Incidence of Electrolyte Abnormalities in Emergency Department Patients Presenting With Ethanol Intoxication

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ABSTRACT

Introduction: Ethanol intoxication is the most common substance use-related emergency department (ED) presentation in the United States, and the proportion of ethanol-related ED visits is increasing. Although ethanol ingestion can lead to electrolyte abnormalities, ethanol intoxication is often diagnosed on the basis of physical examination, and clinicians frequently defer laboratory testing in clinically intoxicated patients. The purpose of this study was to describe the incidence of electrolyte abnormalities in a cohort of patients evaluated in the ED for ethanol intoxication.

Methods: A retrospective cohort study was performed on Veteran Affairs (VA) ED visit data from 2010 through 2019. Eligible encounters included ED visits with a serum ethanol concentration greater than 50 mg/dL and available electrolyte results.

Results: A total of 223456 encounters involving 83178 patients were included in the analysis. The study population was 94.2% male, and the median age was 55 years. Overall, 48.8% of encounters had at least 1 electrolyte abnormality, and 2.9% had a severe electrolyte abnormality. Hypokalemia was associated with hypomagnesemia (OR, 2.64; 95% CI, 2.56-2.73) and hypophosphatemia (OR, 2.51; 95% CI, 2.21-2.84).

Discussion: The prevalence of electrolyte derangements was substantial among patients with ethanol intoxication. Abnormalities in commonly measured electrolytes were associated with abnormalities in less frequently measured electrolytes.

Conclusions: Routine serum chemistry testing should be considered in patients presenting with ethanol-related complaints to screen for electrolyte abnormalities. In particular, hypokalemia should increase concern for hypomagnesemia and hypophosphatemia.

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INTRODUCTION

Approximately 8.6 million emergency department (ED) visits in the United States were related to ethanol use from January 2021 through September 2023, with 80% attributed solely to ethanol without coingestants.[1] Multiple electrolyte abnormalities are associated with both acute and chronic ethanol ingestion, including hypoglycemia, hyponatremia, hypokalemia, hypomagnesemia, hypocalcemia, and hypophosphatemia.[2] These electrolyte abnormalities can have serious consequences, as demonstrated by a recent case report of central pontine myelinolysis after sodium correction in a patient with chronic ethanol use.[3] Despite the prevalence of electrolyte abnormalities, emergency medicine providers may be hesitant to obtain serum chemistries in patients presenting with presumed ethanol ingestion because of the perception that these presentations are low acuity[4] or concern for prolonging ED length of stay.[5]

This study aimed to better define the incidence of electrolyte abnormalities and identify factors associated with more severe electrolyte derangements among patients presenting with ethanol ingestion. We performed a retrospective study of patients presenting to Veterans Affairs (VA) EDs from 2010 through 2019 for ethanol intoxication.

METHODS

An automated Microsoft Structured Query Language query was conducted using the VA Corporate Data Warehouse to identify

Table 1. Demographics Characteristics of Study Population, N = 83 178

Sex	n (%)
Male	78 346 (94)
Female	4832 (6)
Race	
White	54 585 (66)
Black	20 852 (25)
Other	2096 (3)
Unknown	5645 (7)
Ethnicity	
Non-Hispanic	74 244 (89)
Hispanic	5101 (6)
Unknown	3833 (5)
Median age	55 (IQR 45-62)

Abbreviation: IQR, interquartile range.

all ED visits within the VA hospital network from January 1, 2010, through December 31, 2019, as previously reported.[6] Any ED visit at which the patient had a serum ethanol concentration greater than 50 mg/dL was included. Visits without available serum chemistry data were excluded.

Demographic data, including age, sex, race, and ethnicity, were collected. Laboratory measurements of serum ethanol, sodium, potassium, calcium, magnesium, phosphorus, glucose, and creatinine were obtained. ED disposition data also were obtained. Glucose and electrolyte abnormalities were categorized as mild, moderate, or severe based on predefined cutoffs shown in Table 2. Calcium values were not corrected for serum albumin. Hypoglycemia was defined as a serum glucose concentration below 70 mg/dL.

Descriptive statistics and odds ratio were calculated for variables of interest. To quantify effect size, odds ratios were converted to Cohen's *d* using established methods, with larger absolute values indicating greater effect magnitude. The primary outcome was a composite of any electrolyte abnormality or hypoglycemia. Secondary outcomes included any severe electrolyte abnormality, hospital admission, and disposition among admitted patients (medical admission, including intensive care unit admission, vs hospital discharge or psychiatric admission). We also examined rates of electrolyte abnormalities among patients with renal insufficiency, defined as a serum creatinine concentration greater than 1.4 mg/dL, versus those with a creatinine concentration of 1.4 mg/dL or less. A sensitivity analysis excluding patients with a creatinine greater than 1.4 mg/dL also was performed. This study was approved by the VA Milwaukee Institutional Review Board (protocol #1598912).

RESULTS

There were 223 456 distinct encounters during the study period, encompassing 83 178 individual patients. The median age was 55 years, and 109 119 encounters (48.8%) resulted in hospital admission. Most patients were male (94.2%), White (65.6%), and non-Hispanic (89.3%). Patients younger than 60 years accounted for 64.3% of visits. Additional demographic characteristics are shown in Table 1.

Table 2. Electrolyte and Glucose Abnormalities

Electrolyte Abnormalities	**N**	**%**
Total sodium assays	220 210	
Low (< 135 mEq/L)	30 251	13.7
Mild (130–134 mEq/L)	21 876	9.9
Moderate (120–129 mEq/L)	7754	3.5
Severe (< 120 mEq/L)	621	0.3
High (> 145 mEq/L)	14 367	6.5
Mild (145–149 mEq/L)	13 486	6.1
Moderate (150–159 mEq/L)	873	0.4
Severe (> 160 mEq/L)	8	<0.01
Total potassium assays	219 314	
Low (< 3.5 mEq/L)	43 686	19.9
Mild (3.0–3.4 mEq/L)	37 620	17.2
Moderate (2.5–2.9 mEq/L)	5450	2.5
Severe (< 2.5 mEq/L)	616	0.3
High (> 5.0 mEq/L)	2474	1.1
Mild (5.0–5.4 mEq/L)	1610	0.7
Moderate (5.5–5.9 mEq/L)	600	0.3
Severe (> 6 mEq/L)	264	0.1
Total calcium assays	198 555	
Low (< 8.5 mg/dL)	39 949	20.1
Mild (8.0–8.4 mg/dL)	25 773	13.0
Moderate (7.0–7.9 mg/dL)	10 589	5.3
Severe (< 7.0 mg/dL)	3627	1.8
Total magnesium assays	118 120	
Low (< 1.7 mg/dL)	20 452	17.3
Mild (1.5–1.6 mg/dL)	11 962	10.1
Moderate (1.2–1.4 mg/dL)	6667	5.6
Severe (< 1.2 mg/dL)	1823	1.5
Total phosphorus assays	11 124	
Low (< 2.5 mg/dL)	1217	10.9
Mild (2.0–2.4 mg/dL)	856	7.7
Moderate (1.0–1.9 mg/dL)	346	3.1
Severe (< 1.0 mg/dL)	15	0.1
Glucose Abnormalities	**N**	**%**
Total glucose assays	214 661	
Low (< 70 mg/dL)	6706	3.1
Severe (< 55 mg/dL)	1853	0.9
High (> 200 mg/dL)	9450	4.4
> 300 mg/dL	3645	1.7
> 500 mg/dL	532	0.2

The prevalence of various electrolyte abnormalities is summarized in Table 2. Sodium, potassium, calcium, magnesium, and phosphorus concentrations were obtained in 98.6%, 98.2%, 88.9%, 52.9%, and 5.0% of all encounters, respectively. Overall, 48.8% of tests performed identified at least 1 electrolyte abnormality, and 2.9% demonstrated a severe electrolyte abnormality (n = 6529). There were 12 467 encounters with a severely elevated ethanol concentration (> 400 mg/dL). Serum creatinine values were available for 83.5% of encounters, and renal insufficiency was identified in 4.4%.

Hyponatremia and hypernatremia were observed in 30 251 and 14 367 sodium assays, respectively. Severe hyponatremia was present in 621 assays, whereas severe hypernatremia occurred in 8 assays. Hypokalemia occurred in 43 686 cases, including 616 cases of severe hypokalemia. Serum magnesium concentrations were measured in 26 230 (60%) of hypokalemia cases. Hyperkalemia occurred in 2474 potassium assays, including 264 cases of severe hyperkalemia.

Table 3. Assessment of Factors Associated With Electrolyte Abnormalities

Variable (n)	Any electrolyte abnormality, %	Odds Ratio (95% CI)	Severe electrolyte abnormality, %	Odds Ratio (95% CI)
Age > 60 years (75 099)	55.9	1.41 (1.39–1.44)	3.38	1.48 (1.41–1.56)
10+ ED visits (39 468)	54.1	1.21 (1.18–1.23)	2.72	1.02 (0.96–1.09)
Serum ethanol > 400 mg/dL (12 467)	59.3	1.47 (1.42–1.53)	2.54	0.94 (0.85–1.06)
Serum creatinine > 1.4 mg/dL (8228)	59.2	1.55 (1.48–1.62)	9.7	3.94 (3.64–4.26)
Female (4832)	50.1	1.02 (0.99–1.07)	2.60	0.97 (0.86–1.10)
Admitted to hospital (108 952)	54.9	1.64 (1.62–1.67)	74.2	3.10 (2.93–3.29)

Abbreviation: ED, emergency department.

Among calcium assays, 39 949 were consistent with hypocalcemia, including 3627 cases of severe hypocalcemia. Hypomagnesemia was present in 20 452 cases, of which 1823 were severe. Among phosphorus assays, 1217 were consistent with hypophosphatemia, including 15 cases of severe hypophosphatemia.

Patients with hypokalemia were more likely to have hypomagnesemia (OR, 2.64; 95% CI, 2.56-2.73; Cohen's $d = 0.535$) and hypophosphatemia (OR, 2.51; 95% CI, 2.21-2.84; $d = 0.507$). In contrast, patients with hyponatremia were less likely to have hypomagnesemia (OR, 0.37; 95% CI, 0.35-0.40; $d = 0.548$) or hypophosphatemia (OR, 0.35; 95% CI, 0.27-0.47; $d = 0.579$).

Serum glucose concentrations are summarized in Table 2. Glucose concentrations were obtained in 96.1% of all encounters. Among all glucose assays, 6706 were consistent with hypoglycemia, including 1853 cases of severe hypoglycemia. Hyperglycemia was identified in 9450 samples, with 3645 and 532 glucose concentrations exceeding 300 and 500 mg/dL, respectively.

Several factors were associated with electrolyte abnormalities (Table 3). Patients with 10 or more study-related visits during the 10-year period accounted for 39 468 encounters (17.7%). These patients were more likely to have an electrolyte abnormality than patients with fewer visits (OR, 1.21; 95% CI, 1.18-1.23; $d = 0.105$). However, frequent ED visits were not associated with severe electrolyte abnormalities (OR, 1.02; 95% CI, 0.96-1.09; $d = 0.011$).

Similarly, patients with a severely elevated ethanol concentration (> 400 mg/dL) were more likely to have an electrolyte abnormality than those with lower ethanol concentrations (59.3% vs 49.7%; OR, 1.47; 95% CI,1.42-1.53; $d = 0.212$) but were not more likely to have a severe electrolyte abnormality (OR, 0.95; 95% CI, 0.85-1.06; $d = 0.014$).

Patients aged 60 years or older were more likely than those younger than 60 years to have any electrolyte abnormality (55.9% vs 47.4%; OR, 1.41, 95% CI, 1.39-1.44; $d = 0.189$) and any severe electrolyte abnormality (3.38% vs 2.31%; OR, 1.48; 95% CI, 1.41-1.56; $d = 0.216$). Older patients also were less likely to have an ethanol concentration greater than 400 mg/dL (OR, 0.39; 95% CI, 0.36-0.40; $d = 0.519$). Sex was not significantly associated with electrolyte abnormalities. Patients with electrolyte abnormalities were more likely to be admitted to the hospital (OR, 1.64; 95% CI, 1.62-1.67; $d = 0.273$), particularly those with severe electrolyte abnormalities (OR, 3.10; 95% CI, 2.93-3.29; $d = 0.624$).

In a sensitivity analysis excluding 8228 encounters involving patients with renal insufficiency, results were similar to those of the primary analysis, except that older age was no longer associated with electrolyte abnormalities or severe electrolyte abnormalities.

DISCUSSION

Alcohol was involved in an estimated 1.8% of ED visits in the United States in 2020 (52 174 507 total visits), and there is a global trend toward increased hospitalization for alcohol-related reasons.[7,8] In this study, nearly half of patients presenting with ethanol intoxication who underwent laboratory testing had at least 1 electrolyte abnormality. Although patients who underwent laboratory testing may have been more likely to have abnormalities than those who did not, it is noteworthy that most intoxication cases in the database from which this cohort was derived were identified by ethanol assays (78.3%) without associated ICD-9 or ICD-10 codes related to alcohol intoxication. Therefore, the incidence of these abnormalities is likely substantial despite the potential for selection bias.

Our findings are generally consistent with existing data regarding the most common electrolyte abnormalities among patients with alcohol use disorder,[9] although previous studies have primarily focused on long-term ethanol use rather than acute ethanol intoxication. A single-center study from Austria evaluating laboratory abnormalities in acute ethanol intoxication found elevated serum electrolytes more frequently than electrolyte deficiencies. Hypernatremia, hyperchloremia, and hypermagnesemia were the most common abnormalities, occurring in 41%, 21%, 17% of patients, respectively. In contrast, hypokalemia and hypophosphatemia were each identified in fewer than 5% patients.[10] The authors speculated that suppression of antidiuretic hormone release and subsequent polyuria may have contributed to the high prevalence of hypernatremia and hyperchloremia and suggested that electrolyte deficiencies may be less common when laboratory testing is performed shortly after acute ingestion.[10,11]

The marked differences between their findings and ours may have several explanations. First, our study included a substantially larger cohort drawn from a national health care system. Second, many patients in our cohort had multiple ED visits, suggesting a population with chronic ethanol intoxication.

Many clinicians are reluctant to pursue diagnostic workup in patients who are clinically intoxicated because observation periods, particularly when medicolegal concerns arise regarding discharge of patients with markedly elevated ethanol concentrations, can place additional demands on EDs already facing boarding and staffing challenges.[4] As a result, discharging patients once they appear clinically sober may be preferred. However, studies have shown that physicians are often inaccurate when estimating blood alcohol concentrations based on clinical assessment alone.[12] Accordingly, deferring laboratory testing in patients presenting with ethanol-related complaints may result in missed electrolyte abnormalities in a population that is often medically underserved. Interestingly, a multicenter study from Minnesota found that obtaining laboratory studies increased ED length of stay by approximately 23%; however; specific ethanol concentrations had no effect on total time to discharge among intoxicated patients.[5]

Point-of-care electrolyte testing may be a reasonable option for patients with suspected ethanol intoxication when a serum ethanol concentration is not clinically necessary. Although a complete electrolyte and metabolic panel may not be necessary in all patients, a two-tiered approach to laboratory evaluation may be useful when abnormalities are identified on a basic metabolic panel or point-of-care testing. In particular, patients with hypokalemia were more likely to have concomitant hypomagnesemia and hypophosphatemia. Therefore, hypokalemia should prompt a lower threshold for additional testing. Although the association between hypomagnesemia and hypokalemia is well established,[13] our finding suggest that additional electrolyte evaluation should be considered when hypokalemia is identified.

We also found that older patients with ethanol intoxication were more likely than younger patients to have electrolyte abnormalities overall and severe electrolyte derangements specifically, a finding that parallels observations older adults presenting to the ED.[14] Based on our sensitivity analysis, this association appears to be largely driven by the higher prevalence of renal insufficiency among older patients. Regardless of the underlying mechanism, suspected ethanol intoxication in patients aged 60 years or older should prompt heightened concern for electrolyte disturbances and may justify a lower threshold for routine laboratory evaluation.

Limitations

This study has several limitations. Given its retrospective design, causal relationships cannot be established, and the data may be subject to errors or omissions. We were only able to identify patients with documented serum ethanol concentrations of 50 mg/dL or greater; therefore, clinically intoxicated patients who did not undergo ethanol testing were not included.

In addition, because of the nature of database review, we were limited to predefined electrolyte abnormalities and could not adjust for factors such as pseudohyponatremia related to hyperglycemia or abnormalities associated with acute kidney injury or concurrent chronic kidney disease. Consequently, we cannot definitively conclude that all observed electrolyte abnormalities were directly attributable to ethanol consumption, and the underlying etiologies are likely multifactorial. We also were unable to determine how many patients received electrolyte repletion as therapy.

As noted previously, although we found a high prevalence of electrolyte abnormalities, patients who underwent laboratory testing may have been inherently more likely to have such abnormalities than those who did not. Furthermore, there was discordance between factors predictive of any electrolyte abnormality and those with severe electrolyte abnormalities, the reasons for which remain unclear. This analysis included all patients with serum ethanol concentrations greater than 50 mg/dL, including those with incidental ethanol intoxication who presented for unrelated complaints. We also lacked morbidity and mortality data for the study population. Finally, because the study population was limited to patients treated at VA facilities, generalizability of these findings to other patient populations may be limited.

CONCLUSIONS

This retrospective study found that ethanol intoxication is frequently associated with electrolyte derangements, many of which are clinically significant and can be readily identified in the ED using routine serum chemistry testing. Older patients, frequent ED users, and those with markedly elevated ethanol concentrations were more likely to have electrolyte derangements, with older patients also at increased risk for severe derangements. Clinicians should consider expanding laboratory evaluation to include less commonly tested electrolytes when abnormalities are identified on a basic chemistry panel. In particular, hypokalemia was associated with both hypomagnesemia and hypophosphatemia and may warrant additional testing.

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REFERENCES

1. Drug Abuse Warning Network (DAWN): alcohol-related ED visits short report. Substance Abuse and Mental Health Services Administration. Published March 18, 2024. Accessed October 22, 2026. https://www.samhsa.gov/data/report/dawn-alcohol-related-ed-visits-short-report

2. Yip L. Ethanol. In: Nelson LS, Howland MA, Lewin NA, Smith SW, Goldfrank LR, Hoffman RS, eds. *Goldfrank's Toxicologic Emergencies.* 11th ed. McGraw-Hill Education; 2019:1143-1156.

3. Nimodia D, Parihar P, Gaur S, Desale P, Mishra K. Consequences of hyponatremia:

central pontine and extrapontine myelinolysis in a chronic alcohol user. *Cureus*. 2024;16(5):e61360. doi:10.7759/cureus.61360

4. Lee S, Oh H. Triage and length of stay in emergency department visits due to alcohol intoxication: a retrospective chart review. *Australas Emerg Care*. 2023;26(1):90-95. doi:10.1016/j.auec.2022.08.004

5. Klein LR, Driver BE, Miner JR, Martel ML, Cole JB. Emergency department length of stay for ethanol intoxication encounters. *Am J Emerg Med.* 2018;36(7):1209-1214. doi:10.1016/j.ajem.2017.12.017

6. Farkas A, Mandich M, Sherman K. Emergency department visits at Veterans Health Administration hospitals related to alcohol intoxication: a ten-year retrospective. *Alcohol*. 2024;119:23-27. doi:10.1016/j.alcohol.2023.12.001

7. Esser MB, Idaikkadar N, Kite-Powell A, Thomas C, Greenlund KJ. Trends in emergency department visits related to acute alcohol consumption before and during the COVID-19 pandemic in the United States, 2018-2020. *Drug Alcohol Depend Rep.* 2022;3:100049. doi:10.1016/j.dadr.2022.100049

8. Smith BT, Schoer N, Sherk A, Thielman J, McKnight A, Hobin E. Trends in alcohol-attributable hospitalisations and emergency department visits by age, sex, drinking group and health condition in Ontario, Canada. *Drug Alcohol Rev*. 2023;42(4):926-937. doi:10.1111/dar.13629

9. Elisaf M, Kalaitzidis R. Metabolic abnormalities in alcoholic patients: focus on acid base and electrolyte disorders. *J Alcohol Drug Depend*. 2015;3(01):185. doi:10.4172/2329-6488.1000185

10. Rauchenzauner M, Kountchev J, Ulmer H, et al. Disturbances of electrolytes and blood chemistry in acute alcohol intoxication. *Wien Klin Wochenschr*. 2005;117(3):83-91. doi:10.1007/s00508-004-0280-0

11. Ragland G. Electrolyte abnormalities in the alcoholic patient. *Emerg Med Clin North Am*. 1990;8(4):761-773.

12. Marco CA, Studebaker H, Repas SJ, et al. Clinician assessment of blood alcohol levels among emergency department patients. *Am J Emerg Me*d. 2023;63:110-112. doi:10.1016/j.ajem.2022.10.045

13. Ahmed F, Mohammed A. Magnesium: the forgotten electrolyte-a review on hypomagnesemia. *Med Sci (Basel)*. 2019;7(4):56. doi:10.3390/medsci7040056

14. Lindner G, Pfortmüller CA, Leichtle AB, Fiedler GM, Exadaktylos AK. Age-related variety in electrolyte levels and prevalence of dysnatremias and dyskalemias in patients presenting to the emergency department. *Gerontology*. 2014;60(5):420-423. doi:10.1159/000360134

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