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UNDERREPORTING OF ALCOHOL USE IN TRAUMA PATIENTS: A RETROSPECTIVE ANALYSIS

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Abstract

Background: This study assessed the inconsistencies between self-reported alcohol consumption and blood alcohol content (BAC) in trauma patients. We aimed to identify the incidence of positive BAC in trauma patients who reported a zero score on the Alcohol Use Disorders Identification Test (AUDIT). We also sought to identify characteristics of individuals who were likely to negate alcohol use, yet yielded a positive BAC, to improve our ability to provide alcohol screening and healthcare to these at-risk alcohol consumers.

Methods: We conducted a retrospective study from 2010-2018 at a university-based, level-one trauma emergency department. We identified 2,581 adult trauma patients who reported a zero score on the AUDIT from the trauma registry. We collected BAC, age, gender, race, education level, mechanism of injury, language and injury severity score (ISS) from patient charts, and used descriptive analyses and multivariate logistic regression to analyze the data.

Results: One hundred and thirty-one (5.08%) trauma patients who reported AUDIT of zero had a positive BAC. We found that being male (OR 1.53), assaulted or injured from a penetrating mechanism (OR 2.29) and having an ISS greater than 25 (OR 3.76) were independent positive predictors of trauma patients who reported an AUDIT of zero and had a positive BAC. Age (OR 0.99) was an independent negative predictor of trauma patients who reported an AUDIT of zero and had a positive BAC in this cohort.

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Conflict of Interest: None

Conclusions: Inaccurate self-reporting of alcohol drinking behavior does exist in trauma patients. A composite of objective alcohol screening modalities, in addition to AUDIT, is needed to screen for alcohol use in this population. Healthcare providers should remain highly suspicious of alcohol-related injuries in individuals with the identified characteristics.

INTRODUCTION

Alcohol-related trauma is a significant public health concern. Studies have shown that 50% of trauma patients who present to the emergency department (ED) have a blood alcohol content (BAC) above 0 mg/dL.[1] In the trauma patient population, those with moderate alcohol drinking behaviors have a higher risk of sustaining a penetrating mechanism of injury (such as a gunshot wound, stab wound or any open wound on the body) and increased injury severity scores (ISS).[2] In 2016, the National Highway Traffic Safety Administration estimated that one-third of all traffic collision fatalities were a result of drunk driving. Furthermore, drunk drivers involved in a fatal motor vehicle collision were 4.5 times more likely to have a prior conviction of drunk driving.[3] Trauma patients who consume alcohol also have a greater risk of repeated injury.[4] Therefore, it is important to identify these victims early within their first incidents to prevent future occurrences.

In 2006, the American College of Surgeons (ACS) Committee on Trauma mandated all trauma centers to implement an alcohol screening and intervention program for trauma patients. The screening portion identifies patients with hazardous drinking behaviors through the Alcohol Use Disorders Identification Test (AUDIT), which is recommended by the National Institute on Alcohol Abuse and Alcoholism.

AUDIT is a validated, ten-question survey developed by the World Health Organization, which inquires patients about their alcohol use within the past 12 months. The score ranges from zero to 40 and categorizes patients into three categories: not at-risk for alcohol-related health problems (scores of 0-7), at-risk for hazardous use (scores of 8-19) and at-risk for alcohol use disorders (scores of 20 and over). Patients at-risk for hazardous use, scores of 8-19, have the highest benefit from brief interventions whereas patients with an alcohol use disorder should be referred to a specialist.[5] At our institution, we utilize the Computerized Alcohol Screening and Intervention (CASI) system, an AUDIT on a self-administered tablet, to minimize biases, decrease institutional costs and reduce provider contact time.[6,7] AUDIT is a self-reported alcohol drinking behavior survey, which can lead to multiple biases including social desirability, recall bias, misclassifications and fear of legal repercussions.

Studies show mixed results and some discrepancies between different modalities of biological alcohol testing and self-reported drinking surveys. Some studies reported the AUDIT as an accurate tool for assessing alcohol use behavior when compared to BAC.[8,9] Other studies reported a small discrepancy (3%) between using AUDIT and the breath alcohol test or BAC to report alcohol drinking behavior.[10,11] We found that the inaccuracy rate in self-reporting alcohol drinking habits became higher, 15% to 52.9%, when direct biomarkers are used and by participants fear of repercussion either by law, health or social perception.[12,13,14] The same inaccuracy rate has been reported in the ED population as well.[15,16]

Given the mixed results in AUDIT accuracy when compared to other biological alcohol markers and the importance of detecting the underreported alcohol drinking habits of trauma patients, our study aimed to quantify the discrepancy between AUDIT scores and BAC in a larger trauma cohort. We also hoped to identify common characteristics of this underreporting cohort. These findings will allow us to improve the alcohol screening process for this specific trauma population.

METHODS

Study Setting and Design

We conducted a retrospective, chart review study at a level 1 trauma center, tertiary care, university-based ED. We obtained trauma patient information from the existing databases collected between 2010 and 2018. We included data from both English- and Spanish-speaking patients ages 18 and above, who completed the CASI with an AUDIT score of zero. An AUDIT score of zero indicates that the patient denied any alcohol consumption within the past 12 months. A patient was classified as a trauma patient if they met the trauma activation protocol criteria (Supplemental document 1) and were subsequently evaluated by the trauma surgery team. The study was reviewed and approved by the university's Institutional Review Board. Patient informed consent is not applicable to this study.

Study Protocol

We obtained the research data from two existing databases: the Trauma Registry and the CASI database.

The trauma registry database collects patient information and procedures for the hospital as a part of quality assurance. Data analysts abstracted demographic information for each patient, and nurse abstractors inputted all patient injuries, treatments and outcomes. Data is abstracted when trauma patients are admitted to the hospital, and within 30 days of the date of service for all patients discharged from the ED. We obtained mechanism of injury, BAC and ISS from this database. All subjects had venous blood drawn for a BAC test upon arrival to the ED.

The CASI database was obtained by trained research associates (RAs) as part of standard management for trauma patients, from 8:00 AM to midnight in the ED and 8:00 AM to noon in the inpatient units. The RAs asked patients to complete the AUDIT on a CASI tablet privately unless the patient specifically requested assistance from the RAs. The software program automatically closed after the survey was completed; therefore, the responses to each question were confidential. The RAs printed the AUDIT score, shared the score with the patient and placed the printout of the score in the patient's medical record. We excluded patients who were on a psychiatric hold, incarcerated, pregnant or refused the screening. For patients with cognitive impairments such as acute intoxication, altered mental status and critical illness, the RAs approached the patients once their conditions were resolved which was typically within 48 hours while the patients were still in the emergency department. AUDIT results and demographic information were electronically recorded and automatically

stored in a secured hospital database. We extracted patient demographic data and AUDIT scores from this database.

We linked the two databases by a unique identifier for each patient using Python software [Python Software Foundation. Python Language Reference, version 2.7. Available at http://www.python.org].

Outcomes

We used two BAC cutoff points, 0 mg/dL and 80 mg/dL, for our analysis. The BAC cutoff point of 0 mg/dL was chosen because patients who reported an AUDIT score of zero should not have a positive BAC at any level or any given time. The BAC cutoff point of 80 mg/dL was chosen in accordance with the BAC cutoff point for driving under the influence in California. Mechanism of injury was categorized as automotive, motorcycle, pedestrian, bicyclist or other recreational transport, fall, assault, penetrating mechanism, unknown/found down or other. We reported race within four categories: White, Black/African American, Asian and Other. Subjects reported their education levels from nine categories: no schooling, elementary, high school, some college, college: associate, college: bachelor, master, professional and doctorate. According to the literature and ACS recommendations, we categorized ISS into three groups: minor (ISS 1-15), moderate (ISS 16-25) and severe (ISS > 25). Each category is associated with different mortality rates and patient management.[17,18]

Statistical Analysis

The demographic statistics were presented and stratified according to BAC > 0 mg/dL, BAC > 80 mg/dL, age, gender, race, education level, mechanism of injury, language and ISS. Multivariable logistic regression for positive BAC was conducted to assess the association between characteristics of patients and a positive BAC for patients with an AUDIT score of zero. The primary outcome was a positive BAC (BAC > 0 mg/dL). Odds ratios (OR) were determined for each variable, with a 95% confidence interval (CI). P-values of 0.05 or less were considered statistically significant. Patients who did not have their mode of injury documented were categorized as unknown/found down. The missing ISS data were not included in the analysis. All statistical analyses were performed using SAS version 9.4 [SAS Institute Inc 2013. SAS/ACCESS® 9.4 Cary, NC].

RESULTS

A total of 2,581 trauma patients reported an AUDIT score of zero over the eight-year period of this study. There were nearly equal amounts of female and male patients in the cohort (50.61% and 49.39%, respectively). The mean age of patients is 53.99 years, with a standard deviation of 23.99 years. Of these patients, 5.08% had a positive BAC. Furthermore, 2.75% of the patients had a BAC > 80 mg/dL. The most prevalent mechanism of injury was automotive (41.92%), followed by fall (28.52%). The mean ISS is 6.86, with a standard deviation of 8.12. Demographic data for race, education and screening language were also provided (Table 1).

The multivariate logistic regression showed that younger patients had higher odds of having positive BAC among those with an AUDIT score of zero (OR 0.99 (95% CI: 0.98 - 1.00), p-

value = 0.02 in BAC > 0 mg/dL) and (OR 0.98 (95% CI: 0.97 - 1.00), p-value = 0.01 in BAC > 0 mg/dL). Male patients had higher chances of falsely reporting their drinking behavior (OR 1.53 (95% CI: 1.04 - 2.26), p-value = 0.03 in BAC > 0 mg/dL) and (OR 2.45 (95% CI: 1.40 - 4.29), p-value = 0.00 in BAC > 80 mg/dL). Assault and penetrating mechanism patients had double odds of having positive BAC when denying drinking behavior in both BAC cutoff point groups (OR 2.29 (95% CI: 1.31 - 3.98), p-value = 0.00 in BAC > 0 mg/dL) and (OR 2.04 (95% CI: 1.00 - 4.15), p-value = 0.05 in BAC > 80 mg/dL). Lastly, we found that patients with ISS > 25 were more than three times likely in odds of having positive BAC and reporting AUDIT of zero (OR 3.76 (95% CI: 2.11 - 6.69), p-value < 0.00 in BAC > 0 mg/dL) and (OR 3.78 (95% CI: 1.87 - 7.63), p-value = 0.00 in BAC > 80 mg/dL) (Table 2).

DISCUSSION

Our results illustrate that 5.08% of trauma patients self-reported alcohol abstinence but had positive BAC. Furthermore, 2.75% of the trauma patients who reported an AUDIT score of zero had a BAC > 80 mg/dL, which is above the legal limit of alcohol consumption for vehicle drivers. Blood alcohol tests are valid for a finite time after ingestion of alcohol and often miss small amounts of alcohol in the body; thus, our results may be an underestimate of the actual percentage of false negatives. This finding urges our community to explore other objective modalities, in addition to the AUDIT, to screen for alcohol misuse. These modalities include the assessment of BAC and alcohol biomarkers, such as phosphatidylethanol (PEth) and Gamma-Glutamyltransferase (GGT). These biomarkers have been studied previously and suggest an objective analysis of alcohol use in patients.[19]

We found significantly higher odds of inaccurately self-reporting an AUDIT score of zero in younger individuals who are male, suffered an injury due to assault or penetrating mechanism or have an ISS greater than 25. A study suggested that men are more likely to misreport their alcohol use as compared to women.[20] Another prior study on trauma patients also found that younger male individuals with a positive BAC on admission are more likely to engage in hazardous drinking behaviors.[21,22] We observed that the shared characteristics, of being young and male, are associated with higher odds in denial of alcohol use and engaging in hazardous drinking behaviors. Identifying hazardous drinkers and providing them with interventions are crucial. A study showed a sustained 47% decrease in injury recidivism and a marked decrease in alcohol consumption even after three years of injury in patients who received an intervention. Those who did not receive the intervention increased their alcohol consumption after six months of initial injury.[23,24]

Apart from the alcohol screening process, our findings also raise awareness in healthcare providers to be vigilant of alcohol screening in trauma patients who are young, male and have a sustained injury from assault or a penetrating mechanism, and report no alcohol use. Because positive BAC could mask symptoms, i.e. pain when a patient is presented, if BAC is known, a healthcare provider might adjust the patient management plan to include more investigating tests or a longer observation period.

Limitations

Due to the nature of a retrospective study, we were not able to project the causation for the inaccurate, self-reporting alcohol use behavior. We could only describe the associations and identify predictors of patient characteristics towards the behavior. Approximately five percent of approached patients refused to take the survey and were not included in the study. Furthermore, individuals who visited and were discharged from the ED between midnight and 8:00 AM might not be included due to the unavailability of RAs, introducing convenience sampling biases. Given that the study was conducted in only one ED and criterion for trauma activation and classification of our trauma population may be different in other regions, our results may not reflect other trauma populations and may not be applicable to the general population.

Conclusions

It is evident that a portion of alcohol consumers in the trauma population are not reporting their alcohol use accurately through AUDIT. We identified characteristics that are associated with the cohort that reported their alcohol use inaccurately. Our next steps in this research field include exploring objective modalities, in addition to AUDIT, to improve the alcohol screening process in this specific population. We also recommend healthcare providers to remain vigilant of alcohol-related injuries in younger individuals who are male, sustained from assault or a penetrating mechanism and have an ISS greater than 25.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1:

Comparison of Patients' Characteristics Between Different Blood Alcohol Levels

Variable	Categories	Overall N	BAC = 0 (N = 2450)		BAC > 0 (N = 131)		BAC < 80 (N = 2510)		BAC >,= 80 (N = 71)	
			N	%	N	%	N	%	N	%
Sex	Female	1286	1240	50.61	46	35.11	1268	50.52	18	25.35
	Male	1295	1210	49.39	85	64.89	1242	49.48	53	74.65
Race	Not reported / declined to state	47	45	1.84	2	1.53	45	1.79	2	2.82
	White	1792	1704	69.55	88	67.18	1747	69.60	45	63.38
	Black / African American	40	37	1.51	3	2.29	40	1.59	0	0
	Asian	414	396	16.16	18	13.74	404	16.10	10	14.08
	Other	288	268	10.94	20	15.27	274	10.92	14	19.72
Education	No schooling	109	104	4.24	5	3.82	105	4.18	4	5.63
	Elementary	265	253	10.33	12	9.16	257	10.24	8	11.27
	High school	969	923	37.67	46	35.11	945	37.65	24	33.80
	Some college	456	427	17.43	29	22.14	442	17.61	14	19.72
	College: Associates	245	233	9.51	12	9.16	237	9.44	8	11.27
	College: Bachelor	376	360	14.69	16	12.21	367	14.62	9	12.68
	Master's	110	107	4.37	3	2.29	109	4.34	1	1.41
	Professional	29	24	0.98	5	3.82	27	1.08	2	2.82
	Doctorate	20	19	0.78	1	0.76	20	0.80	0	0
Mechanism of Injury	Missing	5	5	0.20	0	0	5	0.20	0	0
	Auto	1082	1039	42.41	43	32.82	1057	42.11	25	35.21
	Motorcycle	189	174	7.10	15	11.45	184	7.33	5	7.04
	Pedestrian	182	170	6.94	12	9.16	173	6.89	9	12.68
	Bicyclist or other recreational transport	130	122	4.98	8	6.11	124	4.94	6	8.45
	Fall	736	710	28.98	26	19.85	724	28.84	12	16.90
	Assault	40	36	1.47	4	3.05	36	1.43	4	5.63
	Penetrating Mechanism	128	112	4.57	16	12.21	120	4.78	8	11.27
	Unknown/found down	47	40	1.63	7	5.34	45	1.79	2	2.82
	Other	42	42	1.71	0	0	42	1.67	0	0
Language	English	2418	2295	93.67	123	93.89	2354	93.78	64	90.14
	Spanish	163	155	6.33	8	6.11	156	6.22	7	9.86
ISS	Missing	72	71	2.90	1	0.76	72	2.87	0	0
	Minor	2116	2020	82.45	96	73.28	2063	82.19	53	74.65
	Moderate	279	263	10.73	16	12.21	272	10.84	7	9.86
	Severe	114	96	3.92	18	13.74	103	4.10	11	15.49
			Mean	**Std**	**Mean**	**Std**	**Mean**	**Std**	**Mean**	**Std**
Continuous Variables	Age		53.99	23.99	46.96	22.95	53.90	24.03	44.06	20.24

Variable	Categories	Overall N	BAC = 0 (N = 2450)		BAC > 0 (N = 131)		BAC < 80 (N = 2510)		BAC >,= 80 (N = 71)	
			N	%	N	%	N	%	N	%
	ISS		6.86	8.12	10.62	12.61	6.95	8.21	10.83	13.95

Abbreviations: N: sample size; BAC: Blood Alcohol Content; ISS: injury severity score; AA/AS: Associates Degree; BA/BS: Bachelor of Art/Science (respectively); std: standard deviation

Table 2:

Logistic Regression Analysis of Patient Characteristics Associated with Positive Blood Alcohol Levels in Trauma Patients Who Report an AUDIT Score of Zero

Variable	Category	Outcome: BAC > 0		Outcome: BAC > 80	
		OR (95% CI)	p-value	OR (95% CI)	p-value
Age		0.99 (0.98, 1)	0.02	0.98 (0.97, 1)	0.01
Sex	Female	1		1	
	Male	1.53 (1.04, 2.26)	0.03	2.45 (1.40, 4.29)	0.00
Race	White	1		1	
	Other	0.87 (0.57, 1.34)	0.54	1 (0.57, 1.74)	0.99
Education	≥College graduate (5-9)			1	
	Some college + ≤ HS (1-4)	1.04 (0.68, 1.58)	0.86	0.95 (0.54, 1.66)	0.86
Cause of injury	Collision	1		1	
	Fall/Unknown/found down	1.37 (0.82, 2.27)	0.23	1.07 (0.53, 2.16)	0.86
	Assault/Penetrating mechanism	2.29 (1.31, 3.98)	0.00	2.04 (1.00, 4.15)	0.05
Language	English	1		1	
	Spanish	0.96 (0.44, 2.08)	0.91	1.57 (0.67 ,3.68)	0.30
ISS category	Minor (1-15)	1		1	
	Moderate (16-25)	1.13 (0.64, 1.99)	0.68	0.76 (0.32, 1.82)	0.54
	Severe (>25)	3.76 (2.11, 6.69)	<0.00	3.78 (1.87, 7.63)	0.00

Abbreviations: AUDIT: Alcohol Use Disorders Identification Test; BAC: Blood Alcohol Content; OR: Odds Ratio; CI: Confidence Interval; HS: High School; ISS: Injury Severity Score