

# Early Sustained Ventricular Arrhythmias Complicating Acute Myocardial Infarction\*

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## ABSTRACT

**OBJECTIVE:** Sustained ventricular arrhythmias complicate 2% to 20% of acute myocardial infarctions (MIs) and are associated with increased in-hospital mortality. However, it remains unclear whether successful mechanical revascularization improves outcomes in these patients. The objective of this analysis was to identify predictors of sustained ventricular arrhythmias after acute MI and to determine the influence of successful revascularization on in-hospital mortality.

**METHODS:** We conducted a retrospective cohort study of all patients who underwent percutaneous coronary intervention for acute MI in New York State between 1997 and 1999.

**RESULTS:** Of the 9015 patients who underwent percutaneous coronary intervention for acute MI, 472 (5.2%) developed sustained ventricular tachycardia (VT) or ventricular fibrillation (VF) before revascularization. After multivariable adjustment, independent predictors of sustained VT/VF included cardiogenic shock (odds ratio [OR], 4.10; 95% confidence interval [CI], 3.20-5.58;  $P < .001$ ), heart failure (OR, 2.86; 95% CI, 2.24-3.67;  $P < .001$ ), chronic kidney disease (OR, 2.58; 95% CI, 1.27-5.23;  $P = .009$ ), and presentation within 6 hours of symptom onset (OR, 1.46; 95% CI, 1.18-1.81;  $P = .001$ ). Patients with sustained VT/VF had greater in-hospital mortality (16.3% vs 3.7%,  $P < .001$ ). Although successful percutaneous coronary intervention was associated with decreased in-hospital mortality in patients with VT/VF ( $P < .001$ ), patients with sustained VT/VF and successful revascularization experienced increased mortality compared with patients without sustained ventricular arrhythmias ( $P < .001$ ).

**CONCLUSION:** Among patients undergoing percutaneous coronary intervention for acute MI, sustained VT/VF remains a significant complication associated with a 4-fold increased risk of in-hospital mortality. Early mortality is reduced after successful percutaneous coronary intervention, but remains elevated in this high-risk group.

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**KEYWORDS:** Angioplasty; Mortality; Myocardial infarction; Ventricular arrhythmia

Ventricular arrhythmias are a well-recognized complication of acute myocardial infarction (MI). Acute myocardial ischemia leads to regional dispersion of repolarization, increased tissue excitability, and enhanced automaticity in the ischemic border zone. These electrochemical changes promote the develop-

ment of ventricular arrhythmias, which ultimately affect 2% to 20% of patients with acute MI.<sup>1-4</sup>

Initial reports suggested that sustained ventricular tachycardia (VT) and ventricular fibrillation (VF) occurring in the setting of acute MI were not associated with worse outcomes.<sup>5-8</sup> Subsequently, randomized controlled trials of thrombolytic therapy in acute MI demonstrated that sustained ventricular arrhythmias were not benign and were associated with both persistent occlusion of the infarct related artery and increased early mortality.<sup>9,10</sup> More importantly, the increased mortality observed in those patients with sustained ventricular arrhythmias occurred despite the use of thrombolytic therapy. Notwithstanding these observations, controversy remains as to whether sustained ven-

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tricular arrhythmias occurring early in the course of acute MI are associated with increased mortality in patients who undergo mechanical revascularization.<sup>11</sup>

Little data are available regarding the incidence and prognosis of sustained VT/VF in the modern era of mechanical reperfusion. The purpose of this investigation was to identify the incidence and predictors of sustained VT/VF early after acute MI and to determine whether successful percutaneous coronary intervention is associated with improved outcomes in these patients.

## MATERIALS AND METHODS

### Patients

The study population included 9015 consecutive patients undergoing percutaneous coronary intervention for acute MI in New York State between January 1, 1997 and December 31, 1999. The time from symptom onset to treatment was recorded as less than 6 hours, 6 to 23 hours, or the number of days. Because significant numbers of patients with acute MI present more than 6 hours from symptom onset<sup>12</sup> and late presentation may be associated with worse outcome,<sup>13</sup> we included patients who underwent attempted percutaneous coronary intervention for acute MI within 23 hours of symptom onset. This definition of primary angioplasty is consistent with that used by the Society of Cardiac Angiography and Interventions.<sup>14</sup>

### Data Ascertainment

Prospectively defined data elements, including demographics, comorbidities, procedural details, complications, and in-hospital outcomes, are required by New York State to be submitted to the Department of Health for every angioplasty performed in nonfederal hospitals in the state to make up the Coronary Angioplasty Reporting System Database. The Department of Health is the coordinating center, and hospitals and their catheterization laboratories are responsible for the accurate documentation and transfer of data. The Department of Health conducts periodic site visits to check for the accuracy of data entry, and errors and discrepancies are brought to the attention of each laboratory to be rectified.<sup>15</sup> All patients with acute MI who undergo angioplasty, including both non-ST-segment elevation and ST-segment elevation MIs, are included in the registry.

### Definitions

Ventricular arrhythmia was defined as the occurrence of VT or VF. VF was defined as irregular undulations, varying in amplitude and contour, without distinct QRS complexes or T waves accompanied by hemodynamic compromise. VT

was defined as a regular wide complex tachycardia of ventricular origin that was sustained (duration >30 seconds) or accompanied by hemodynamic compromise requiring electrical defibrillation or the use of intravenous antiarrhythmic agents.<sup>9,11</sup> For the purpose of this analysis, only early ven-

tricular arrhythmias (those occurring before percutaneous coronary intervention) were included.

Intravenous glycoprotein IIb/IIIa inhibitors were considered to be administered when abciximab, eptifibatid, or tirofiban was given during or within 3 hours of percutaneous coronary intervention. Angiographic assessments were made at the individual hospital by visual assessment. Angiographic success was defined as a reduction of the treated lesion by at least 20% with a residual stenosis of less than 50%.<sup>16</sup> All procedural decisions, including device selection and adjuvant pharmacotherapy, were made at the discretion of the individual physician performing

the catheterization. Stent deployment during percutaneous coronary intervention was at high pressure. Major adverse cardiac events were defined as recurrent MI, stroke, or death.

### Statistical Analysis

Categoric variables were compared by chi-square or log-linear analysis when appropriate. Continuous variables are presented as mean  $\pm$  standard deviation and were compared using the Student *t* test or analysis of variance, as indicated. Univariable analysis, followed by multivariable logistic regression analysis, was performed to identify independent predictive variables from the categoric and continuous variables. Potential confounders were entered into models if they were clinically relevant or showed univariable differences between groups with a *P* value less than .10. Statistical significance was defined as a *P* value less than .05 or confidence intervals (CIs) that did not include 1.0. All probability values are 2-tailed. All analyses were performed using the Statistical Package for the Social Sciences 11.0 (SPSS Inc, Chicago, Ill).

## RESULTS

Among 9015 patients who underwent primary percutaneous coronary intervention within 23 hours of the onset of acute MI, 472 (5.2%) had sustained VT/VF before revascularization. The baseline characteristics of the population according to the occurrence of VT/VF are shown in Table 1. The mean age of patients was 61 years and did not differ between groups. There was no difference in the sex or history of tobacco use among those with and without sustained VT/VF. Patients with sustained VT/VF were more likely to have chronic kidney disease (2.3% vs 1.0%, *P* = .001) and

### CLINICAL SIGNIFICANCE

- In the setting of an acute myocardial infarction, sustained ventricular tachycardia and fibrillation are associated with worse outcomes despite successful percutaneous coronary intervention.
- Patients with sustained ventricular tachycardia or fibrillation have a 4-fold increase in in-hospital mortality, a 3-fold increase in major adverse cardiac events, and a 50% increase in hospital length of stay.

**Table 1** Baseline Characteristics

	Ventricular Arrhythmia (n = 472)	No Ventricular Arrhythmia (n = 8543)	P Value
<b>Demographics</b>			
Mean age (y) ± SD	61.1 ± 12.6	60.7 ± 12.7	.481
Female (%)	30.3	29.0	.541
White (%)	92.8	87.8	.001
BMI ± SD	28.1 ± 5.7	28.2 ± 5.1	.621
<b>Clinical history (%)</b>			
Diabetes	12.3	17.9	.002
Current smoker	29.7	28.7	.670
Hypertension	48.1	56.2	.001
LVH	3.2	3.8	.487
Stroke	3.0	4.0	.260
Peripheral vascular disease	7.2	5.8	.205
Carotid/cerebrovascular	1.7	2.1	.521
Aortoiliac	3.6	2.3	.066
Femoral/popliteal	3.4	2.5	.235
Chronic kidney disease	2.3	1.0	.005
Creatinine > 2.5 mg/dL	2.3	0.8	.001
Dialysis	0.4	0.5	.739
COPD	7.4	4.6	.006
<b>Cardiac history (%)</b>			
Previous CHF	2.3	2.3	.959
Previous MI (>1)	16.7	17.0	.894
Previous cardiac surgery	7.0	6.8	.865
Previous PTCA	11.5	14.9	.100

SD = standard deviation; BMI = body mass index; LVH = left ventricular hypertrophy; COPD = chronic obstructive pulmonary disease; CHF = congestive heart failure; MI = myocardial infarction; PTCA = percutaneous transluminal coronary angioplasty.

chronic obstructive pulmonary disease (7.4% vs 4.6%,  $P = .006$ ). Patients with sustained VT/VF were less likely to have hypertension or diabetes. Patients with sustained VT/VF were no more likely to have end-organ cardiovascular disease, including stroke, left ventricular hypertrophy, heart failure, or previous MI (Table 1).

The clinical presentation of the cohort according to the presence or absence of sustained VT/VF is detailed in Table 2. Patients with sustained VT/VF were more likely to present within the first 6 hours of their infarct and more commonly had a transmural MI. They were 3 times more likely to develop heart failure (29.9% vs 9.9%,  $P < .001$ ) and 6 times more likely to develop cardiogenic shock (18.6% vs 3.1%,  $P < .001$ ). Patients with sustained VT/VF had lower left ventricular ejection fractions ( $31.4\% \pm 19.2\%$  vs  $40.2\% \pm 19.9\%$ ,  $P < .001$ ). Sustained VT/VF developed no more commonly in patients undergoing rescue percutaneous coronary intervention after failed thrombolytic therapy than in patients who underwent primary percutaneous coronary intervention ( $P = .335$ ). Table 3 presents the angiographic and procedural characteristics of the cohort. There was no difference in the number of diseased vessels in those with and without sustained VT/VF (mean  $1.6 \pm 0.8$  vessels for both groups). Certain angiographic findings, including left main coronary artery stenosis greater than 70% and proximal left anterior descending artery stenosis, were more common in patients with sustained VT/VF. Pharmacologic therapies, including glycoprotein IIb/IIIa inhibition,

intravenous nitroglycerin, and heparin, did not differ between groups (Table 3). Although angiographic success was the same in both groups (95.1% vs 95.7%,  $P = .558$ ), patients with

**Table 2** Clinical Presentation

	Ventricular Arrhythmia (n = 472)	No Ventricular Arrhythmia (n = 8543)	P Value
<b>Clinical Presentation (%)</b>			
Heart failure	29.9	9.9	<.001
MI < 6 h	68.2	56.0	<.001
Transmural MI	55.3	44.8	<.001
Thrombolytic use	8.9	7.7	.335
within 7 d			
CCS class ± SD	3.9 ± 0.5	3.8 ± 0.6	.122
1	2.3	2.1	
2	1.5	2.4	
3	3.8	6.8	
4	92.4	88.8	
Cardiogenic shock	18.6	3.1	<.001
Unstable	13.6	5.0	<.001
hemodynamics			
Mean ejection	31.4 ± 19.2	40.2 ± 19.9	<.001
fraction ± SD			

MI = myocardial infarction; CCS = Canadian Cardiovascular Society; SD = standard deviation.

**Table 3** Angiographic and Procedural Characteristics

	Ventricular Arrhythmia (n = 472)	No Ventricular Arrhythmia (n = 8543)	P Value
<b>Angiographic characteristics (%)</b>			
CAD: No. of diseased vessels $\pm$ SD	1.6 $\pm$ 0.8	1.6 $\pm$ 0.8	.165
0	0.2	0.5	
1	54.4	56.5	
2	29.0	28.7	
3	16.3	14.2	
Left main disease > 50%	2.5	1.8	.210
Left main disease > 70%	1.9	0.9	.032
LAD disease	66.9	60.6	.006
Proximal	44.3	36.1	<.001
Mid	37.7	36.4	.569
Circumflex disease	34.7	40.0	.022
RCA disease	57.8	55.1	.238
Stent thrombosis	1.6	2.3	.452
<b>Procedural characteristics (%)</b>			
Glycoprotein IIb/IIIa inhibitor use	59.0	54.9	.159
IV nitroglycerin use	88.3	87.2	.734
IV heparin use	95.6	94.6	.379
IABP (%)	26.7	6.4	<.001
Stent use	73.9	78.5	.018
Angiographic success (%)	95.1	95.7	.558

CAD = coronary artery disease; SD = standard deviation; LAD = left anterior descending artery; RCA = right coronary artery; IV = intravenous; IABP = intra-aortic balloon pump.

sustained VT/VF were more likely to receive intraaortic balloon counterpulsation (26.7% vs 6.4%,  $P < .001$ ).

Complications, including stent thrombosis, arteriovenous injury at the access site, emergency coronary artery bypass grafting, stroke, renal failure requiring dialysis, or postprocedural MI, did not differ between those with and without sustained VT/VF (Table 4). However, patients with sustained ventricular arrhythmias were hospitalized for an additional 3 days (9.5  $\pm$  12.2 days vs 6.2  $\pm$  10.9 days,  $P < .001$ ) and had a 3-fold increase in major adverse cardiac events (19.1% vs 6.2%,  $P < .001$ ). The increased incidence of major adverse cardiac events in the patients with sustained VT/VF was primarily driven by differences in mortality, as reflected in Table 4.

Patients with sustained VT/VF had significantly increased in-hospital mortality compared with those without sustained ventricular arrhythmias (16.3% vs 3.7%,  $P < .001$ ). After controlling for baseline patient characteristics, clinical history, and clinical presentation, sustained VT/VF was a significant, independent predictor of mortality (odds ratio [OR], 2.196; 95%

CI, 1.538-3.136;  $P < .001$ ). The observed increase in mortality persisted even after excluding patients with cardiogenic shock (10.2% vs 2.6%,  $P < .001$ ).

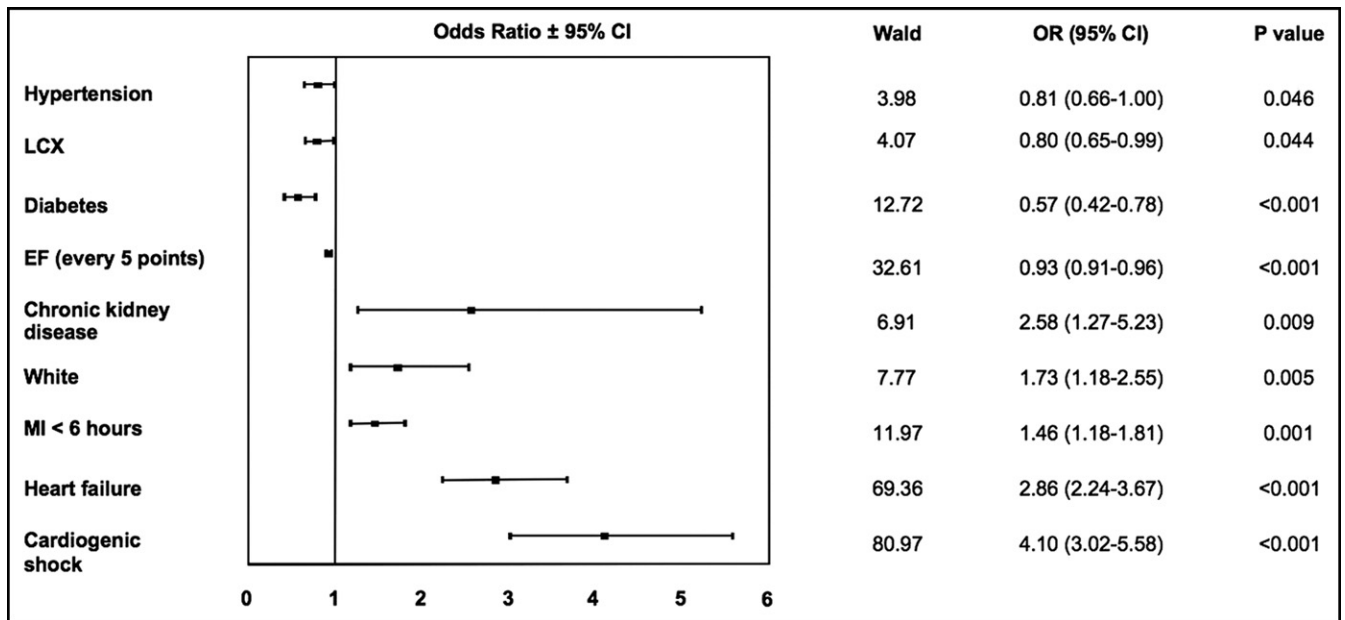
Independent predictors of ventricular arrhythmias identified via multivariable analysis are shown in Figure 1. Heart failure (OR, 2.86; 95% CI, 2.24-3.67;  $P < .001$ ) and cardiogenic shock (OR, 4.10; 95% CI, 3.02-5.58;  $P < .001$ ) were the strongest predictors of sustained VT/VF. Increased ventricular function (per 5% increase in left ventricular ejection fraction) and diabetes were associated with a decreased risk of sustained VT/VF. When excluding patients with a previous MI or those with previous open-heart surgery, the results were identical. An increase in the number of readily identifiable risk factors for sustained VT/VF on presentation (as identified by stepwise logistic regression) was associated with an increased incidence of sustained ventricular arrhythmia and in-hospital mortality, such that among those patients with 3 or more risk factors, the incidence of sustained VT/VF was 21% with an associated in-hospital mortality of 26.2% (Figure 2).

The effect of successful percutaneous coronary intervention on in-hospital mortality is shown in Figure 3. Three-way log-linear analysis revealed a significant interaction among the occurrence of sustained ventricular arrhythmias, successful percutaneous coronary intervention, and in-hospital mortality ( $P$  for interaction  $< .001$ ). Successful percutaneous coronary intervention was associated with a reduction in mortality from 41% to 14% among patients with sustained VT/VF ( $P < .001$ ). After successful percutaneous coronary intervention, patients with sustained VT/VF had significantly greater in-hospital mortality than patients after successful percutaneous coronary intervention without sustained VT/VF ( $P < .001$ ).

**Table 4** In-Hospital Outcomes

	Ventricular Arrhythmia (n = 472)	No Ventricular Arrhythmia (n = 8543)	P Value
In-hospital mortality (%)	16.3	3.7	<.001
MACE (%)	19.1	6.2	<.001
Length of stay (d) $\pm$ SD	9.5 $\pm$ 12.2	6.2 $\pm$ 10.9	<.001
Acute occlusion (%)	0.4	0.9	.270
Stent thrombosis	1.3	0.9	.413
AV injury at catheter site (%)	1.1	0.9	.746
Any CABG (%)	1.7	1.0	.126
MI (nontransmural) (%)	1.1	0.8	.513
MI (transmural) (%)	0.2	0.3	.639
Stroke (%)	0.4	0.7	.507
Renal failure requiring dialysis (%)	0.0	0.4	.170

MACE = major adverse cardiac events; SD = standard deviation; AV = arteriovenous; CABG = coronary artery bypass grafting; MI = myocardial infarction.



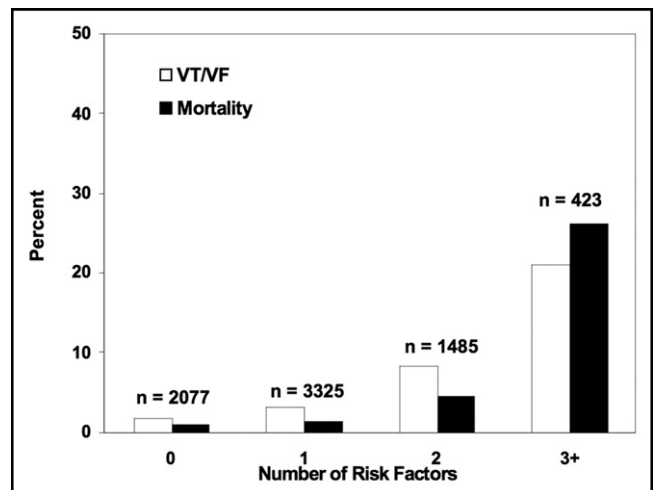
**Figure 1** Independent predictors of sustained ventricular arrhythmias identified via multivariable logistic regression after adjustment for age, race, diabetes, hypertension, aortoiliac disease, chronic kidney disease, chronic obstructive pulmonary disease, congestive heart failure, cardiogenic shock, left ventricular ejection fraction, MI within 6 hours, left circumflex artery stenosis, proximal left anterior descending artery stenosis, and left main coronary artery disease. OR = odds ratio; CI = confidence interval; LCX = left circumflex; EF = ejection fraction; MI = myocardial infarction.

**DISCUSSION**

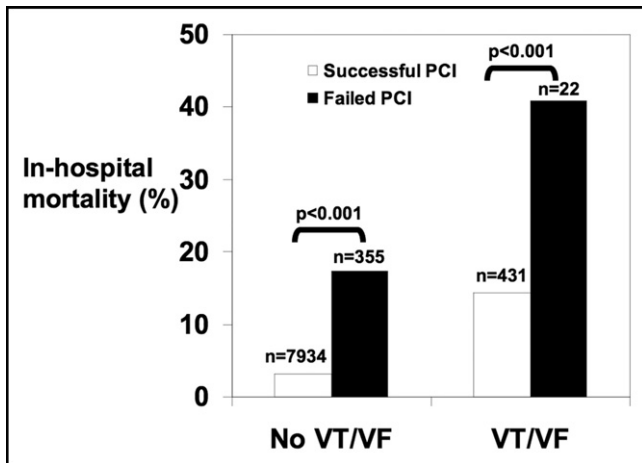
There are 3 main findings of this study. First, 1 of every 20 patients developed early sustained VT/VF before percutaneous coronary intervention for acute MI. Second, heart failure, cardiogenic shock, chronic kidney disease, and presentation within 6 hours of symptom onset were major predictors of sustained VT/VF. Finally, the occurrence of sustained VT/VF was associated with worse outcomes despite successful percutaneous coronary intervention, including a 4-fold increase in in-hospital mortality, a 3-fold increase in major adverse cardiac events, and a 50% increase in hospital length of stay. Taken together, these findings suggest that sustained VT/VF is a significant complication of acute MI that requires careful attention by clinicians and investigators given its frequency and sizable morbidity and mortality.

Previous reports on the incidence of sustained VT/VF complicating acute MI have varied widely (2%-20%) depending on the type of acute coronary syndrome (non-ST-segment elevation vs ST-segment elevation) and the acuity of the patient population.<sup>1,3,5,8</sup> Among the 40,895 patients with ST-segment elevation MI in the Global Use of Strategies to Open Occluded Coronary Arteries in Acute Coronary Syndromes trial who were treated with thrombolytic therapy, 10.2% developed sustained VT/VF, which was associated with a 3-fold increase in mortality at both 30 days and 1 year.<sup>3</sup> In the Gruppo Italiano per lo Studio della Sopravvivenza nell'Infarto-2 trial of thrombolytic therapy, the incidence of primary VF was 3.1%.<sup>17</sup> Patients with VF had worse in-hospital mortality, although 6-month outcomes were not different between those with and without

VF. In the largest description of sustained VT/VF complicating non-ST-segment elevation acute coronary syndromes, the incidence of sustained VT/VF was 2%.<sup>18</sup>



**Figure 2** Incidence of sustained VT/VF and in-hospital mortality according to the number of readily identifiable risk factors\* on presentation that had a P value <.1 in univariate analysis and subsequently identified through stepwise logistic regression.\*Risk factors were chronic kidney disease, left ventricular ejection fraction < 40%, cardiogenic shock, heart failure during admission, and presentation within 6 hours. (Note, n = 7310 for this analysis, because we only included those patients with a known ejection fraction.) VT/VF = ventricular tachycardia/ventricular fibrillation.



**Figure 3** In-hospital mortality according to successful percutaneous intervention in those patients with and without sustained ventricular arrhythmia. Log-linear analysis identified a significant interaction among sustained VT/VF, successful percutaneous coronary intervention, and in-hospital mortality (3-way  $P < .001$ ). Successful percutaneous coronary intervention was associated with decreased mortality (2-way  $P < .001$ ), and sustained VT/VF was associated with increased mortality (2-way  $P < .001$ ). There was no difference in the rates of angiographic success in those with and without sustained VT/VF (2-way  $P =$  not significant). PCI = percutaneous coronary intervention; VT/VF = ventricular tachycardia/ventricular fibrillation.

More recently, the incidence of sustained VT/VF in patients undergoing primary angioplasty was reported in the 3065 patients enrolled in the Primary Angioplasty in Myocardial Infarction (PAMI) trials.<sup>11</sup> In PAMI, the incidence of sustained VT/VF was 4.3%, similar to that observed in this report. The PAMI trials excluded patients with cardiogenic shock and renal failure; thus, our patient population was more inclusive. In our population of more than 9000 patients, which represents the largest observational study of sustained VT/VF among patients with acute MI undergoing percutaneous coronary intervention, we identified presentation within 6 hours of symptom onset as predictive of sustained VT/VF. This is consistent with previous studies, in which sustained VT/VF was most prevalent in the first few hours after symptom onset.<sup>4,19-21</sup> Notably, we also found that age was not predictive of sustained VT/VF. The presence of heart failure or cardiogenic shock was associated with a 2- to 3-fold increase in the occurrence of sustained VT/VF.

Although the PAMI investigators found no difference in acute and 1-year mortality in those with and without sustained VT/VF, they excluded patients who received initial thrombolytic therapy; those with renal failure; those with contraindications to aspirin, heparin, or thienopyridine therapy; those with cardiogenic shock; or those with a life expectancy less than 1 year.<sup>11</sup> These patients are at increased risk for adverse outcomes after acute MI and may account for the absence of increased in-hospital mortality.<sup>22-24</sup> In addition, renal failure and cardiogenic shock were major predictors of sustained ventricular arrhythmias in this study. Our study reflects the find-

ings of previous investigations, in which sustained VT/VF complicating acute MI has been associated with increased in-hospital mortality.<sup>3,6,10,17,25</sup>

In this registry, patients with chronic kidney disease were more likely to have sustained VT/VF. Impaired creatinine clearance and end-stage renal disease have been independently associated with an increased risk of accelerated idioventricular rhythm, sustained VT, and VF.<sup>26</sup> Patients with chronic kidney disease are more likely to have left ventricular hypertrophy, which leads to transmural dispersion of repolarization and an increased risk of ventricular arrhythmias and sudden cardiac death.<sup>27-29</sup> More recently, end-stage renal disease has been identified as a strong predictor of implantable cardioverter defibrillator therapies for VT/VF.<sup>30</sup> Given the clear association between ventricular arrhythmias and renal impairment, and the 2-fold increased risk of sustained VT/VF in patients with chronic kidney disease observed in this study, patients with renal impairment should be recognized to be at increased risk of sustained ventricular arrhythmias in the catheterization laboratory. Every effort should be made to attenuate this risk, including maximizing beta-blocker administration, avoiding QT prolonging agents, and aggressively treating recurrent or residual ischemia.

Diabetes was associated with a decreased incidence of sustained VT/VF. Although this finding was unexpected, a potential explanation is that patients with diabetes were more likely to be taking sulfonylurea medications, which inhibit cardiac triphosphate-sensitive potassium channels and have been associated with a decreased risk of ventricular arrhythmia.<sup>31,32</sup> This hypothesis merits further analysis given the frequent co-existence of diabetes and coronary artery disease.

Sustained VT/VF has been associated with increased mortality early after acute MI,<sup>3,10,33,34</sup> however, to date it is unknown whether successful percutaneous coronary intervention ameliorates this risk. This is the first study to assess the impact of percutaneous coronary intervention on early mortality in patients with sustained VT/VF. We found a significant interaction among the occurrence of sustained ventricular arrhythmias, successful percutaneous coronary intervention, and in-hospital mortality. Notably, there was no difference in the rates of successful reperfusion between those with and without sustained VT/VF. Although successful reperfusion was associated with decreased mortality, patients with sustained VT/VF had an increased risk of in-hospital death despite successful reperfusion therapy. Thus, our data demonstrate that despite successful percutaneous coronary intervention, in-hospital mortality remains elevated in those patients with sustained VT/VF.

The primary limitation of this study is the retrospective nature of the analysis. We did not have long-term follow-up and thus cannot comment on the long-term implications these arrhythmias have on prognosis after discharge. Although our findings remained significant, even after excluding the sickest patients, we cannot exclude the influence of bias. We did not have information regarding beta-blockers and antiarrhythmic medications, which in all likelihood influenced both the incidence and outcomes reported within

this analysis. Patients who developed sustained VT/VF with spontaneous termination would have been less likely to be diagnosed with sustained VT/VF, which could have introduced ascertainment bias. However, failure to diagnose sustained VT/VF would be expected to bias our analysis toward the null hypothesis. Finally, the New York registry database does not specify the timing or specific morphology of the ventricular arrhythmias (VT vs VF), both of which are known to influence prognosis. Despite these limitations, and given the large number of patients included, the identified associations are not likely to be spurious in nature.

## CONCLUSIONS

In more than 9000 patients with acute MI, 1 in 20 patients developed early sustained VT/VF. Patients with cardiogenic shock, heart failure at presentation, left ventricular ejection fraction less than 40%, chronic kidney disease, and presentation within 6 hours of symptom onset were at high risk of developing sustained life-threatening arrhythmia. In this unselected and inclusive patient population, sustained VT/VF was associated with a 3-fold increased incidence of major cardiovascular adverse events and a 4-fold increase in in-hospital mortality, despite successful revascularization. Accordingly, when caring for patients undergoing percutaneous coronary intervention in the setting of acute MI, special attention should be paid to those patients with risk factors for sustained VT/VF. Therapies with proven mortality benefits known to be effective in reducing the incidence of these arrhythmias (eg, beta-blockers) should be implemented whenever possible. Further research is needed to identify additional interventions to improve the outcome in these patients and to clarify whether sustained VT/VF complicating acute MI is associated with a long-term increased risk of mortality.

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