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ORIGINAL RESEARCH

Alcohol-Related Diagnoses and Increased Mortality in Acute Myocardial Infarction Patients: An Analysis of the Nationwide Inpatient Sample

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BACKGROUND: Moderate alcohol consumption has been associated with lower risk of coronary heart disease death, but heavy alcohol consumption may increase risk.

OBJECTIVE: We sought to determine the association of alcohol-related diagnoses with in-hospital mortality in patients with acute myocardial infarction (AMI).

DESIGN/SETTING/PATIENTS: Discharge data collected from all admissions recorded in the Nationwide Inpatient Sample (NIS) database from 2011. A cross-sectional analysis was performed using regression methods appropriate for the NIS sample design.

MEASURES: The outcome measures were in-hospital mortality, length of stay, and cardiac procedures.

RESULTS: AMI accounted for 610,963 (1.9%) of adult inpatient admissions, with an in-hospital mortality rate of 5.3%. Alcohol-related diagnoses were associated with increased mortality in AMI patients after controlling for factors associated with alcoholism including age, sex, liver disease, hypertension, diabetes, renal failure, peripheral vascular disease, arrhythmias, drug abuse, gastrointestinal bleed, and smoking (adjusted odds ratio [OR]: 1.5, 95% confidence interval [CI]: 1.2-1.7, $P < 0.001$). This association was significant in both ST-elevation myocardial infarction patients (adjusted OR: 1.7, 95% CI: 1.4-2.2, $P < 0.001$) and non–ST-elevation myocardial infarction patients (adjusted OR: 1.3, 95% CI: 1.0-1.7, $P = 0.025$). Chronic alcohol-related diagnoses were significantly associated with death, but acute alcohol effects (as estimated by withdrawal and intoxication) were not associated.

CONCLUSION: Chronic alcohol-related diagnoses were associated with a modest increase in the risk for death in individuals presenting with AMI. This risk was not accounted for by common alcohol-related comorbidities. As a component of global efforts to limit hospital deaths from AMI, future research should identify the factors underlying this association. *Journal of Hospital Medicine* 2016;11:563–567. © 2016 Society of Hospital Medicine

Moderate alcohol consumption has been associated with lower risk of coronary heart disease death.[1–3] This benefit has been shown across all age groups, both sexes, in low-risk patients (without prior cardiovascular disease [CVD], diabetics and even in patients with established CVD.[3–12] The relationship between the dose of alcohol and total mortality has been depicted in many observational studies as a J-shaped curve, attributed to a combined effect of both benefits and harms.[3,4,13] Unlike moderate drinking, heavy drinking and particularly binge drinking may have net negative cardiovascular effects. For example, higher levels of intake of alcohol were associated with increased mortality in men with previous myocardial infarction,[14] whereas some reports suggest a continued beneficial association with acute myocardial infarction (AMI).[15–17] In other studies, the association between AMI and binge or chronic heavy drinking is inconsistent or lacks enough power to report the risk/benefit estimates.[3] Data are sparse on the effects of alcoholism on outcomes in patients hospitalized due to an AMI. Therefore, we sought to investigate the prevalence and association of alcohol-related diagnoses with in-hospital mortality in patients presenting with AMI in the United States.

METHODS

This study was a cross-sectional analysis of the 2011 Nationwide Inpatient Sample (NIS). The NIS is a publicly available deidentified database of hospital discharges in the United States.[18] It contains data from approximately 8 million hospital stays that were selected using a complex probability sampling design and weighting scheme intended to represent all discharges from nonfederal hospitals in the United States. Each record includes 1 primary diagnosis and up to 24 secondary diagnoses.

Analysis was conducted for all patients aged 21 years and greater with a primary discharge diagnosis of AMI based on International Classification of Diseases, 9th Revision (ICD-9) codes. ST-elevation myocardial infarction (STEMI) and non–ST-elevation myocardial infarction (NSTEMI) were recorded when the principal diagnosis included the appropriate ICD-9 codes (see Supporting Table 1 in the online version of this article). Alcohol-related diagnosis was categorized as the presence of alcohol use disorders or other

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chronic conditions caused by heavy drinking such as alcoholic cardiomyopathy and alcoholic liver disease among others. Variables reflecting acute effects and chronic effects of alcohol use were created for analytic purposes. Acute effects that increase the risk for acute withdrawal syndrome and hemodynamic instability (and may thereby effect mortality) were characterized by alcohol withdrawal, acute alcoholic hepatitis, alcoholic gastritis, or acute alcohol intoxication. Chronic effects of alcohol were characterized by alcohol dependence, alcoholic polyneuropathy, alcoholic cardiomyopathy, or alcoholic liver damage other than acute hepatitis. A number of comorbidities were generated from ICD-9 codes including smoking, chronic liver disease, peripheral vascular disease, hypertension, diabetes, renal failure, drug abuse, arrhythmia, and gastrointestinal bleeding using Clinical Classification Software codes provided by the Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality[19] (see Supporting Table 1 in the online version of this article).

The risk for alcohol-related diagnoses in AMI patients adjusting for age and sex was estimated using all adult discharge records. All other analyses included only AMI discharges. The principal outcome measure was in-hospital mortality. Secondary outcomes included having a cardiac procedure (diagnostic catheterization, percutaneous coronary angioplasty, or coronary bypass grafting), and length of stay.

All statistical analyses were performed using Statistical Analysis Software version 9.4 (SAS Inc., Cary, NC). Logistic regression methods appropriate for the NIS sample design were utilized to predict AMI mortality risk associated with alcohol-related diagnoses (overall and separately for acute and chronic alcohol-related diagnoses). Mortality risk was evaluated in all AMI discharges and again for STEMI and NSTEMI discharges. To control for factors frequently associated with alcoholism, adjustment was made for age, sex, liver disease, hypertension, diabetes, renal failure, peripheral vascular disease, arrhythmias, drug abuse, gastrointestinal bleed, and smoking. For secondary outcomes, odds ratios were calculated for having a cardiac procedure performed during the hospital admission and length of stay above the median.

RESULTS

Table 1 lists characteristics of AMI patients stratified by in-hospital mortality. In 2011, AMI accounted for 610,963 (1.9%) of overall adult hospital admissions, with an in-hospital mortality of 5.3%. Thirty-two percent were STEMI admissions and 68% were NSTEMI admissions with in-hospital mortality of 8.5% and 3.8%, respectively. Patients with alcohol-related diagnoses comprised 18,684 (3.1%) of all AMI admissions. This prevalence was significantly lower relative to non-AMI admissions (4.9%), even after age and sex adjustment (adjusted odds ratio [OR]: 0.7, 95% confidence interval [CI]: 0.6-0.7, $P < 0.001$).

TABLE 1. Baseline Characteristics of AMI Patients

Variables	AMI, In-hospital Death	AMI, Alive at Discharge	*P* Value
No.	32,399 (5.3)	578,564 (94.7)	<0.0001
Age, y (SD)	76 (75–77)	67 (66–68)	
Sex			
Males	17,483 (54)	352,943 (61)	<0.0001
Females	14,916 (46)	225,621 (39)	<0.0001
Race			
White	22,517 (70)	387,816 (67)	<0.0001
Black	2,580 (7.9)	56,735 (9.8)	<0.0001
Hispanic	2,002 (6.1)	41,399 (7.2)	<0.0001
Asian	685 (2)	11,160 (1.9)	<0.0001
Native American	146 (0.3)	2,240 (0.4)	<0.0001
Others	991 (3)	17,711 (3.2)	<0.0001
Unspecified	3,478 (10.7)	61,503 (10.5)	<0.0001
STEMI	16,437 (50.7)	177,240 (30.6)	<0.0001
NSTEMI	15,962 (49.3)	401,324 (69.4)	<0.0001
Alcohol diagnoses			
Acute drinking	110 (0.3)	2,615 (0.5)	0.1389
Chronic drinking	816 (2.5)	15,143 (2.6)	0.2473
Comorbidities			
Diabetes mellitus	11,497 (35.5)	211,321 (36.5)	0.5963
Hypertension	20,068 (61.9)	411,853 (71.2)	<0.0001
Peripheral vascular disease	4,962 (15.3)	70,024 (12.1)	<0.0001
Renal failure	9,929 (30.6)	113,714 (19.7)	<0.0001
Drug abuse	330 (1.0)	13,263 (2.3)	<0.0001
Arrhythmias	14,977 (46.2)	167,286 (28.9)	<0.0001
Liver disease	442 (1.4)	6,493 (1.1)	0.0753
Smoking history	6,736 (20.8)	210,205 (36.3)	<0.0001
Gastrointestinal bleed	1,982 (6.1)	12,086 (2.1)	<0.0001

NOTE: Values are expressed as weighted number of patient's (%) for dichotomous variables and mean for continuous variables. **Abbreviations:** AMI, acute myocardial infarction; NSTEMI, Non–ST-elevation myocardial infarction; SD, standard deviation; STEMI, ST-elevation myocardial infarction.

Table 2 lists the characteristics of AMI patients stratified by alcohol status. Patients with alcohol-related disorders presenting with AMI were younger, overwhelmingly male, and had a higher prevalence of the following comorbid conditions: drug abuse, liver disease, gastrointestinal bleeding, and smoking history. They had a lower prevalence of diabetes, hypertension, and renal failure.

Among AMI patients, unadjusted in-hospital mortality was observed to be similar in the alcohol use disorder group (4.7% vs 5.3%, $P = 0.131$), STEMI hospitalizations (7.9% vs 8.5%, $P = 0.475$), and lower in NSTEMI hospitalizations (3% vs 3.9%, $P = 0.035$). However, as shown in Table 2, there were a number of factors that may have influenced death in AMI patients that differed between those with and without alcohol diagnoses. Table 3 shows the adjusted risk for death and each secondary outcome. After adjusting for factors associated with alcoholism, including age, sex, liver disease, hypertension, diabetes, renal failure, drug abuse, gastrointestinal bleed, and smoking, alcohol-related diagnoses were associated with increased mortality in AMI hospitalizations (adjusted OR: 1.5, 95% CI: 1.2-1.7, $P < 0.001$).

TABLE 2. Acute Myocardial Infarction Patient Characteristics With and Without Alcohol-Related Diagnoses

Variables	Alcohol-Related Diagnoses	No Alcohol-Related Diagnoses	P Value
No.	18,684 (3.1)	592,279 (96.9)	<0.0001
Age, y, mean	59 (58–60)	68 (67–69)	<0.0001
Sex			
Males	16,315 (87.3)	354,051 (59.8)	<0.0001
Females	2,369 (12.7)	238,228 (40.2)	<0.0001
Race			
White	11,917 (63.8)	398,766 (67.2)	<0.0001
Black	2,613 (13.9)	56,723 (9.6)	<0.0001
Hispanic	1,400 (7.5)	42,052 (7.1)	<0.0001
Asian	125 (0.7)	11,724 (1.9)	<0.0001
Native American	165 (0.9)	2,221 (0.4)	<0.0001
Others	570 (2.9)	18,139 (3.2)	<0.0001
Unspecified	1,894 (10.1)	62,654 (10.6)	<0.0001
STEMI	6,541 (35.1)	187,136 (31.2)	<0.0001
NSTEMI	12,143 (64.9)	405,143 (68.8)	<0.0001
Died	881 (4.7)	31,518 (5.3)	0.1312
Comorbidities			
Diabetes mellitus	4,663 (24.9)	218,446 (36.8)	<0.0001
Hypertension	12,501 (66.8)	420,001 (70.8)	<0.0001
Peripheral vascular disease	2,269 (12.1)	72,773 (12.3)	0.7987
Renal failure	1,937 (10.4)	121,925 (20.6)	<0.0001
Drug abuse	2,894 (15.5)	10,708 (1.8)	<0.0001
Arrhythmias	5,476 (29.3)	177,088 (29.9)	0.4076
Liver disease	887 (4.7)	6,053 (1.0)	<0.0001
Smoking history	12,771 (68.3)	204,390 (34.5)	<0.0001
Gastrointestinal bleed	730 (3.9)	13,347 (2.3)	<0.0001

NOTE: Values are expressed as weighted number of patient's (%) for dichotomous variables and mean for continuous variables. **Abbreviations:** NSTEMI, non–ST-elevation myocardial infarction; STEMI, ST-elevation myocardial infarction.

Contrary to our expectations, however, acute alcohol-related diagnoses were not independently associated with mortality. The association with alcohol-related diagnoses was significant in both STEMI (adjusted OR: 1.7, 95% CI: 1.4-2.2, $P < 0.001$) and NSTEMI patients (adjusted OR: 1.3, 95% CI: 1.0-1.7, $P = 0.025$).

Regarding secondary outcomes, alcohol-related diagnoses were associated with an increased length of stay, fewer diagnostic catheterizations and angioplasties, but higher coronary artery bypass grafting (CABG) procedures (Table 3).

DISCUSSION

In this analysis of AMI discharges, a modestly increased risk of in-hospital mortality was found for patients with alcohol-related diagnoses, although AMI patients were less likely to have a diagnosis related to alcohol. This increased risk of in-hospital mortality was present in both STEMI and NSTEMI patients with alcohol-related diagnoses, and was present in patients with chronic alcohol-related diagnoses but not with withdrawal or intoxication. In addition to mortality differences, AMI patients with alcohol-related diagnoses had a higher length of stay, but were less likely to have a cardiac procedure.

TABLE 3. Multivariate Regression Analysis Predicting Odds of Mortality, Increased Length of Stay, and Cardiac Procedures

	Adjusted Odds Ratio*	95% Confidence Intervals	*P* Value
Primary outcome: death			
AMI			
Alcohol diagnoses	1.5	1.2–1.7	<0.001
Acute alcohol diagnoses...	1.0	0.7–1.5	0.886
Chronic alcohol diagnoses°	1.5	1.2–1.8	0.001
STEMI			
Alcohol diagnoses	1.7	1.4–2.2	<0.001
Acute alcohol diagnoses...	1.1	0.6–1.9	0.835
Chronic alcohol diagnoses°	1.6	1.2–2.1	0.001
NSTEMI			
Alcohol diagnoses	1.3	1.0–1.7	0.025
Acute alcohol diagnoses...	1.2	0.7–2.1	0.581
Chronic alcohol diagnoses°	1.4	1.1–1.9	0.022
Secondary outcomes			
AMI			
Length of stay	1.5	1.3–1.6	<0.001
All cardiac procedures	0.6	0.6–0.7	<0.001
CABG	1.2	1.0–1.3	0.008
Angioplasty	0.6	0.6–0.7	<0.001
Diagnostic angiogram	0.7	0.6–0.8	<0.001
STEMI			
Length of stay	1.2	1.1–1.4	<0.001
All cardiac procedures	0.6	0.5–0.7	<0.001
CABG	1.2	0.9–1.5	0.125
Angioplasty	0.6	0.5–0.7	<0.001
Diagnostic angiogram	0.7	0.6–0.9	<0.001
NSTEMI			
Length of stay	1.6	1.5–1.8	<0.001
All cardiac procedures	0.7	0.6–0.8	<0.001
CABG	1.1	0.9–1.5	0.125
Angioplasty	0.6	0.6–0.7	<0.001
Diagnostic angiogram	0.7	0.6–0.8	<0.001

NOTE: **Abbreviations:** AMI, Acute myocardial infarction; CABG, coronary artery by-pass grafting; NSTEMI, non–ST-elevation myocardial infarction; STEMI, ST-elevation myocardial infarction. *Adjusted for age, sex, hypertension, diabetes, liver disease, renal failure, gastrointestinal bleeding, drug abuse, and smoking. †Acute effects of alcohol characterized by alcohol withdrawal, acute alcoholic hepatitis, alcoholic gastritis, or acute alcohol intoxication. ‡Chronic effects of alcohol characterized by alcohol dependence, alcoholic polyneuropathy, alcoholic cardiomyopathy, or alcoholic liver damage.

The association of alcohol-related diagnoses with cardiovascular outcomes is not as well defined as the beneficial association between coronary heart disease and moderate alcohol use. Heavy drinking has been associated with greater risk of sudden cardiac death in subjects with preexisting coronary heart disease.[20,21] Data from the Nurses Health Study demonstrated a U-shaped curve between alcohol use and sudden cardiac death, but with limited power for assessing heavy drinking patterns.[22] In the Physicians Health Study, there was no significant increase in the risk of sudden cardiac death in men with higher intake of alcohol (≥2 drinks/day), but again with limited power for evaluating truly heavy drinking.[23] More recently, as shown by Mukamal et al., there was a trend toward higher overall cardiovascular deaths (OR: 1.07, 95% CI: 0.94-1.22) but lower coronary heart disease mortality (OR: 0.80, 95% CI: 0.61-1.05) in heavy drinkers, but results were not statistically significant

even after adjusting for age, sex, and race.[3] One study demonstrated that heavy episodic drinking within the preceding 24 hours was associated with an increased risk of myocardial infarction (OR: 1.4, 95% confidence interval: 1.1-1.9), particularly in the elderly (>65 years old) (OR: 5.3, 95% CI: 1.6-18),[24] but the study did not consider mortality. The more recent study done by Mostofsky et al. has shown higher incidence of AMI onset within 1 hour after alcohol consumption among people who are not daily drinkers,[25] but the study did not consider mortality outcomes.

As an extension of knowledge regarding the association of alcohol-related diagnoses with cardiovascular outcomes, we believe that our analysis of the NIS is the first to show a statistically significant positive age-adjusted association of in-hospital mortality with alcohol-related diagnoses in AMI patients. Episodic or binge drinking has been noted to have proarrhythmogenic effects leading to sudden cardiac death.[26] This would often occur prior to hospitalization, but once hospitalized the presence of rhythm abnormalities was not associated with alcohol diagnoses. Alcohol effects might also be expected to lead to increased AMI mortality due to autonomic instability, gastrointestinal bleeding, or liver disease, but intoxication, withdrawal, gastrointestinal bleeding, liver disease, or comorbid tobacco or drug abuse did not account for excess alcohol-associated AMI mortality in this study. Additional research will be required to determine the reasons underlying the increased age-adjusted mortality.

The important strength of the present study includes the use of a large national database that allowed us to link alcohol-related diagnoses to AMI death in the hospital, and to explore potential confounders of this association (eg, gastrointestinal bleeding, withdrawal, liver disease). However, a number of limitations merit consideration. The NIS sampling frame is limited to hospital discharges. As such, we have no data on prehospital AMI death and alcohol use pattern immediately preceding hospitalization. Similarly, we were unable to consider mortality immediately beyond the hospital discharge. Other important predictors that are not recorded in the NIS are details regarding a patient's physical activity and medications such as statins and β-blockers that could affect survivorship in AMI patients. Another potential limitation of our analysis is the lack of differentiating between type 2 myocardial infarction, occurring from sepsis or acute kidney injury, from a true NSTEMI. However, we included only primary discharge diagnoses of AMI, and results for STEMI and NSTEMI discharges were similar. Regarding the cross-sectional study design, we are unable to establish a cause and effect relationship between in-hospital AMI mortality and alcohol-related diagnoses. The NIS data were abstracted from administrative databases that may lack important details on alcohol-related problems. In particular, it seems likely that heavy drinkers with less obvious alcohol-related problems would be underidentified in clinical settings, and this may have biased our results toward an overestimation of the alcohol-associated risk. Due to these limitations, AMI mortality will need to be evaluated in other samples to definitively evaluate associations with diagnoses related to heavy drinking and determine the reasons underlying the association. The increased death and CABG despite decreased angiography and angioplasty suggests that these patients presentations may be with more severe coronary heart disease, which is a question requiring further study. Finally, an alcohol user who presents with an AMI is less likely to have cardiac risk factors like diabetes, renal failure, and possibly hypertension. Rather, alcohol diagnoses in AMI patients associate with tobacco and drug abuse, liver disease, and higher age-adjusted risk for death. It is important for a practicing hospitalist to have a high index of suspicion for these atypical AMI patients.

CONCLUSION

Although alcohol-related diagnoses are less commonly documented in AMI patients relative to other admission diagnoses, results of this study suggest that they independently predict in-hospital mortality. More research is needed to definitively measure the risk of such death attributable to alcohol and determine the mechanisms underlying the association.

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