Premature Atrial and Ventricular Contractions: Prevalence, Clinical Evaluation, and Associated Morbidity as Noted from the Nationwide Inpatient Sample

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Abstract

Introductions: Premature atrial and ventricular contractions have been noted in a subset of the population and have been previously demonstrated to increased morbidity and mortality. We set forth to quantify what proportion of inpatient admissions were documented to have premature atrial or ventricular contractions, and the association of morbidity and mortality, by using data from the Nationwide Inpatient Sample.

Methods: Data from the Nationwide Inpatient Sample was utilized. Admissions with premature atrial or ventricular contractions were identified using ICD9 codes. Comorbidities, procedures, and mortality were also identified using ICD9 codes. Characteristics of admissions, comorbidities, and mortality were then compared between those with and without premature atrial contractions and those with and without premature ventricular contractions.

Results: A total of 6,907,109 admissions were included in the analyses. Of these, 0.14% were documented as having premature atrial contractions while 0.45% were documented as having premature ventricular contractions. Premature atrial contractions were both associated with myocardial infraction but not mortality. Premature ventricular contractions were also associated with myocardial infraction but not mortality. Both premature atrial and ventricular contractions were also associated with arrhythmias.

Conclusions: Both premature atrial or ventricular contractions are associated with myocardial infarction, arrhythmias, but not mortality.

Keywords: Premature Atrial and Ventricular Contractions; Prevalence; Nationwide Inpatient Sample

Introduction

Premature atrial and ventricular contractions are come across frequently. A study by Ofoma and colleagues using data from the Atherosclerosis Risk in Communities study demonstrated 4.9% prevalence of premature atrial contractions and 5.5% prevalence of premature ventricular contractions as determined by a baseline 2-minute electrocardiogram done as part of baseline assessment [1]. Both premature atrial and ventricular contractions may be associated with underlying cardiac abnormalities which include congenital heart disease, acquired structural heart disease, heart and failure [2]. Noncardiac causes include indwelling catheters, electrolyte abnormalities, and obstructive sleep apnea [2].

Premature atrial and ventricular contraction are often found secondary to complaints of palpitations in those with otherwise structurally normal hearts and are self-resolving. A subset of patients, however, may develop atrial fibrillation secondary to atrial fibrillation which may also mediate an increased risk of stroke [3]. Some with premature ventricular contractions will go on to develop coronary artery disease, myocardial infarction, and heart failure [4,5]. Both premature atrial and ventricular contractions have been demonstrated by previous studies to be associated with increased risk of mortality, particularly with increasing rate of the premature beats [4,5].

This study was carried out to assess the prevalence of premature atrial and ventricular contractions in hospitalized patients, assess what evaluation these patients undergo, assess what other comorbidities are associated with these premature beats, and assess the association of myocardial infarction, stroke, and heart failure with these premature beats. The Nationwide Inpatient sample was used for this study.

Premature Atrial and Ventricular Contractions: Prevalence, Clinical Evaluation, and Associated Morbidity as Noted from the Nationwide Inpatient Sample

11

Methods

Institutional review board review approval was waived as this studied utilizes deidentified data from a national database. This study is in compliance with the Helsinki declaration.

Patient identification

Data regarding hospital admissions was obtained from the 2012 iteration of the Nationwide inpatient sample which is the most recent iteration of the database. This database was developed for the Healthcare Cost and Utilization Project and was developed in partnership with the Agency for Healthcare Research and Quality. Patients with premature atrial or ventricular contractions were identified using the following international classification of disease, ninth edition codes: 427.61 for premature atrial contractions and 427.69 for premature ventricular contractions.

Data identification and collection

Demographic information including, gender, and race were collected for each admission. Admission characteristics such as admission month, length of stay, and cost of stay were collected as well. Information regarding comorbid conditions was also collected. Hyperlipidemia was identified using 272.0, 272.1, 272.2, and 272.3 hypertension using 401.0, 401.1 and 401. Overweight or obese patients were identified using 278.00, 278.01, and 278.02 with current smokers being identified by 305.1.

Data of interest in regards to isomerism included cardiac anatomy as well splenic anatomy. The following congenital cardiac malformations were also collected for use in later regression: functionally univentricular hearts using 745.6, double outlet right ventricle using 745.11, atrioventricular septal defect using 745.6, partial anomalous pulmonary venous connection using 747.42, total anomalous pulmonary venous connection using 747.41, ventricular septal defect using 745.4, and atrial septal defect using 745.5.

Admissions associated with arrhythmias or a history of arrhythmias were identified using a variety of ICD-9 codes: 427.31 for atrial fibrillation, 427.32 for atrial flutter, 427.89 for other specified paroxysmal arrhythmia, 427.0 for paroxysmal supraventricular tachycardia, 427.1 for paroxysmal ventricular tachycardia, 427.41 for ventricular fibrillation, 427.42 for ventricular flutter, 427.81 for sinus node dysfunction, and 427.89 for other specified arrhythmia. Patients with heart block were identified using 426.0 for complete atrioventricular block, 426.10 for unspecified atrioventricular block, 426.11 for first degree atrioventricular block, 426.12 for type I second degree atrioventricular block, 426.13 for type II second degree atrioventricular block.

An aggregate of atrial flutter and atrial fibrillation, was created and labeled as atrial arrhythmia. An aggregate of ventricular flutter, ventricular fibrillation, and paroxysmal ventricular tachycardia was created and labeled as ventricular arrhythmias.

Statistical analysis

Continuous variables were reported using mean and standard deviation while categorical variables were reported using absolute frequency and percentages. Continuous variables were analyzed using a student t-test or Mann-Whitney-U test as appropriate with categorical variables being analyzed using chi-square analysis. Baseline characteristics such as age, gender, race, and comorbid conditions were compared between those with and without premature atrial or ventricular contractions. A univariate cross tabulation analysis was conducted to determine the odds of specific comorbidities, diagnostic procedure, interventional procedures, and mortality.

Logistic regression was then conducted with age, gender, race, body habitus, myocardial infarction, presence of arrhythmia other than premature atrial or ventricular contractions (except when this was made the dependent variable), and various congenital cardiac malformations as the independent variables. Separate regressions were run for the following dependent variables: stress test, echocardiogram, computed tomography angiography, diagnostic catheterization, coronary artery bypass graft, percutaneous transluminal angioplasty, atrial arrhythmias other than ectopy, ventricular arrhythmias other than ectopy, myocardial infarction, and mortality. All statistical analysis was done utilizing SPSS Version 20.0 (Chicago, IL).

Results

Premature atrial contractions, univariate analysis

A total of 6,907,109 admissions were included in the analyses. Of these, 9,533 (0.14%) were coded as having premature atrial contractions. The average age of admission differed between those with and without premature atrial contractions, with those with premature atrial contractions being older (68.27 years vs 51.25 years, p < 0.0001). Those with premature atrial contractions were less likely to be female when compared to those without (odds ratio 0.810, 95% confidence interval 0.779 to 0.844). Those with premature atrial contractions were less likely to be current smokers. They more likely to have diabetes mellitus, hyperlipidemia, obesity, myocardial infarction, atrial flutter, atrial fibrillation, paroxysmal supraventricular tachycardia, paroxysmal ventricular tachycardia, ventricular fibrillation, sinus node dysfunction, and atrioventricular block. Those with premature atrial contractions were also more likely to have the aggregate endpoint of atrial arrhythmia or the aggregate endpoint of ventricular arrhythmia (Table 1).

Premature Atrial and Ventricular Contractions: Prevalence, Clinical Evaluation, and Associated Morbidity as Noted from the Nationwide Inpatient Sample

12

	Without premature atrial contractions (n = 6,897,556)	With premature atrial contractions (n = 9,553)	Odds ratio (95% confidence interval)	p-value
Age at admission (years)	51.25 ± 25.82	68.27 ± 23.29	--	< 0.0001
Female	4,002,853 (58.0)	5,049 (52.9)	0.810 (0.779 to 0.844)	< 0.0001
Race			--	< 0.0001
White	4,354,499 (66.8)	6,974 (76.6)		
Black	966,319 (14.8)	1,150 (12.6)		
Hispanic	741,996 (11.4)	540 (5.9)		
Asian or Pacific Islander	167,905 (2.6)	174 (1.9)		
Native American	47,028 (0.7)	41 (0.5)		
Other	236,488 (3.6)	231 (2.5)		
Current smoker	887,303 (12.9)	1,023 (10.7)	0.812 (0.761 to 0.867)	< 0.0001
Diabetes mellitus	1,507,503 (21.9)	2,398 (25.1)	1.198 (1.144 to 1.255)	< 0.0001
Hyperlipidemia	347,713 (5.0)	842 (8.8)	1.821 (1.696 to 1.954)	< 0.0001
Obesity	723,613 (10.5)	1,146 (12.0)	1.163 (1.093 to 1.237)	< 0.0001
Myocardial infarction	171,927 (2.5)	467 (4.9)	2.011 (1.832 to 2.207)	< 0.0001
Atrial flutter	74,363 (1.1)	408 (4.3)	4.094 (3.706 to 4.522)	< 0.0001
Atrial fibrillation	748,621 (10.9)	2,561 (26.8)	3.008 (2.875 to 3.148)	< 0.0001
Paroxysmal supraventricular tachycardia	20,144 (0.3)	271 (2.8)	9.968 (8.827 to 11.257)	< 0.0001
Paroxysmal ventricular tachycardia	73,075 (1.1)	426 (4.5)	4.359 (3.954 to 4.805)	< 0.0001
Ventricular fibrillation	12,567 (0.2)	29 (0.3)	1.668 (1.158 to 2.403)	0.005
Ventricular flutter	264 (0.1)	2 (0.1)	5.471 (0.985 to 15.352)	0.107
Sinus node dysfunction	43,430 (0.6)	250 (2.6)	4.241 (3.739 to 4.810)	< 0.0001
Any atrial arrhythmia other than ectopy	786,539 (11.4)	2,815 (29.5)	3.246 (3.106 to 3.392)	< 0.0001
Any ventricular arrhythmia other than ectopy	81,747 (1.2)	444 (4.6)	4.064 (3.694 to 4.471)	< 0.0001
First degree atrioventricular block	25,881 (0.4)	517 (5.4)	15.191 (13.891 to 16.613)	< 0.0001
Second degree atrioventricular block, Mobitz type I	2,736 (0.1)	40 (0.4)	10.596 (7.750 to 14.488)	< 0.0001
Second degree atrioventricular block, Mobitz type II	9,414 (0.1)	149 (1.6)	11.593 (9.849 to 13.647)	< 0.0001
Complete atrioventricular block	16,531 (0.2)	51 (0.5)	2.234 (1.696 to 2.943)	< 0.0001
Noninvasive electrophysiology study	599 (0.1)	3 (0.1)	3.694 (1.188 to 11.490)	0.015
Cardiac mapping	9,786 (0.2)	84 (1.4)	6.406 (5.160 to 7.953)	< 0.0001
Catheter electrophysiology study	12,198 (0.3)	111 (1.9)	6.819 (5.647 to 8.235)	< 0.0001
Stress test	14,644 (0.3)	76 (1.3)	3.864 (3.079 to 3.847)	< 0.0001
Echocardiogram	172,621 (4.0)	727 (12.3)	3.400 (3.146 to 3.675)	< 0.0001
Computed tomography angiography	28,529 (0.7)	90 (1.5)	2.347 (1.905 to 2.891)	< 0.0001
Diagnostic catheterization	242,194 (5.5)	711 (12.0)	2.323 (2.148 to 2.513)	< 0.0001
Coronary artery bypass grafting	40,368 (0.9)	222 (3.7)	4.174 (3.649 to 4.775)	< 0.0001
Percutaneous transluminal coronary angioplasty	106,704 (2.4)	222 (3.7)	1.555 (1.360 to 1.778)	< 0.0001
Coronary artery thrombolysis	859 (0.1)	1 (0.1)	0.858 (0.121 to 6.102)	0.879
Length of hospitalization (days)	4.64 ± 6.73	6.05 ± 8.80	--	< 0.0001
Cost of hospitalization (US dollars)	38,521.15 ± 70,448.45	57,059.98 ± 98,121.43	--	< 0.0001
Mortality	133,810 (1.9)	229 (2.4)	1.241 (1.089 to 1.415)	0.001

Table 1: *Premature atrial contractions characteristics.*

Premature Atrial and Ventricular Contractions: Prevalence, Clinical Evaluation, and Associated Morbidity as Noted from the Nationwide Inpatient Sample

13

In regards to diagnostic and interventional procedures, those with premature atrial contractions were more likely to undergo noninvasive electrophysiologic study, cardiac mapping, catheter electrophysiology study, stress test, echocardiogram, computed tomography angiography, diagnostic catheterization, coronary artery bypass grafting, and percutaneous transluminal angioplasty (Table 1).

Length of hospitalization tended to be 1.5 days longer in those with premature atrial contractions and cost approximately 9,000 US dollars more. Those with premature atrial contractions were more likely to have inpatient mortality (2.3% versus 1.9%, p < 0.0001) (Table 1).

Premature atrial contractions, multivariate analysis

Premature atrial contractions were also an independent risk factor for atrial arrhythmias (odds ratio 1.516) and ventricular arrhythmias (odds ratio 1.301). Premature atrial contractions were associated with myocardial infarction or mortality after logistic regression. The following were found to be associated with mortality in this cohort: increasing age, male gender, myocardial infarction, congenital heart disease, and having an arrhythmia other than ectopy (Table 2).

	Premature atrial contractions an independent risk factor?	Premature ventricular contractions an independent risk factor?
Atrial arrhythmia other than ectopy	Yes (odds ratio 1.516, p < 0.0001)	Yes (odds ratio 1.368, p < 0.001)
Ventricular arrhythmia other than ectopy	Yes (odds ratio 1.301, p < 0.0001)	Yes (odds ratio 7.368, p < 0.001)
Mortality	No	No

Table 2: *Regression.*

Results of logistic regression. The dependent variable is listed in the first column. Premature atrial contractions and premature ventricular contractions were independent variables entered into the regression. Odds ratios are presented when either premature atrial contractions or premature ventricular contractions were identified as an independent risk factor for the respective dependent variable.

Premature ventricular contractions, univariate analysis

Of the included admissions, 24,513 (0.35%) were coded as having premature ventricular contractions. The average age of admission tended to be older for those with premature ventricular contractions (68.07 years vs 51.21 years, p < 0.0001). Those with premature ventricular contractions were less likely to be female when compared to those without (odds ratio 0.593, 95% confidence interval 0.540 to 0.568). Those with premature ventricular contractions were less likely to be current smokers. They were, however, more likely to have diabetes mellitus, hyperlipidemia, obesity, myocardial infarction, atrial flutter, atrial fibrillation, paroxysmal supraventricular tachycardia, paroxysmal ventricular tachycardia, ventricular fibrillation, ventricular flutter, sinus node dysfunction, and atrioventricular block. Those with premature ventricular contractions were also more likely to have the aggregate endpoint of atrial arrhythmia or the aggregate endpoint of ventricular arrhythmia (Table 3).

	Without premature atrial contractions (n = 6,882,596)	With premature atrial contractions (n = 24,513)	Odds ratio (95% confidence interval)	p-value
Age at admission (years)	51.21 ± 25.83	68.07 ± 17.95	--	< 0.0001
Female	3,997,264 (58.1)	10,638 (43.4)	0.593 (0.540 to 0.568)	< 0.0001
Race			--	< 0.0001
White	4,342,798 (66.8)	17,675 (76.0)		
Black	964,442 (14.8)	3,027 (13.0)		
Hispanic	741,156 (11.4)	1,380 (5.9)		
Asian or Pacific Islander	167,655 (2.6)	424 (1.8)		
Native American	46,948 (0.7)	121 (0.5)		
Other	236,096 (3.6)	623 (2.7)		
Current smoker	885,294 (12.9)	3,032 (12.4)	0.956 (0.920 to 0.993)	0.021
Diabetes mellitus	1,503,040 (21.8)	6,861 (28.0)	1.391 (1.353 5o 1.431)	< 0.0001
Hyperlipidemia	346,314 (5.0)	2,241 (9.1)	1.899 (1.818 to 1.984)	< 0.0001
Obesity	721,263 (10.5)	3,496 (14.3)	1.421 (1.371 to 1.473)	< 0.0001
Myocardial infarction	170,799 (2.5)	1,595 (6.5)	2.735 (2.599 to 2.878)	< 0.0001
Atrial flutter	73,919 (1.1)	852 (3.5)	3.317 (3.096 to 3.553)	< 0.0001
Atrial fibrillation	745,394 (10.8)	5,788 (23.6)	2.545 (2.471 to 2.621)	< 0.0001
Paroxysmal supraventricular tachycardia	20,044 (0.3)	371 (1.5)	5.261 (4.744 to 5.835)	< 0.0001

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Premature Atrial and Ventricular Contractions: Prevalence, Clinical Evaluation, and Associated Morbidity as Noted from the Nationwide Inpatient Sample

14

Paroxysmal ventricular tachycardia	70,553 (1.0)	2,948 (12.0)	13.199 (12.692 to 13.727)	< 0.0001
Ventricular fibrillation	12,361 (0.2)	235 (1.0)	5.380 (4.726 to 6.125)	< 0.0001
Ventricular flutter	256 (0.1)	10 (0.1)	10.972 (5.832 to 20.640)	< 0.0001
Sinus node dysfunction	43,131 (0.6)	549 (2.2)	3.633 (3.336 to 3.956)	< 0.0001
Any atrial arrhythmia other than ectopy	783,108 (11.4)	6,246 (25.5)	2.663 (2.588 to 2.741)	< 0.0001
Any ventricular arrhythmia other than ectopy	79,129 (1.1)	3,062 (12.5)	12.273 (11.809 to 12.755)	< 0.0001
First degree atrioventricular block	25,476 (0.4)	922 (3.8)	10.519 (9.838 to 11.248)	< 0.0001
Second degree atrioventricular block, Mobitz type I	2,726 (0.1)	50 (0.2)	5.158 (3.899 to 6.825)	< 0.0001
Second degree atrioventricular block, Mobitz type II	9,378 (0.1)	185 (0.8)	5.573 (4.816 to 6.450)	< 0.0001
Complete atrioventricular block	16,384 (0.2)	198 (0.8)	3.413 (2.965 to 3.928)	< 0.0001
Noninvasive electrophysiology study	580 (0.1)	22 (0.1)	10.716 (6.999 to 16.407)	< 0.0001
Cardiac mapping	9,427 (0.2)	443 (2.9)	13.620 (12.366 to 15.002)	< 0.0001
Catheter electrophysiology study	11,756 (0.3)	553 (3.6)	13.727 (12.586 to 14.972)	< 0.0001
Stress test	14,519 (0.3)	201 (1.3)	3.944 (3.429 to 4.537)	< 0.0001
Echocardiogram	171,505 (3.9)	1,843 (11.9)	3.307 (3.149 to 3.473)	< 0.0001
Computed tomography angiography	28,428 (0.7)	191 (1.2)	1.907 (1.652 to 2.200)	< 0.0001
Diagnostic catheterization	239,864 (5.5)	3,041 (19.7)	4.208 (4.044 to 4.380)	< 0.0001
Coronary artery bypass grafting	40,045 (0.9)	545 (3.5)	3.944 (3.619 to 4.298)	< 0.0001
Percutaneous transluminal coronary angioplasty	105,876 (2.4)	1,050 (6.8)	2.929 (2.750 to 3.1119)	< 0.0001
Coronary artery thrombolysis	847 (0.1)	13 (0.1)	4.333 (2.505 to 7.495)	< 0.0001
Length of hospitalization (days)	4.64 ± 6.73	5.20 ± 6.49	--	< 0.0001
Cost of hospitalization (US dollars)	38,487.45 ± 70,447.76	55,214.43 ± 81,634.86	--	< 0.0001
Mortality	133,466 (1.9)	573 (2.3)	1.210 (1.114 to 1.315)	< 0.0001

***Table 3:** Premature ventricular contractions characteristics.*

In regards to diagnostic and interventional procedures, those with premature ventricular contractions were more likely to undergo noninvasive electrophysiologic study, cardiac mapping, catheter electrophysiology study, stress test, echocardiogram, computed tomography angiography, diagnostic catheterization, coronary artery bypass grafting, and percutaneous transluminal angioplasty, and coronary artery thrombolysis (Table 3).

Length of hospitalization tended to be half a day longer in those with premature ventricular contractions and cost approximately 7,000 US dollars more. Those with premature ventricular contractions were more likely to have inpatient mortality (2.4% vs 1.9%, p < 0.0001) (Table 3).

Premature ventricular contractions, multivariate analysis

Premature ventricular contractions were also associated with atrial arrhythmias (odds ratio 1.368) and ventricular arrhythmias (odds ratio 7.368). Premature ventricular contractions were associated with myocardial infarction but not mortality after logistic regression (Table 2).

Discussion

This large database study demonstrates a prevalence of 0.14% and 0.35% of premature atrial and ventricular contractions, respectively. This is lower than other studies that have reported a prevalence of either of these premature beats at least being 4%. This is likely an underestimation of the true prevalence as not all patients underwent cardiac monitoring for the duration of the hospitalization. Spot electrocardiogram assessment may have yielded no premature beats in patients who may have otherwise demonstrated some during the hospitalization had they otherwise undergone cardiac monitoring. As such, the patients coded in the Nationwide Inpatient Sample may represent a subset of patients who have a greater burden of these premature beats, although quantitative data is not available in this database.

Premature Atrial and Ventricular Contractions: Prevalence, Clinical Evaluation, and Associated Morbidity as Noted from the Nationwide Inpatient Sample

15

Patients with premature atrial contractions were more likely to be older, male, and Caucasian when compared to those without. These patients were also more likely to have diabetes mellitus, hyperlipidemia, obesity and arrhythmias other than premature beats. Logistic regression demonstrated that premature atrial contractions were independently associated with myocardial infarction but not mortality.

Patients with premature ventricular contractions were more likely to be older, male, and Caucasian when compared to those without. These patients were also more likely to have diabetes mellitus, hyperlipidemia, obesity, and arrhythmias other than premature beats. Logistic regression demonstrated that premature ventricular contractions were independently associated with myocardial infarction.

Other studies have demonstrated an increasing burden of premature ventricular contractions with increasing age and premature ventricular contractions being more frequent in females, consistent with the findings of our current study [6-8]. Our study also noted an increased prevalence of atrial and ventricular arrhythmias in those with premature ventricular contractions which is in concordance with previous studies [9,10]. These previous studies were able to associate particular types of premature ventricular contractions with lethal arrhythmias although that is beyond the scope of what we were able to do with data present in the Nationwide Inpatient Sample.

Our study did not demonstrate an association between premature ventricular contractions and mortality after adjustment for other variables. This is in contrast to previous studies which have demonstrated increased risk of sudden cardiac death and total cardiac death in those with premature ventricular contractions [4,7,11-17]. A meta-analysis of these studies found a pooled odds-ratio of 2.64 for sudden cardiac death and a pooled odds-ratio of 2.07 for total cardiac death [4]. Another meta-analysis found similar results with a significant increase in mortality in those with structurally normal hearts and premature ventricular contractions when compared to those without premature ventricular contractions (odds ratio 1.72) [5]. Previous studies selected patients with significant burden of premature ventricular contractions while we are unable to quantify the precise burden in our study. This may account for the lack of an association between premature ventricular contractions and mortality in our study. It is possible that our study contains a larger proportion of individuals with lower premature ventricular contraction burden which are not associated with increased mortality. Anthony and colleagues demonstrated in patients with implanted cardiac defibrillators that 77% of ventricular fibrillation episodes were initiated by a premature ventricular contraction [18].

The mechanisms proposed for the association between premature ventricular contractions and mortality proposed in studies who have found such a correlation include the increased likelihood of fatal arrhythmias in the presence of premature ventricular contractions and a reverse causation with sicker patients simply having more premature ventricular contractions secondary to underlying disease [19-21].

This study is a large database study which is a strength of this study. Additionally, this study included all patients with premature ventricular contractions and adjusted for congenital heart disease in the logistic regression analysis. However, there are several limitations to this current study that must be acknowledged. Firstly, providers may have coded for premature atrial or ventricular contraction with varying thresholds. For instance, some providers may have coded premature beats if fewer beats were present when compared to others. This is not entirely clear and there was no data available which quantified the percent of beats that were premature. Additionally, many of these patients were likely coded using results of a spot electrocardiogram. The sensitivity and specificity of spot electrocardiograms for detecting significant premature ventricular contractions when compared to holter monitoring is 74% and 94%, respectively [22]. Because of the nature of the data we are not able to draw any conclusions about causality or incidence, merely association and prevalence. While we adjusted for several confounders, it is possible that other unrecognized confounders were not included. Nonetheless, despite the limitations present in this study we feel that it accurately demonstrates the inpatient prevalence of premature atrial and ventricular contractions and provides insight into what evaluation is done with what frequency in the setting of these premature beats.

Conclusion

Premature atrial and ventricular contractions were found in a small proportion of admissions. Premature atrial contractions were associated with myocardial infarction and arrhythmia but not mortality. Premature ventricular contractions were also associated with myocardial infarction and arrhythmia but not mortality.

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Premature Atrial and Ventricular Contractions: Prevalence, Clinical Evaluation, and Associated Morbidity as Noted from the Nationwide Inpatient Sample

16

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