Cardiac Events in New Jersey After the September 11, 2001, Terrorist Attack

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ABSTRACT *The higher stress associated with the World Trade Center (WTC) attacks on September 11, 2001, may have resulted in more cardiac events particularly in those living in close proximity. Our goal was to determine if there was an increase in cardiac events in a subset of emergency departments (EDs) within a 50-mi radius of the WTC. We performed a retrospective analysis of consecutive patients seen by ED physicians in 16 EDs for the 60 days before and after September 11 in 2000–2002. We determined the number of patients admitted to an inpatient bed with a primary or secondary diagnosis of acute myocardial infarction (MI) or tachyarrhythmia. In each year, we compared patient visits for the 60 days before and after September 11 using the chi-square statistic. For the 360 days during the 3 years, there were 571,079 patient visits in the database of which 110,766 (19.4%) were admitted. Comparing the 60 days before and after September 11, 2001, we found a statistically significant increase in patients with MIs (79 patients before versus 118 patients after, P =.01), representing an increase of 49%. There were no statistically significant differences for MIs in 2000 and 2002 and in tachyarrhythmias for all three years. For the 60-day period after September 11, 2001, we found a statistically significant increase in the number of patients presenting with acute MI but no increase in patients admitted with tachyarrhythmias.*

KEYWORDS *Acute myocardial infarction, Emergency care, Tachyarrhythmia, Terrorism.*

INTRODUCTION

After the attacks on the World Trade Center (WTC), there was a period of anxiety and an increase in stress. This has been documented not only in New York City communities[1,2] but also in bordering states[3] and the country at large.[4] For example, Adinaro et al.[5] showed a large increase in the rate of anxiety-related visits to selected emergency departments (EDs) in New Jersey after September 11, 2001. The daily rate of anxiety-related complaints was 93% higher for September 11–14 than average.

The higher stress associated with the WTC attacks on September 11, 2001, may have resulted in more cardiac events, particularly in those living in close proximity. Several researchers have documented the effect of stress on increases in cardiac events.[6–12] Armenian et al.[13–16] considered the effects of earthquake stressors on

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mortality and posttraumatic stress disorder (PTSD), demonstrating an increased risk of depression with greater intensity of the disaster,[14,16] the relationship between depression and the increased risk of acute myocardial infarction (MI),[10] and the benefit of and need for early psychiatric support and medical attention.[15] Armenian has been involved in similar work considering wartime stressors.[17,18] Greenwald et al.[19] reported an increase in cardiac event visits to two northern Manhattan EDs, and a recent report showed that the proportion of patients with acute MI and tachyarrhythmias admitted to an inpatient bed in a Brooklyn hospital increased significantly after the September 11 attacks.[20] Our goal was to determine whether there was a similar increase in a subset of New Jersey EDs within a 50-mi radius of the WTC.

METHODS

We performed a retrospective analysis of a computerized billing database of ED visits. The study population consisted of a cohort of patients visiting 16 New Jersey Emergency Departments within a 50-mi radius of the WTC. The EDs are located in urban and suburban areas and include teaching and nonteaching hospitals. Total ED volumes range from 20,000 to 65,000 visits per year. Emergency physicians see 80–95% of all ED patient visits; private physicians see the remainder of the patients. We included consecutive patients seen by ED physicians for the 60 days before and after September 11 in 2000–2002; there are no non-ED patient groups included in the database. The physicians' billing department assigns International Classification of Disease (ICD) codes according to the International Classification of Diseases, Ninth Revision, and Clinical Modification (ICD-9-CM codes). All coders receive an intensive 1-week training course and are reviewed for quality control by a supervisor. Patients were included as acute MI and tachyarrhythmia patients if any of the primary or secondary ICD diagnoses included the ICD9 codes in Table 1, and the patients were admitted to an inpatient bed.

In each year, we compared patients admitted with acute MIs and tachyarrhythmias for 60 days before and after September 11 using the chi-square statistic [Microsoft Excel 2002 (10.2614.2625) Microsoft Corporation, Redmond, Washington, DC]. We calculated expected values for the chi square using total ED visits for each 60-day period for each year in the denominator. This was done to take into account slight differences in the total ED visits in each period.

RESULTS

Over the 3 years for the 60 days before and after September 11, there were 571,079 patient visits in the database of which 110,766 (19%) were admitted. The only statistically significant difference was for acute MI before and after September 11, 2001. In that year, there were 79 patients with acute MI in the 60 days before September 11 and 118 patients in the 60 days after September 11 (Table 2). This represents an increase of 49%, or 42% if one normalizes for total ED visits.

DISCUSSION

Our results demonstrating an increase in acute MIs were similar to the 35% increase found by Feng et al.[20] who analyzed data from patients admitted to the Telemetry and Coronary Care Units of a Brooklyn hospital 60 days before and after

TABLE 1.   ICD9 codes and descriptions used for Myocardial infarction and Tachyarrhythmias

Total visits (primary and secondary)	ICD9 code	ICD9 description
Myocardial infarction		
5,087	410.90	MYOCARDIAL INFARCT. UNSPE
1,343	410.41	MYOCARDIAL INFARCT. INFER
437	410.91	MYOCARDIAL INFARCT. INITI
423	410.11	MYOCARDIAL INFARCT. ANT.W
253	410.12	MYOCARDIAL INFARCT. ANTER
250	410.81	MYOCARDIAL INFARCT. OTHR
62	410.71	MYOCARDIAL INFARCT. SUBEN
55	410.10	MYOCARDIAL INFARCT. ANT.W
42	410.51	MYOCARDIAL INFARCT. LATER
41	410.21	MYOCARDIAL INFARCT. INFER
20	410.01	MYOCARDIAL INFARCT. ANTER
19	410.31	MYOCARDIAL INFARCT. INFER
13	410.50	INFARCTION LATERAL WALL O
13	410.60	MYOCARDIAL INFARCT. POST.
7	410.92	MYOCARDIAL INFARCT. SUBSE
0	410.30	MYOCARDIAL INFARCT.INFERO
0	410.40	MI INFERIOR WALL OTHER UN
0	410.70	SUBENDOCARDIAL INFARCTION
0	410.80	MYOCARDIAL INFARCT.SPE/SI
0	410.9	MYOCARDIAL INFARCTION N
Tachyarrhythmias		
17,033	427.31	ATRIAL FIBRILLATION
4,724	427.0	SUPRAVENTRICULAR TACHYCAR
1,345	427.32	ATRIAL FLUTTER
987	427.1	TACHYCARDIA VENTRICULAR
351	427.41	VENTRICULAR FIBRILLATION
238	427.2	PAROXYSMAL TACHYCARDIA, U
10	427.42	VENTRICULAR FLUTTER

TABLE 2.   Incidence of cardiac events 60 days before and 60 days after September 11 for 2000–2002

	All emergency department patients	Admitted patients	Acute myocardial infarction	Tachyarrhythmia
2000				
Before	87,091	16,707	89	122
After	88,621	17,695	113	120
P value			.12	.79
2001				
Before	95,163	18,079	79	110
After	99,950	18,777	118	136
P value			.01	.20
2002				
Before	100,218	19,513	83	151
After	100,036	19,995	74	148
P value			.48	.87

the September 11 attacks. However, we found no change in tachyarrhythmias, whereas Feng et al.[20] found a 40% increase. This dissimilarity between our results may be because of the differences in the cohorts as we did not count patients admitted directly from private physicians' offices to an inpatient bed.

There are many articles in the literature[6–9,11,19] that demonstrate an increase in mental stress and that anxiety leads to increased cardiac events. For example, Jiang et al.[21] demonstrated that patients who displayed mental stress-induced ischemia had almost three times the relative risk of having a cardiac event or of dying compared with patients who did not exhibit mental stress-induced ischemia. Fries et al.[22] showed that physical and mental stress are factors that significantly increase relative risk of spontaneous recurrence of sustained ventricular tachyarrhythmias in patients with internal cardiac defibrillators. They found that the relative risk of arrhythmia recurrence during the presence of stress was 7.5 for physical activity and 9.5 for mental activity. Pratt et al.[10] found that compared to controls, a history of major depression or dysphoria (2 weeks of sadness) were associated with odds ratios for MIs of 4.5 and 2.1. It is possible that the rise in acute MIs was because of stress, depression, and sadness related to the 9-11 terrorist attacks.

LIMITATIONS

A significant limitation with retrospective studies is that association does not imply causality. For example, the increase in acute MIs may have been because of other factors such as increased smoking, increased use of cocaine, change in diet, or change in exercise patterns.

Seasonality may have affected the results. Previous studies have shown increase in acute MIs in the winter months.[23] However, we did not see a statistically significant change in the acute MIs for the year before and after September 11, 2001, for the time periods studied.

In this study, we did not examine possible late effects occurring for more than 60 days after the event. We chose 60 days before and after September 11 to compare with the results of Feng et al.[20] who also used this time frame. The shorter time frame also seemed appropriate as the incidence of acute MI varies with the season of the year.[23] If we chose a six month period before and after September 11, the seasonal changes may have obscured the immediate effect of September 11.

It is possible that the increase in acute MIs was the result of an increase in the population at risk in New Jersey in the aftermath of the WTC attacks. Many people who usually commuted to Manhattan, especially the financial district, may have stayed at home in New Jersey. We attempted to correct for possible population shifts by using as denominator the total number of ED visits. One could argue that it may be more appropriate to use as a denominator the number of admitted patients; however, the results using admitted patients would be similar to the results using total ED visits (Table 2).

Our study is based on ICD9 billing codes, which may be biased by physician's habits with regard to assigning a diagnosis and coders' assignment of ICD9 codes. There may have been a drift in coding practices over the years. However, it seems unlikely that this would cause the specific increase found in 2001 over the preceding and the following years. Another criticism of ICD9 codes is that different sites may vary in local practices in assigning ICD9 codes. However, this data is from a single billing company that uses a centralized coding system.

A diagnosis of acute MI is given in the ED when the clinical presentation and electrocardiograph (EKG) are consistent with an acute MI. Thus, many who later would be classified as an acute MI based on elevation of cardiac enzymes may be given an ED diagnosis of acute chest pain or unstable angina. However, we would not expect this undercounting to have a systematic effect which would favor 2001 over the other two years.

CONCLUSIONS

We found a significant increase in the number of patients with acute MI but not tachyarrhythmias presenting to a subset of New Jersey EDs within a 50-mi radius of the WTC during the 60-day period after September 11, 2001. This supports the correlation between psychological stress and acute MI and illustrates the powerful impact of terrorism even on populations set apart from the site actively attacked.

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