Am J Cardiovasc Dis 2023;13(4):247-251
www.AJCD.us /ISSN:2160-200X/AJCD0150645

Original Article

Very low risk of ST-elevation and non-ST-elevation myocardial infarction in patients with chest trauma

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Received April 10, 2023; Accepted August 15, 2023; Epub August 15, 2023; Published August 30, 2023

Abstract: Background: The goal of this study was to evaluate any association between blunt chest trauma and occurrence of ST-elevation myocardial infarction and non-ST-elevation myocardial infarction. Methods: Data from the National Inpatient Sample (NIS) database from 2010-2014, of patients over the age of 40, hospitalized for blunt chest trauma (ICD 959.11), with STEMI or NSTEMI, was used in this study. We performed a chi-squared test to analyze this association. We also performed a multivariant analysis adjusting for race, gender, and age. Results: We found that there is not an increased risk of STEMI/NSTEMI following blunt chest trauma, $P > 0.05$. We also found no correlation between STEMI or NSTEMI and chest trauma after adjusting for race, gender, and age. For STEMI after adjustments in 2010 (P=0.52), 2011 (P=0.19), 2012 (P=0.60), 2013 (P=0.88), and 2014 (P=0.14). For NSTEMI adjustments in 2010 (P=0.03), 2011 (P=0.06), 2012 (P=0.01), 2013 (P=0.21), and 2014 (P=0.03). Conclusion: Both ST-elevation myocardial infarction and non-ST-elevation myocardial infarction were not significantly associated with blunt chest trauma.

Keywords: STEMI, NSTEMI, blunt chest trauma, cardiovascular injury, myocardial infarction, trauma

Introduction

With acute myocardial infarction (MI) being one of the leading causes of death in the world, many studies have aimed to understand common causes of ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI) [1]. MI results in permanent damage to the heart due to lack of oxygen in addition to numerous other serious complications including impaired blood pressure and increased risk of arrhythmias [1]. ST-elevation myocardial infarction is typically caused by atherosclerotic plaque rupture with vessel occlusion due to secondary thrombosis. The extent of the myocardial injury depends on the area of the myocardium impacted by the vessel and the duration of the event [2]. While thrombosis is the primary cause, other pathologies can cause STEMI, including, dissection, myocarditis, and stress cardiomyopathy [3]. Non-ST-elevation myocardial infarction can occur due to a variety of causes, including, stable plaque, vasospasms, coronary embolism, or coronary arteritis [4]. Non-coronary injury as well as conditions comparatively unrelated to coronary arteries or myocardium can also cause NSTEMI, including, myocarditis, hypotension, hypertension, dissection and tachycardia [4]. NSTEMI typically poses an increased risk, compared to STEMI, due to delayed diagnosis [5].

Chest trauma (ICD 959.11) is classified as injury of the chest wall and normally occurs due to motor vehicle accidents, falls, blunt instrument injury, or physical assault. Blunt chest trauma can cause various cardiac injuries, including myocardial contusion, cardiac rupture, arrhythmia, and coronary artery injury [6]. The most common pathology is cardiac contusion [7]. Typically, myocardial infarction following blunt chest trauma is caused by coronary artery dissection, occlusion, spasm, plaque rupture, or external compression from epicardial hematoma. The goal of this study was to analyze the association between STEMI/NSTEMI and blunt chest trauma (ICD 959.11).

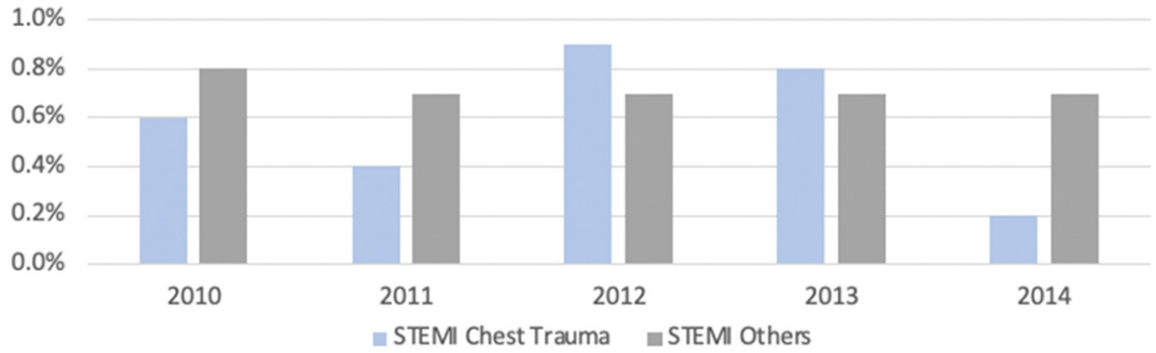

Figure 1. STEMI association with chest trauma vs. other incidents from 2010-2014.

Methods

Data base

Data from the National Inpatient Sample (NIS) database, from 2010-2014, of patients over the age of 40, hospitalized for blunt chest trauma, with STEMI or NSTEMI, was used in this study to determine whether there was a correlation between STEMI and NSTEMI to blunt chest trauma. ICD 9 code 959.11 was used to identify chest trauma. For STEMI, the following codes consistent with STEMI were selected: true posterior wall infarction (410.61), AMI of the anterolateral wall (410.01), infarction of other anterior walls (410.11), infarction of inferolateral wall (410.21), infarction of inferior-posterior wall (410.31), other inferior wall (410.41), lateral wall (410.51) infarctions and other wall infarctions (410.61, 410.81). For Non-STEMI, the following codes were utilized: subendocardial infarction (410.71) and acute MI of unspecified sites (410.91). Inclusion was patients over the age of 40. No other exclusion.

Statistics

Statistical analysis: Patient demographic, clinical, and hospital characteristics are reported as means, with 95% confidence intervals for continuous variables and proportions, and 95% confidence intervals for categorical variables. Chi-squared analysis was used for categorical outcomes and univariate linear regression for continuous variables. Multivariable logistic regression ascertained the odds of binary clinical outcomes relative to patient and hospital characteristics as well as the odds of clinical outcomes over time. All analyses were conducted following the implementation of population discharge weights. Data were analyzed using STATA 17 (Stata Corporation, College Station, TX). All *p*-values are 2-sided and $P < 0.05$ was considered statistically significant.

Results

This analysis found no correlation between chest trauma and STEMI or NSTEMI, $P > 0.05$. There was no increased risk of STEMI or NSTEMI associated with blunt chest trauma (**Figures 1**, **2**).

STEMI associations

For STEMI associations with blunt chest trauma in 2010 (OR: 0.77, CI: 0.29-2.07, P=0.82), in 2011 (OR: 0.49, CI: 0.16-1.52, P=0.3), in 2012 (OR: 1.26, CI: 0.57-2.81, P=0.57), in 2013 (OR: 1.12, CI: 0.47-2.70, P=0.8), and in 2014 (OR: 0.23, CI: 0.032-1.31, P=0.14) (**Table 1**).

NSTEMI associations

For NSTEMI associations with blunt chest trauma in 2010 (OR: 0.46, CI: 0.23-0.92), in 2011 (OR: 0.60, CI: 0.35-1.03), in 2012 (OR: 0.39, CI: 0.18-0.82), in 2013 (OR: 0.70, CI: 0.40-1.24), and in 2014 (OR: 0.45, CI: 0.22-0.90) (**Table 1**).

Additional adjustments

We also found no correlation between STEMI or NSTEMI and chest trauma adjusting for race, gender, and age. For STEMI after adjustments in 2010 (OR: 0.73 (0.27-1.94), C.I.: 95%, P= 0.52), in 2011 (OR: 0.47 (0.14-1.45), C.I.: 95%, P=0.19), in 2012 (OR: 1.24 (0.55-2.77) C.I.: 95%, P=0.60), in 2013 (OR: 1.07 (0.44-2.95), C.I.: 95%, P=0.88), and in 2014 (OR: 0.23 (0.03-1.65), C.I.: 95%, P=0.14). For NSTEMI

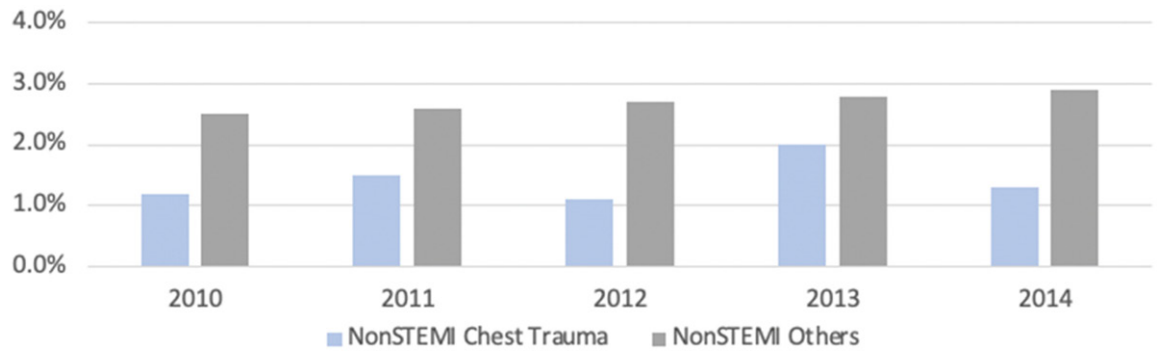

Figure 2. NSTEMI association with chest trauma vs. other incidents from 2010-2014.

Table 1. STEMI and NSTEMI associations with chest trauma

Year	STEMI and Chest Trauma	STEMI and Other	OR (CI)	*P* Value	NSTEMI and Chest Trauma	NSTEMI and Other	OR (CI)	*P* Value
2010	0.6%	0.8%	0.77 (0.29-2.07)	0.82	1.2%	2.5%	0.46 (0.23-0.92	0.02
2011	0.4%	0.7%	0.77 (0.29-2.07)	0.3	1.5%	2.6%	0.60 (0.35-1.03)	0.06
2012	0.9%	0.7%	0.77 (0.29-2.07)	0.57	1.1%	2.7%	0.39 (0.18-0.82)	0.01
2013	0.8%	0.7%	0.77 (0.29-2.07)	0.8	2.0%	2.8%	0.70 (0.40-.124)	0.27
2014	0.2%	0.7%	0.23 (0.032-1.31)	0.14	1.3%	2.9%	0.45 (0.22-0.90)	0.02

after adjustments in 2010 (OR: 0.46 (0.23-0.92), C.I.: 95%, P=0.03), in 2011 (OR: 0.59 (0.34-1.02), C.I.: 95%, P=0.06), in 2012 (OR: 0.38 (0.18-0.80), C.I.: 95%, P=0.01), in 2013 (OR: 0.69 (0.39-1.23), C.I.: 95%, P=0.21) and in 2014 (OR: 0.47 (0.23-0.94), C.I.: 95%, P=0.03) (**Table 2**). The mean age was similar between the two groups (66.2 vs. 66.9). Gender and race-based demographics can be seen in **Table 3**.

Discussion

It has been previously established that the male gender, smoking, and a family history of coronary artery disease (CAD) are most frequently associated with myocardial infarction [8]. ST-elevation myocardial infarction develops from completed and prolonged occlusion of the coronary arteries, whereas non-ST-elevation myocardial infarction develops from extreme coronary artery narrowing, transient occlusion, or microembolization [9]. This study was designed to analyze the association between blunt chest trauma and the occurrence of STEMI or NSTEMI. This association has been previously reported in various case reports as a rare outcome [6-8, 10-17], though this study shows that the occurrence of STEMI or NSTEMI following blunt chest trauma is not statistically significant.

Blunt chest injury (BSI) is a common outcome of blunt chest trauma occurring in 10% of general traumas and in > 70% of high-impact chest traumas [18]. There is a wide variety of developed symptoms, both pulmonary and cardiac. Pulmonary symptoms may include rib fractures, pneumothorax, pulmonary contusion, and tracheobronchial injuries leading to respiratory distress or simple dyspnea [19]. Cardiac symptoms may include arrhythmia, new onset murmurs, myocardial contusion, cardiac muscle rupture, and valve injury [18]. This variety of outcomes can make diagnosis and treatment difficult and the occurrence of rare outcomes including STEMI or NSTEMI can lead to further complications.

ST-elevation myocardial infarction and non-ST-elevation myocardial infarctions are rare outcomes of chest trauma, caused by direct force on the coronary arteries. This force can cause coronary artery dissection, embolism of the arteries, coronary artery occlusion, dislodgement of plaque, vascular spasm, myocardial contusion, and arrhythmia [6-8, 21, 22]. The left anterior descending (LAD) artery is most commonly involved in this complication [8, 15,

Table 2. Multivariant analysis of STEMI/NSTEMI associations with chest trauma adjusting for race, gender, and age

Year		*P* Value	OR (95% C.I.)	Upper	Lower		*P* value	OR (95% C.I.)	Upper	Lower
2010	STEMI	0.52	0.73	1.94	0.27	NSTEMI	0.03	0.46	0.92	0.23
	Race	0.88	1.00	1.05	0.96	Race	0.89	1.00	1.05	0.96
	Gender (male)	0.00	1.32	1.53	1.14	Gender (male)	0.00	1.32	1.54	1.14
	Age > 60	0.06	0.86	1.01	0.74	Age > 60	0.08	0.87	1.02	0.75
2011	STEMI	0.19	0.47	1.45	0.15	NSTEMI	0.06	0.59	1.02	0.34
	Race	0.59	0.99	1.03	0.95	Race	0.59	0.99	1.03	0.95
	Gender (male)	0.00	1.22	1.39	1.06	Gender (male)	0.00	1.22	1.39	1.06
	Age > 60	0.25	0.92	1.06	0.80	Age > 60	0.29	0.93	1.07	0.81
2012	STEMI	0.60	1.24	2.77	0.55	NSTEMI	0.01	0.38	0.80	0.18
	Race	0.33	1.03	1.09	0.97	Race	0.33	1.03	1.09	0.97
	Gender (male)	0.13	1.13	1.32	0.97	Gender (male)	0.10	1.14	1.33	0.97
	Age > 60	0.28	1.09	1.29	0.93	Age > 60	0.24	1.11	1.30	0.94
2013	STEMI	0.88	1.07	2.59	0.44	NSTEMI	0.21	0.69	1.23	0.39
	Race	0.00	0.92	0.97	0.88	Race	0.00	0.92	0.97	0.88
	Gender (male)	0.04	1.18	1.38	1.01	Gender (male)	0.04	1.18	1.39	1.01
	Age > 60	0.31	0.92	1.08	0.78	Age > 60	0.34	0.92	1.09	0.78
2014	STEMI	0.14	0.23	1.65	0.03	NSTEMI	0.03	0.47	0.94	0.23
	Race	0.01	0.91	0.98	0.85	Race	0.01	0.91	0.98	0.85
	Gender (male)	0.00	1.30	1.54	1.11	Gender (male)	0.00	1.31	1.54	1.11
	Age > 60	0.69	0.97	1.15	0.81	Age > 60	0.77	0.97	1.16	0.82

Table 3. Summarizing demographic of the population

	Total	Chest trauma	Others	*p*-value
Total population	23770144	3393	23766751	
Age (Mean ± SD)	66.63±14.17	66.92±14.90	66.63±14.17	0.26
Gender				
Male	46.39%	51.61%	46.39%	
Female	53.61%	48.39%	53.61%	
Race				
White	68.16%	68.76%	68.16%	
Black	13.13%	9.37%	13.13%	
Hispanic	7.53%	9.52%	7.53%	
Asian/Pac Isl	1.84%	2.06%	1.84%	
Native American	0.54%	0.48%	0.54%	
Others	8.80%	9.82%	8.80%	

20]. Followed by the right coronary artery [7, 21]. However, previous studies have reported the occurrence of myocardial infarction following blunt chest trauma to be approximately 2%, primarily due to coronary artery dissections [16]. Differentiation of STEMI vs. NSTEMI development from chest trauma can be attributed to the type and extent of cardiac injury resulting from the trauma.

Conclusion

While MI is a rare outcome of blunt chest trauma, this study found that there is not a statistically significant increased risk of STEMI or NSTEMI. The most common pathology of blunt chest trauma is cardiac contusion.

Limitations

This study is using ICD9 coding which limits diagnosis. Furthermore, patients who died before hospital.

Disclosure of conflict of interest

None.

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