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The Snow-Shoveler's ST Elevation Myocardial Infarction

Rajesh Janardhanan, MD, MRCP[a], **Zachary Henry, MD**[a], **David J. Hur, MD**[a], **Christine M. Lin, MD**[a], **David Lopez, MD**[a], **Patrick M. Reagan, MD**[a], **Sean R. Rudnick, MD**[a], **Travis J. Koshko, BS**[b], and **Ellen C. Keeley, MD, MS**[a,*]

[a] Department of Internal Medicine, Division of Cardiology, University of Virginia, Charlottesville, Virginia

[b] Meteorology Division of WCAV-TV, Charlottesville, Virginia

Abstract

Heavy snowfall, cold temperatures, and low atmospheric pressure during the winter months have been associated with increased adverse cardiovascular events. However, only a few cases of the "snow -shoveler's infarction " have been reported. We present our experience with 6 patients presenting with ST elevation myocardial infarction all within a 24-hour period during an unprecedented snowfall (4 of whom were shoveling snow), and provide a detailed review of previously reported cases of snow-shoveler's infarction. Consistent with other reports, the majority of our patients had the traditional cardiac risk factors of hypertension, hyperlipidemia, diabetes mellitus, tobacco use, and were habitually sedentary. Unique to our case series, however, was that the four patients who had a history of coronary artery disease and prior coronary artery stenting, all presented with subacute stent thrombosis documented on the coronary angiography performed emergently. Moreover, these patients constituted 25% of all the subacute stent thromboses diagnosed in our cardiac catheterization laboratory over the preceding 12 months. In conclusion, our findings suggest that in typically sedentary individuals with cardiac risk factors or a history of coronary artery disease, snow shoveling may trigger ST elevation myocardial infarction and, therefore, should be avoided. This may be most critical in patients with a history of coronary stent placement since our findings suggest that snow shoveling may precipitate subacute stent thrombosis.

Keywords

Snow-shoveling; STEMI; Snow-shoveler's infarction

Introduction

Adverse cardiac events, including acute myocardial infarction and sudden cardiac death, may be triggered during and after major snowstorms by colder temperatures and the physical exertion expended with snow shoveling 1–8. We present a case series of 6 patients who presented with an acute ST elevation myocardial infarction (STEMI) all within a 24-hour period during an unprecedented snowfall: 4 patients experienced symptoms while shoveling snow. Patients with a history of coronary artery disease and previous coronary stent

*Corresponding author: Ellen C. Keeley, M.D., M.S., University of Virginia, Division of Cardiology, P.O. Box 800158, Charlottesville, Virginia 22908-0158, Tel. 434-924-2420, Fax. 434-982-1998, Keeley@Virginia.edu.

placement, all presented with subacute stent thrombosis; a unique presentation which has not been previously described in other cases of “snow - shoveler’s infarction” 9–12.

Patients

In one 24-hour period, from Saturday, December 19, 2009 to Sunday, December 20, 2009, 6 patients were taken emergently to the cardiac catheterization laboratory at the University of Virginia, Charlottesville, Virginia with the diagnosis of STEMI; 4 underwent primary percutaneous coronary intervention (PCI), and 2 underwent rescue PCI following failed thrombolysis. Medical history, medications on admission, laboratory values, 12-lead electrocardiographic results, treatment delay, angiographic findings, procedural details, and in-hospital outcomes for all patients were recorded.

Methods

We searched the literature for reported cases of “snow -shoveler’s infarction ”. We review ed the MEDLINE database (Nation al Library of Medicine, Bethesda, MD) from 1970 to 2010. The following key words were used in the search: ST elevation myocardial infarction, acute coronary syndrome, infarction, snow, snow shoveling, snow blowing, snow removal. We reviewed only articles written in English. We also gathered meteorological data from the McCormick Observatory located on the campus of the University of Virginia, for the time period of December 18, 2009 to December 20, 2009 (data from previous months was reviewed for comparison). Lastly, we searched our cardiac catheterization laboratory database to determine: (1) the daily number of patients with STEMI referred for primary PCI, and (2) the daily number of STEMIs that were a result of subacute stent thrombosis from December 2008 to December 2009.

Results

The baseline characteristics of the patients are listed in Table 1. Of the 6 patients, 4 had a history of previous stent placement (2 with drug-eluting stents, and 2 with bare metal stents) (Table 1); all 4 patients presented with subacute stent thrombosis, and all but one were on chronic dual anti-platelet therapy. Symptom onset to arrival in the emergency department ranged from 40 minutes 6 to 264 minutes. The infarct-related artery was the left anterior descending artery in 3 patients and the right coronary artery in 3 patients; all patients underwent intervention of the infarct related artery, and one patient required an intra-aortic balloon pump. New congestive heart failure was diagnosed in 3 patients, and 1 patient died of cardiogenic shock.

Data obtained from the University of Virginia cardiac catheterization laboratory database revealed a doubling of STEMI cases within a single 24-hour period compared to any other 24-hour period over the past year (Figure 1). Moreover, there was a sharp increase in the incidence of subacute stent thrombosis on December 20, 2009 (diagnosed in 4 of the 6 patients), compared t o daily rates seen over the past year. The spike in the STEMI rate correlated with greater snowfall (Figure 1), as well as colder temperatures, lower atmospheric pressure, and higher wind gusts (Figure 2). A total of 20.5 inches of snow was recorded, the largest single-storm snowfall total for the month of December in the Charlottesville, Virginia area since December 1969 when 16 inches was recorded.

Our review of published reports resulted in a total of 4 case series that fulfilled our search restrictions 9–12. These articles were reviewed by 2 of the authors (RJ and ECK). Pertinent information including year and location of the snowstorm, maximum snowfall recorded (inches), number of patients, cardiac history and whether symptoms were preceded by snow shoveling were collected for these studies and summary data, including our series, is shown in Table 2.

Discussion

The phenomenon of increased rates of adverse cardiac events occurring during the cold winter months was originally described more than 60 years ago 13; patients with pre-existing coronary artery disease are especially vulnerable 14. Temperature changes and seasonal variations have been associated with an increase in the incidence of myocardial infarction and sudden cardiac death 2,6,7,15, and have also been associated with infarct size 16. Numerous studies have suggested that strenuous exertion (such as snow shoveling) in the days following heavy snowfalls is associated with increased cardiac events 1,2,8,10,17–21. In fact, strenuous exercise of other types has been associated with plaque rupture and subsequent thrombosis 22,23.

Snow shoveling results in significant increases in heart rate, systolic blood pressure, and rate–pressure product 5, and is often undertaken in the early morning hours when circadian changes may play a role 24. Moreover, strenuous exercise and colder temperatures have been associated with changes in blood rheology including increased platelet activation, increased fibrinogen, and increased blood viscosity 25,26, and a hazardous effect on blood pressure 27. It is possible that a combination of these factors may trigger an acute cardiac event, particularly in those with underlying coronary artery disease who are habitually sedentary 28–30. Thus, patients with known coronary artery disease (particularly those with a history of coronary stenting) and sedentary persons with cardiac 8 risk factors, should be cautioned regarding the increased myocardial demands of snow shoveling.

Our study has limitations. First, because of the inherent nature of a case series, ours was descriptive and limited by lack of a control group. Second, complete demographic data was not available for many of the patients previously reported in the literature. Third, we do not have blood test results for levels of fibrinogen, platelet activation, or blood viscosity since these are not routinely measured as part of standard of care.

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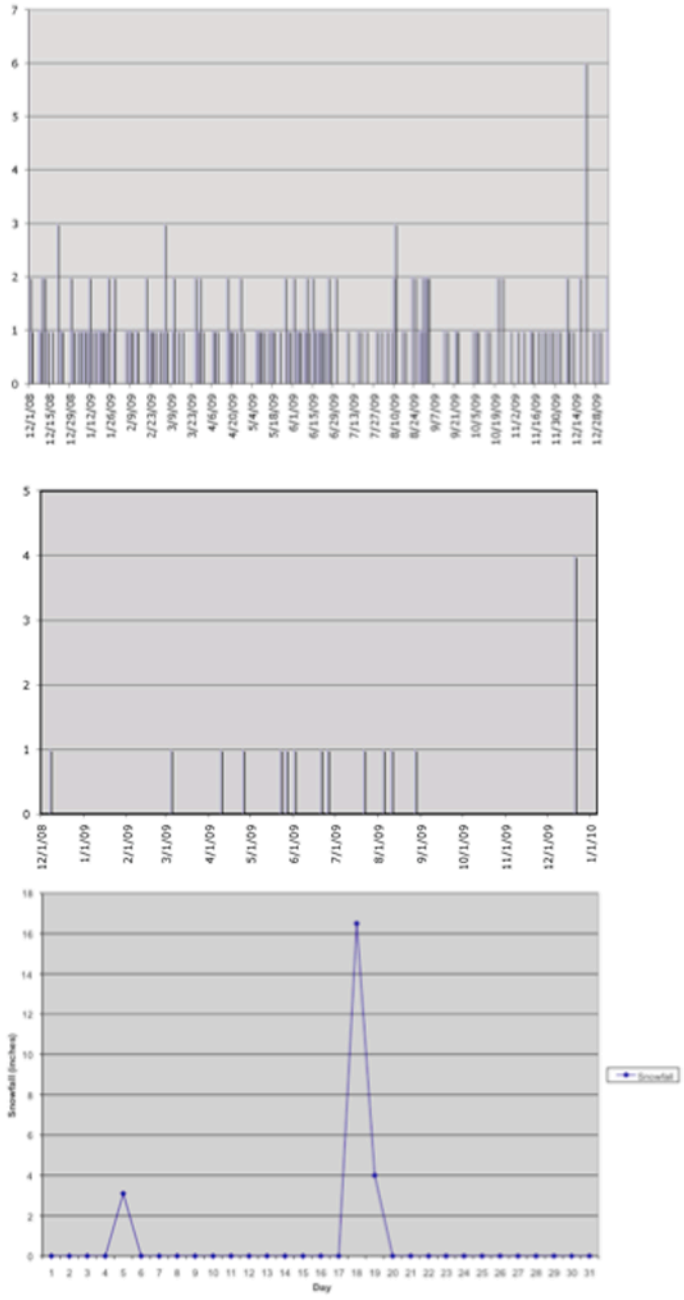

Figure 1.

Daily number of patients with ST elevation myocardial infarction undergoing primary percutaneous coronary intervention at the University of Virginia from December 1, 2008 to December 31, 2009 (top panel), and daily number of patients with subacute stent thrombosis presenting with ST elevation myocardial infarction over the same time period (middle panel). The abrupt spike in the number of STEMI patients correlated with the large snowfall (inches) from December 18, 2009 to December 20, 2009, as recorded by the McCormick Observatory on the campus of the University of Virginia, Charlottesville, Virginia.

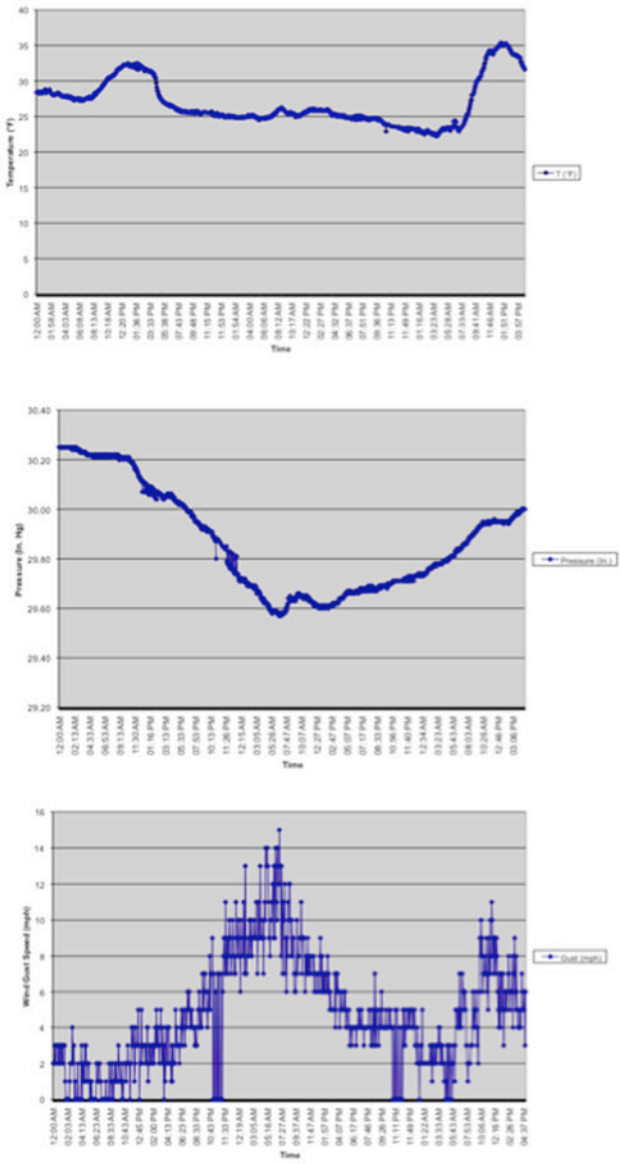

Figure 2.
Hourly meteorological data as recorded by the McCormick Observatory on the campus of the University of Virginia, Charlottesville, Virginia. Temperature (top panel) in degrees Fahrenheit (°F) from 12 am December 18, 2009 to 3:57 pm, December 20, 2009; atmospheric pressure (middle panel) in inches of mercury (in Hg) from 12 am December 18, 2009 to 3:06 pm, December 20, 2009; wind gusts (bottom panel) in miles per hour (mph) from 12 am December 18, 2009 to 4:37 pm, December 20, 2009.

Table 1

Characteristics of 6 patients presenting with ST segment elevation myocardial infarction during a snow storm

Case	Age (years)	Gender	Race	Engaged in Snow Removal	HTN	↑ lipids	DM	CS	Prior MI	Prior Stent*	Prior Angina Pectoris	β-blocker	ACE or ARB	Statins	Aspirin	Clopidogrel
1	44	M	W	+	0	+	+	0	0	0	0	0	0	0	0	0
2	51	M	W	+	+	+	0	+	+	+	0	0	+	+	+	+
3	58	F	W	+	+	+	0	+	0	+	0	+	+	+	+	+
4	59	M	W	+	+	+	0	+	+	+	0	0	+	+	+	0
5	72	F	W	0	+	+	+	0	+	+	0	+	+	+	+	+
6	83	F	W	0	+	0	+	0	0	0	0	+	0	0	0	0

Case	ECG location of ST elevation	Initial Troponin (μg/ L)	Peak Troponin (μg/ L)	Creatinine (mg/ dL)	WBC ($X10^3/mm^3$)	Hg A1c (%)	Total cholesterol (mg/ dL)	LDL (mg/ dL)	HDL (mg/ dL)	Triglycerides (mg/ dL)
1	II, III, aVF	0.25	292	0.9	21.9	6.1	139	106	26	44
2	II, III, aVF	0.02	46.85	1.3	10.12	5.7	164	110	39	89
3	V1-V2 I, aVL	89.68	194.94	0.6	12.90	5.8	148	85	45	107
4	II, III, aVF, V5-V6	0.10	37.53	1.4	12.66	6.0	142	93	33	97
5	V1-V3, new RBBB	>440.0	>440.0	1.3	13.97	8.3	172	114	43	87
6	V1-V3	0.12	293	0.8	22.5	5.9	134	86	35	80

ACE = angiotensin converting enzyme inhibitor; ARB = angiotensin receptor blocker; CS = cigarette smoker; DM = diabetes mellitus; HDL = high -density lipoprotein; Hg = hemoglobin; HTN = hypertension; LDL = low-density lipoprotein; MI = myocardial infarction; RBBB = right bundle branch block; WBC = white blood cell count.

* Case #2 had a bare metal stent placed in the right coronary artery in 2007; Case #3 had a drug-eluting stent placed in the left anterior descending coronary artery in 2006; Case #4 had a bare metal stent placed in the right coronary artery in 2000; Case #5 had a d rug-eluting stent placed in the left anterior descending coronary artery 9 days prior.

Table 2

Summary of case series of patients presenting with myocardial infarction during or after a heavy snowfall

Case series	Total Number of Patients	Number of Patients Shoveling Snow	Year of Snow storm	Location	Snow fall (inches)	Cardiac Risk factors	History of Myocardial Infarction	Prior Angina Pectoris
Franklin et al 9	20*	5	1999	Detroit, Michigan	11	+	1	1
Glass et al 10	60†	NA	1979	Chicago, Illinois	20	+	16	6
Hammoudeh et al 11	9	9	1996	Edison, New Jersey	32	+	NA§	NA§
Heppel et al 12	5	4	1990	Sheffield, England	14	+	0	0
Janardhanan et al	6	4	2009	Charlottesville, Virginia	20.5	+	4	0

*5 patients developed symptoms while shoveling snow, 2 were diagnosed with ST elevation, and 3 with non-ST elevation myocardial infarction

†not specified how many patients presented with ST elevation versus non -ST elevation myocardial infarction

§3 patients were reported to have known coronary artery disease but this was not further defined

NA = data not available