who present with ST-segment–elevation myocardial infarction (STEMI) undergo cardiac catheterization and primary percutaneous coronary intervention (PPCI). There has been a decline in many complications related to percutaneous coronary intervention (PCI) over the past few decades, but not PCI-related stroke.[1] The historical incidence of PCI-related stroke ranged from 0.22% to 1.3% of all PCI procedures.[2–6] The highest risk of PCI-related stroke occurs in patients presenting with STEMI.

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CLINICAL PERSPECTIVE

What Is New?

- The incidence of in-hospital stroke in patients presenting with ST-segment–elevation myocardial infarction is low (0.76%) and has numerically increased over the years but without achieving statistical significance.
- Patients with in-hospital stroke had a high risk of in-hospital mortality (18%).
- Stroke was independently associated with a higher risk of 5-year death after surviving the initial event.

What Are the Clinical Implications?

- Efforts should be maximized to avoid and immediately manage strokes in patients with ST-segment–elevation myocardial infarction through meticulous techniques, optimal antithrombotic therapy, and involving the neurointerventional teams early when suspecting periprocedural cerebrovascular events.

Nonstandard Abbreviations and Acronyms

IHC	Iowa Heart Center
MSC	Midwest STEMI Consortium
PPCI	primary percutaneous coronary intervention

In randomized controlled trials in patients with myocardial infarction (MI), the incidence of stroke ranged from 0.5% to 1.4%.[4,6–9] These strokes mainly were ischemic.[4] The field of interventional cardiology has evolved with broader adoption of radial access, newer antiplatelet agents, such as ticagrelor and prasugrel, and regional systems of care. Given the lack of contemporary, real-world data on the incidence of stroke in patients who present with STEMI, we investigated the Midwest STEMI Consortium (MSC) database to describe the trends and identify the incidence and predictors of acute stroke in patients with STEMI over 17 years.

METHODS

Study Population

The data that support the findings of this study are available from the corresponding author on reasonable request. We included consecutive patients with STEMI (≥1-mm ST-segment elevation in at least 2 contiguous leads or new-onset left bundle-branch block) presented to an MSC hospital within 24 hours of symptom onset. MSC is a collaboration of 4 large regional STEMI programs in the upper Midwest: Iowa Heart Center (IHC) in Des Moines, IA; Minneapolis Heart Institute at Abbott Northwestern Hospital in Minneapolis, MN; Prairie Heart Institute in Springfield, IL; and The Christ Hospital in Cincinnati, OH. Each program has similar standardized STEMI protocols and together serve >100 referral hospitals and emergency medical services. A comprehensive description of MSC has been previously published.[10] Common elements in the MSC protocol include the following: (1) prehospital ECG, (2) activating the STEMI team by a single telephone call, (3) administration of guideline-recommended initial antithrombotic therapy before arrival to PCI-capable hospitals, (4) routing predetermined transfer plan to PCI-capable hospitals, and (5) bypassing the emergency department to proceed directly to the cardiac catheterization laboratory at PCI-capable hospital. Minneapolis Heart Institute started enrollment of patients in 2002, and IHC, Prairie Heart Institute, and The Christ Hospital created their prospective registries in 2004, 2005, and 2007, respectively. We excluded patients from IHC treated before 2009 as information on stroke was not routinely captured before 2009 at IHC.

Data were prospectively collected by a dedicated research assistant using standardized data forms. A comprehensive database, modeled after the American College of Cardiology National Cardiovascular Data Registry definitions, with detailed treatment times, clinical and angiographic variables, and in-hospital and 30-day outcomes, was created at the inception of the program to provide quality assurance and monitor the progress of the program. Two hospitals within MSC (Minneapolis Heart Institute and The Christ Hospital) systematically capture 1-year major adverse cardiovascular events.

The study complied with the Declaration of Helsinki and was approved by the institutional review board. The study protocol, data sharing agreement, and relevant supporting information have been approved by institutional review boards in each center. Informed consent was waived. The MSC was funded by a grant from the American College of Cardiology Accreditation Services.

Definitions and Study Outcomes

Adult patients with ST-segment elevation ≥1 mm in at least 2 contiguous leads or presumably new left bundle-branch block within 24 hours of symptom onset were included in the prospective registry. A stroke was defined as any cerebrovascular event with the loss of neurological function caused by an ischemic or hemorrhagic event. Stroke adjudication in patients without focal neurological symptoms at presentation (unconsciousness, out-of-hospital cardiac arrest, or postsurgical state) relied on the presence of neuroimaging findings consistent with acute or subacute stroke, as determined by neurologist consultant. When such findings were absent or ambiguous, strokes were deemed to be indeterminate.

We attempted to identify the presumed mechanisms of strokes using 3 key data elements: (1) timing of the neurological deficit in relationship to the PPCI procedure (intraprocedure or within 6 hours), (2) neuroimaging findings (acute findings in a brain territory that accounts for the observed neurological deficit, hemorrhagic versus ischemic), and (3) neurology consultation. For example, a patient who developed a neurological deficit intraprocedure, received IIb/IIIa inhibitors, and had intracranial bleeding on neuroimaging was classified as probably PPCI related. In contrast, a patient with STEMI presenting with untreated atrial fibrillation and a stroke with neuroimaging evidence of multiple ischemic defects was classified as probably related to atrial fibrillation.

Statistical Analysis

Categorical variables were described as numbers and percentages. Continuous variables were described with median and interquartile range if they had skewed distributions. Categorical variables were compared across groups using Pearson χ^2 or Fisher exact tests. Continuous variables were compared across groups using Wilcoxon rank-sum test. A *P* value of ≤0.05 was considered statistically significant.

The incidence of in-hospital strokes was calculated for each year, and the trend over the years was analyzed using Poisson regression. A multivariate logistic regression analysis was performed to identify predictors of in-hospital stroke using a backward stepwise selection procedure. Variables used in the model were based on prior knowledge and included age, sex, hypertension, dyslipidemia, diabetes, transfer thrombolytics, out-of-hospital cardiac arrest, and pre-PCI cardiogenic shock. The multivariate logistic regression analysis was performed in 81 patients of 98 (excluding patients in IHC as data on transfer thrombolytics were not available for that group). The cause and stroke mechanisms were adjudicated by reviewing medical records and neurology notes by trained abstractors using standardized data collection forms. We collected data on the number of strokes accurately adjudicated by neurologists and the percentage of brain imaging use.

Long-term outcomes included a 5-year incidence of death and MI. Long-term outcomes were estimated using the Kaplan–Meier method and compared using the log-rank test for mortality and the Gray test for MI, with death being a competing event.

We then performed Cox proportional hazard regression analysis to identify predictors of mortality. Variables used in the model were based on prior knowledge and included in-hospital stroke, age, sex, hypertension, dyslipidemia, diabetes, out-of-hospital cardiac arrest, and pre-PCI cardiogenic shock.

RESULTS

During the study period, a total of 15 123 patients presented with STEMI to 1 of the 4 MSC sites. Of those,

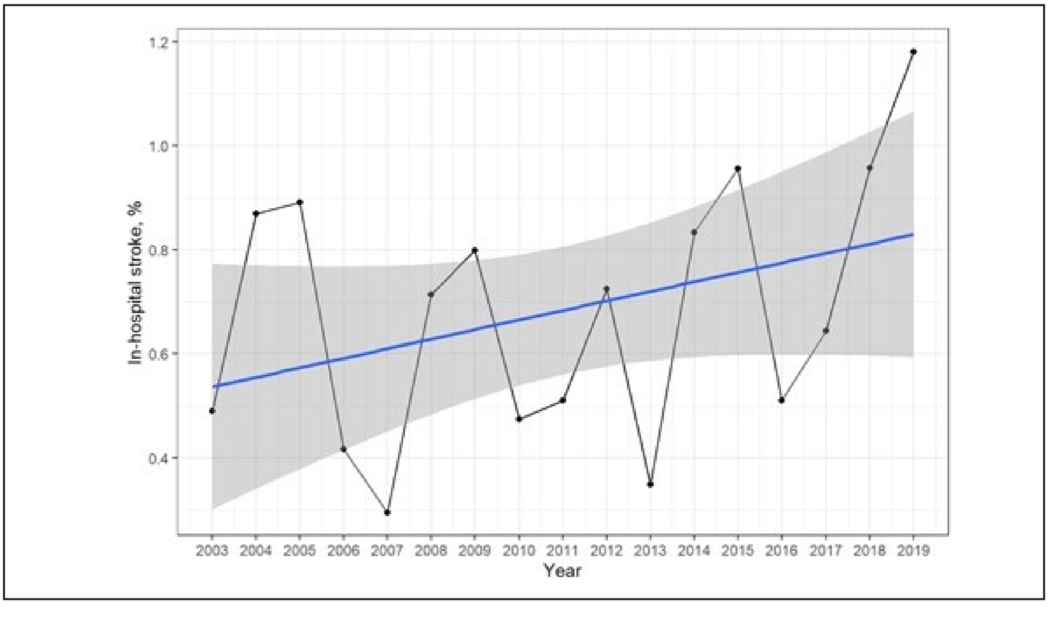

Figure 1. The trend of occurrence of stroke in patients presenting with ST-segment–elevation myocardial infarction.

12 868 patients had data available on stroke and were included in the present analysis. The remainder 2255 were treated at IHC before 2009. Stroke occurred in 98 patients (0.76%). The trend of stroke occurrence remained fairly constant over time (0.5% in 2003, 1.2% in 2019; *P*-trend=0.22) (Figure 1).

The baseline patients' and procedural characteristics in patients with and without in-hospital stroke are shown in Table 1. Patients who had strokes were older (68 versus 62 years; *P*<0.001) and were more likely to have presented with cardiac arrest (20% versus 11%; *P*=0.009), and preintervention cardiogenic shock (27% versus 9.1%; *P*<0.001). Pre-PCI thrombolytics were used in 19% of patients with strokes compared with 12% of patients who did not have strokes (*P*=0.11). In-hospital death was significantly higher for

Table 1. Baseline Characteristics of the Included Patients

Characteristic	All STEMI (n=12 868)	No stroke (n=12 770)	Stroke (n=98)	*P* value
Men, n (%)	9071 (70)	9013 (71)	58 (59)	0.019
Age, median (IQR), y	62 (53–73)	62 (53–72)	68 (61–78)	<0.001
BMI, median (IQR), kg/m²	28 (25–33)	29 (25–33)	28 (25–32)	0.5
Cardiovascular risk factors and pre-PCI conditions, n (%)				
Hypertension	7840 (62)	7777 (62)	63 (65)	0.7
Dyslipidemia	6957 (56)	6907 (56)	50 (53)	0.6
Diabetes	2825 (22)	2801 (22)	24 (25)	0.7
Smoking				0.019
Current	3574 (37)	3556 (37)	18 (22)	
Former	2508 (26)	2486 (26)	22 (28)	
History of CAD	3118 (32)	3091 (32)	27 (34)	0.8
Family history of CAD	4991 (43)	4954 (43)	37 (47)	0.6
Prior PCI	3063 (24)	3042 (24)	21 (22)	0.7
Prior MI	2540 (20)	2518 (20)	22 (23)	0.6
Prior CABG	853 (6.8)	845 (6.8)	8 (8.2)	0.7
Prior AICD (total n=5901)				>0.9
ICD	231 (3.9)	229 (3.9)	2 (3.8)	
Pacemaker	49 (0.8)	49 (0.8)	0	
Both	6 (0.1)	6 (0.1)	0	
History of CHF	886 (9.2)	867 (9.1)	19 (24)	<0.001
History of stroke	303 (4.3)	300 (4.3)	3 (4.5)	0.3
History of TIA	139 (2.0)	136 (2.0)	3 (4.7)	0.14
Cardiogenic shock and out-of-hospital cardiac arrest, n (%)				
Pre-PCI cardiogenic shock	1150 (9.3)	1124 (9.1)	26 (27)	<0.001
Cardiac arrest	1191 (11)	1173 (11)	12 (12)	0.6
Therapeutic hypothermia following cardiac arrest				0.061
	299 (4)	293 (4)	6 (9)	
Transfer thrombolytics (n=9986)	1210 (12)	1195 (12)	15 (19)	0.11
Culprit vessel LAD or LM	4080 (33)	4046 (33)	34 (36)	0.6
Discharge disposition				<0.001
Discharge to home	9173 (71)	9142 (72)	30 (31)	
Discharge to assisted living	212 (1.6)	207 (1.6)	9 (9.2)	
Discharge to skilled nursing facility	388 (3.0)	368 (2.9)	39 (40)	
Survived to discharge, destination unknown	2329 (18)	2305 (18)	2 (2.0)	
Death during hospitalization	757 (5.9)	739 (5.8)	18 (18)	

AICD indicates automatic ICD; BMI, body mass index; CABG, coronary artery bypass grafting; CAD, coronary artery disease; CHF, congestive heart failure; ICD, implantable cardioverter-defibrillator; IQR, interquartile range; LAD, left anterior descending artery; LM, left main coronary artery; MI, myocardial infarction; PCI, percutaneous coronary intervention; STEMI, ST-segment–elevation MI; and TIA, transient ischemic attack.

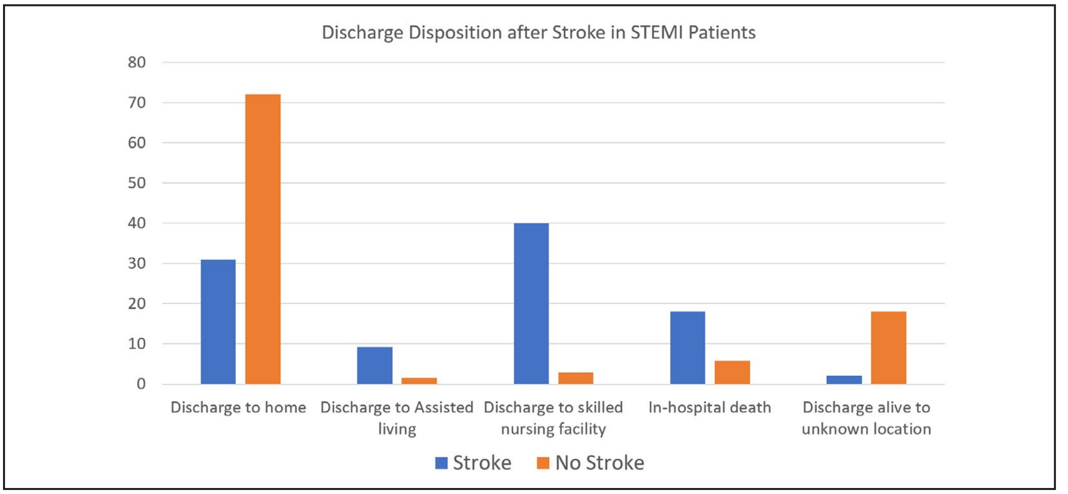

Figure 2. Discharge disposition after stroke in patients with ST-segment–elevation myocardial infarction (STEMI).

patients with in-hospital stroke (18% versus 5.8%; $P<0.01$). Approximately 49.2% of patients who had an in-hospital stroke were discharged to a nursing facility or assisted living compared with only 4.6% for patients without in-hospital stroke ($P<0.001$) (Figure 2).

On multivariate logistic regression analysis, age (increment of 10) (odds ratio [OR], 1.32; 95% CI, 1.10–1.58; *P*-value=0.003) and preintervention cardiogenic shock (OR, 2.03; 95% CI, 1.03–3.78; $P=0.032$) were significantly associated with a higher risk of in-hospital stroke (Table S1).

Timing, Cause, and Treatment of Stroke

Data on the characteristics and outcomes of patients with STEMI who experienced stroke are shown in Table 2. The stroke cause was ischemic in 74.5%, hemorrhagic in 21.4%, and mixed in 3%. Most of the postprocedure strokes were identified >24 hours after PPCI (43%). The median time to stroke symptoms after PCI was 14 hours (interquartile range, 4–72 hours). Stroke occurred before any intervention in 13% of patients and during the procedure in 5%. Of the 21 patients with hemorrhagic stroke, 4 (22%) received thrombolytics and 3 (14%) received IIb/IIIa inhibitors. Two of these strokes (13%) occurred in patients on extracorporeal membrane oxygenation exposed to systemic anticoagulation for >48 hours and found on routine computed tomography indicated by extracorporeal membrane oxygenation.

PPCI was performed predominantly through the femoral approach (81%). The median of the highest activated clotting time recorded during PPCI was 224 seconds (interquartile range, 181–278 seconds). Thrombectomy was only used in 16% of cases and mostly was manual thrombectomy (62.5%). Fifteen patients received pre-PCI thrombolytics. Of those, 11 patients had ischemic strokes, and 4 patients had hemorrhagic strokes ($P=0.50$).

Stroke was treated with the endovascular approach in only 3.1% of patients. The median length of hospital stay was 9 days (interquartile range, 5–15 days). On the basis of the review of medical records and neurology adjudication, the stroke cause was determined to be procedure related, related to anoxic brain injury, or atrial fibrillation in 21%, 10%, and 7.1% of cases, respectively.

Long-Term Outcomes

Long-term outcomes were available for 85% of patients with stroke who survived the index hospitalization (46 of 54). Patients with stroke had a higher risk of 5-year mortality (35% versus 14%; $P<0.001$) but a similar risk of MI (4.8% versus 5.6%; $P=0.60$) (Table S2 and Figure 3). On Cox regression analysis, stroke was independently associated with a higher risk of mortality over 5-year follow-up (hazard ratio, 2.01; 95% CI, 1.13–3.57; $P=0.02$) (Table S3).
The summary of the study results is shown in Figure 4.

DISCUSSION

Our study provides the most comprehensive analysis and description of strokes in a large, contemporary, real-world cohort of patients with STEMI over the past 2 decades. The principal findings of our study are as follows: (1) the incidence of in-hospital stroke in patients presenting with STEMI is low (0.76%) and has numerically increased over the years but without achieving statistical significance (0.5% in 2003, 1.2% in 2019; $P=0.22$); (2) 1 of 5 strokes associated with STEMI was hemorrhagic, and ≈1 in 10 patients had their stroke before PCI;

Table 2. Characteristics and In-Hospital Outcomes of Patients With STEMI Complicated With In-Hospital Stroke From 2003 to 2019

Variable	Value (N=98)
Type of stroke (n=95), n (%)	
Ischemic stroke	73 (74.5)
Hemorrhagic stroke	21 (21.4)
Both hemorrhagic and ischemic strokes	3 (3)
Transient ischemic attacks	3 (3.1)
Timing of stroke (n=95), n (%)	
Presumed to be present before intervention	12 (13)
Intraprocedure	5 (5)
After 0–6 h	18 (19)
After 6–12 h	13 (14)
After 12–24 h	6 (6)
After >24 h	41 (43)
Timing of symptoms (after primary PCI) (n=59), median (IQR), h	14 (4–72)
History of atrial fibrillation (n=95), n (%)	16 (16)
New atrial fibrillation (n=96), n (%)	
During the procedure	14 (14)
On admission	1 (1)
During admission	1 (1)
After PCI	2 (2.1)
Postoperative day 3	1 (1.0)
CT head performed, n (%)	83 (85)
MRI brain performed (n=94), n (%)	64 (65)
Neurology adjudicated, n (%)	88 (90)
NIH scale score (n=30), median (IQR)	6 (2–16)
Access site (n=90), n (%)	
Femoral	73 (81)
Radial	13 (14)
Both	3 (3.3)
Antiplatelet given before PCI (n=93)	
Clopidogrel, n (%)	36 (39)
Ticagrelor, n (%)	26 (28)
Prasugrel, n (%)	2 (2.2)
None, n (%)	29 (31)
Activated clotting time, median (IQR), s	224 (181–278)
Use of IIb/IIIa inhibitors (n=92), n (%)	
Abciximab	2 (2.2)
Eptifibatide	19 (21)
Tirofiban	4 (4.3)
None	67 (73)
Intravenous anticoagulant given during the case (n=91), n (%)	79 (87)
Thrombectomy during the case, n (%)	16 (16)
Cardiogenic shock (all), n (%)	31 (32)
Use of mechanical circulatory support, n (%)	28 (29)
Type of mechanical circulatory support, n (%)	
ECMO	3 (11)
Intra-aortic balloon pump	24 (86)
Impella	1 (3)
Out-of-hospital cardiac arrest, n (%)	12 (12)
In-hospital cardiac arrest, n (%)	12 (12)
Shockable rhythm (n=77), n (%)	20 (26)
Use of Lucas chest compression device (n=79), n (%)	7 (8.9)
Therapeutic hypothermia (n=94), n (%)	10 (11)
Anoxic brain injury (n=80), n (%)	10 (13)
Endovascular treatment of stroke, n (%)	3 (3.1)
Length of stay, median (IQR), d	9 (5–15)
Presumed stroke cause based on review of medical records and neurology adjudication, n (%)	
Procedure (PPCI) related	21 (21)
Atrial fibrillation	7 (7.1)
Cardiac arrest or anoxic encephalopathy	10 (10.2)
CABG related	1 (1.0)
Aortic plaque embolization	1 (1.0)
Hypertensive emergency	1 (1.0)
Indeterminate	57 (58.1)

CABG indicates coronary artery bypass grafting; CT, computed tomography; ECMO, extracorporeal membrane oxygenation; IQR, interquartile range; MRI, magnetic resonance imaging; NIH, National Institutes of Health; PCI, percutaneous coronary intervention; PPCI, primary PCI; and STEMI, ST-segment–elevation myocardial infarction.

(3) variables associated with a higher incidence of in-hospital stroke in patients with STEMI include older age and preintervention cardiogenic shock; (4) patients with in-hospital stroke had a high risk of in-hospital mortality (18%), and approximately half of them were discharged to a skilled nursing facility or nursing home; and (5) patients with STEMI and in-hospital stroke who survived the index STEMI have high mortality over the next 5 years, and stroke was independently associated with a higher risk of 5-year death.

The most contemporary data about the incidence of stroke in patients with STEMI was derived from the administrative Nationwide Inpatient Database. It showed a small increase in stroke risk from 2003 (0.6%) to 2016 (0.96%).[11] The incidence of stroke in our analysis is concordant with the Nationwide Inpatient Database findings. There has been a dramatic increase in the proportion of patients with STEMI with high-risk features, including older age, complex anatomy, and high-risk pre-PCI conditions, such as cardiogenic shock and cardiac arrest, which might explain the perceived lack of progress despite procedural and device enhancements, such as radial access and improved PCI pharmacology.[12]

Patients with STEMI are at a higher risk of post-PCI stroke compared with patients presenting with non–ST-segment–elevation acute coronary

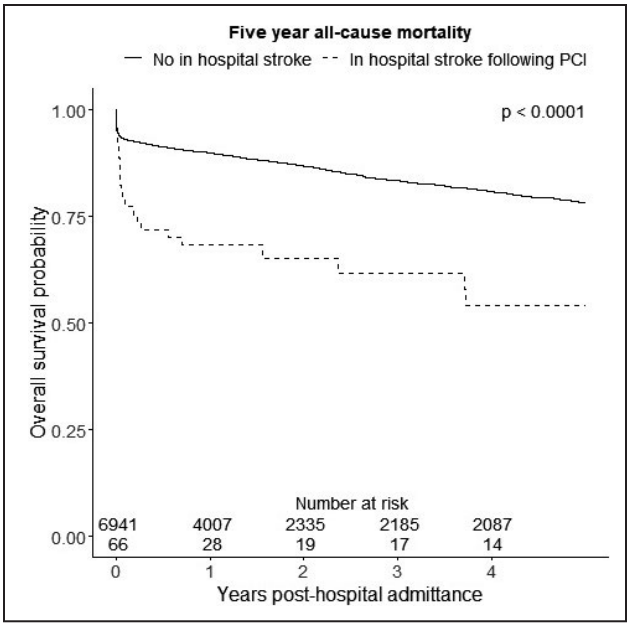

Figure 3. Kaplan–Meier estimates of 5-year mortality in patients with vs without in-hospital stroke in patients presenting with ST-segment–elevation myocardial infarction. PCI indicates percutaneous coronary intervention.

syndrome and stable angina.[11] The cause of strokes in patients presenting with STEMI is heterogeneous and multifactorial.[4] The presence of an intracoronary thrombus was also found to be independently associated with periprocedural stroke.[3] Additional possible mechanisms include vascular inflammation[13] and the risk of hemorrhagic stroke with potent antithrombotic/antiplatelet drugs. Previous studies have found multiple variables independently associated with post-PCI stroke, including older age, use of intra-aortic balloon pump, intervention to a saphenous vein graft, carotid disease, cardiogenic shock, atrial fibrillation, and low ejection fraction.[2,4,11] Although the history of a previous stroke was identified as a significant predictor for stroke after coronary artery bypass grafting,[14,15] this association has not been found with PCI in our analysis. The low incidence of stroke in our study might prevent a more detailed analysis of stroke predictors.

In our analysis, 90% of strokes were adjudicated by a neurologist, and most of them had brain imaging (85% had head computed tomographic scans, and 65% had brain magnetic resonance imaging scans). Therefore, we can provide a reliable analysis of this rare complication. Despite rigorous evaluation, stroke cause could not be determined in 60% of cases, with only 21% being considered a PCI complication. About 1 in 5 patients had hemorrhagic strokes. Although it is a rare event (21 patients over 20 years), the median of the highest activated clotting time recorded during PCI procedures was 224 seconds, representing a high degree of awareness by operators to bleeding complications in general, which should help mitigate the risk of hemorrhagic stroke. In our analysis, endovascular treatment of stroke was rare. This

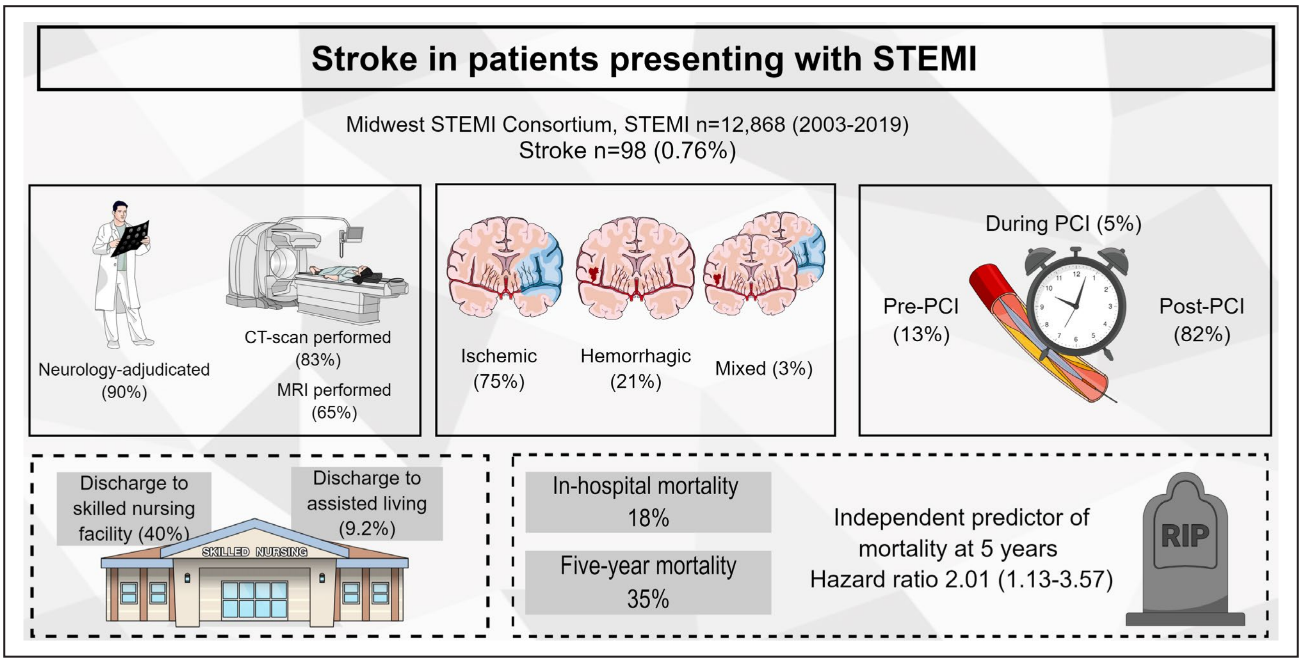

Figure 4. Summary of the study results.
CT indicates computed tomography; MRI, magnetic resonance imaging; PCI, percutaneous coronary intervention; and STEMI, ST-segment–elevation myocardial infarction.

can be partly attributed to some patients having hemorrhagic strokes (21%) and others' stroke related to anoxic brain injury (10%) or stroke timing before any intervention (13%). However, cardiologists should raise awareness to detect and triage patients who would benefit from ischemic stroke intervention. This can be achieved by broader use of stroke alert teams, allowing prompt evaluation of patients and quick interventions if indicated.

Our study highlights the devastating outcomes of in-hospital stroke in patients presenting with STEMI, both during the initial hospitalization and after discharge. The occurrence of in-hospital stroke was associated with a high risk of in-hospital death (18%). It also led to significantly higher discharge rates to a nursing facility or assisted living, which negatively impacts the lifestyle and outcomes of these patients. Previous studies have shown that only 60% of patients discharged to a nursing facility were eventually discharged home.[16] Similarly, previous studies demonstrated a higher risk of both in-hospital mortality and 1-year mortality with post-PCI stroke.[2,11,17] Our study, however, is the first to report long-term data for this cohort of patients, and it showed a continued higher risk of death up to 5 years (35%). In-hospital stroke was associated with a doubling of the risk of death at 5 years after adjusting for important covariates, suggesting the stroke itself might be responsible for the excess mortality. Efforts should be maximized to prevent this devastating complication, and hospitals should be ready for immediate endovascular intervention, when indicated, to prevent its long-term sequelae.

Limitations

Our study has limitations. It is a retrospective analysis with the inherent limitations of selection bias and measured and unmeasured confounders. Second, certain essential variables that might affect long-term mortality or MI in these patients, such as the Syntax score, were not available and could not be further analyzed. Third, adjudication of stroke mechanism is challenging in the population with STEMI because of multiple cardiovascular risk factors, presence of hemodynamic instability, and late presentations, which may limit diagnostic testing. The process used for stroke adjudication relied on timing of symptoms, neuroimaging findings, and neurology consultation. The sensitivity and specificity of this approach is unknown. Fourth, some variables (activated clotting time, MCS, and type of access) were not routinely captured in all patients with STEMI participating in MSC, in particular during the first 10 years of the study. Therefore, we are unable to compare patients with and without strokes on these variables. Finally, given the small number of patients with strokes, the study's power to identify predictors of stroke is limited.

CONCLUSIONS

In patients presenting with STEMI, the risk of stroke is low (0.76%). A stroke in patients presenting with STEMI is associated with significantly higher in-hospital (18%) and long-term mortality (35% at 5 years). Stroke was associated with double the risk of 5-year death.

ARTICLE INFORMATION

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Supplementary Material

Tables S1–S3

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SUPPLEMENTAL MATERIAL

Table S1. Variables associated with increased risk of in-hospital strokes with STEMI.

	Odds ratio	Lower 95% CI	Upper 95% CI	P-value
Age, per 10 years	1.32	1.10	1.58	0.003
Female	1.54	0.94	2.50	0.08
Out of hospital CA	1.93	0.97	3.64	0.051
Pre-intervention cardiogenic shock	2.03	1.03	3.78	0.032

CI: confidence interval

Table S2. **Long-term outcomes in STEMI patients with vs. without in-hospital stroke**.

Outcome	Stroke (n=66)	No stroke (n=6,941)	log-rank p value
Death n (%)	23 (35)	966 (14)	<0.001
Myocardial infarction n (%)	3 (4.8)	389 (5.6)	0.600

Table S3. Variables independently associated with 5-year mortality.

	Hazard Ratio	Lower 95% CI	Upper 95% CI	P-value
In-hospital stroke	2.01	1.13	3.57	0.02
Age, per 10 years	1.93	1.79	2.08	<0.001
Female	0.95	0.79	1.14	0.58
Diabetes	1.68	1.39	2.04	<0.001
Hypertension	1.51	1.22	1.87	<0.001
Dyslipidemia	1.03	0.85	1.24	0.77
Pre-PCI cardiogenic shock	1.76	1.34	2.30	<0.001
LVEF at PCI: <35	2.16	1.74	2.69	<0.001
LVEF at PCI 35-50	1.32	1.08	1.63	0.01
LAD Culprit	0.83	0.69	1.01	0.06

PCI: percutaneous coronary intervention; LAD: left anterior descending artery; LVEF: left ventricular ejection fraction.