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Lack of Observable Intoxication in Humans with High Plasma Alcohol Concentrations

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ABSTRACT: Judging the degree of human alcohol intoxication is an important clinical, social, and medicolegal matter. Assessing the degree of intoxication is not always easy by direct patient observation. Observational instruments have been used in forensic science, medical, and social situations in an endeavor to measure alcohol intoxication. The validity of these observational instruments must be questioned. In this study, twenty-one patients with alcohol related complaints presenting to major city emergency departments were studied using one such observational instrument, the Alcohol Symptom Checklist (ASC). Three independent emergency medicine physicians applied the criteria of ASC to the twenty-one patients and obtained a plasma alcohol concentration (PAC) for correlation purposes. Individual correlation coefficients (r = 0.182, r = 0.202, r = 0.200) and a composite correlation coefficient (r = 0.235) demonstrated lack of correlation between PAC and ASC. This lack of correlation is supported by clinical observations of experienced emergency department personnel.

KEYWORDS: pathology and biology, alcohol, intoxication, medical personnel

Use and abuse of alcohol adds significantly to the incidence of accidents, personal violence, and related social and medical problems. Alcohol impairs judgment and performance in a dose related fashion, and the strong association between alcohol and violence is well known. Alcohol abusers have an incidence of suicide 60 times greater than the general population; half of all fatal traffic accidents involve alcohol; 65% of homicides, 60% of child abuse and spouse abuse, and 50% of rape cases involve alcohol [*1-6*]. A large number of patients who visit emergency departments have alcohol related injuries or illness, especially on weekends and holidays [*7-10*].

Litigation arising from automobile accidents involving alcohol which was served in restaurants and bars is based on the misperception that people will uniformly appear intoxicated at plasma alcohol concentrations (PAC) over 100 mg/dL (0.1%). The serving establishment, it is argued, is providing obviously intoxicated customers with alcoholic beverages. However, judging degree of intoxication and human impairment is not easy. Trained professionals have difficulty assessing degree of intoxication in persons with plasma alcohol concentra-

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tions well above 100 mg/dL. In many instances, people with these high plasma alcohol concentrations appear to be relatively sober to beverage servers. Therefore, is it reasonable to state that either trained or untrained persons can accurately assess a person's state of intoxication? Clinical tools have been developed with this goal in mind. One such tool is the Alcohol Symptom Checklist (ASC, Table 1) [*11*]. This observational instrument, which uses an eleven-symptom format, had a 0.84 correlation coefficient between PAC and ASC scores when applied to randomly selected patients in an emergency department. The authors calculated an ASC cutoff score between 3 and 5 for a PAC greater than or equal to 50 mg/dL, and an ASC cutoff score between 4 and 6 for a PAC greater than or equal to 100 mg/dL. However, it has been the experience of the authors that some patients exhibit remarkably few symptoms of intoxication at PACs much greater than 100 mg/dL. The medical literature contains reports of individuals with PACs greater than 500 mg/dL who manifest minimal or no signs of intoxication [*12–15*]. If indeed it is only a matter of simple observation, or a matter of using a reliable clinical tool to assess the degree of intoxication, then experienced clinicians and law enforcement personnel should be able to do this. We used the ASC as a tool to predict plasma alcohol concentrations of individuals presenting to three emergency departments.

Methods

Twenty-one patients with histories of alcohol use who were admitted to the emergency departments at the University of Arizona Medical Center and Kino Community Hospital in Tucson and St. Anthony's Hospital in Denver were the basis for this clinical study (Table 2). One of the three authors, all experienced emergency medicine clinicians, interviewed the patient and obtained an ASC score at the time the PAC was measured. Scoring was performed according to the exact instructions of the ASC and before the author had knowledge of the PAC. All alcohol concentrations were performed on plasma using DuPont's ACA V clinical analyzer at the respective institution. All blood was collected in the usual manner using nonisopropanol containing betadine swabs for cleansing venipuncture sites. Study admission criteria were a history of recent alcohol use and no recent drug use. Patients were excluded from the study in cases of head injury or medical illness that would interfere with level of consciousness. Patients who were obtunded or comatose were excluded because the

TABLE 1—*Alcohol Symptom Checklist (ASC).*

Item	Symptom	Sign
1	odor of alcohol on breath	detected during face-to-face discussions
2	fine motor control	impairment in digital dexterity
3	gross motor control	difficulty walking, sitting, standing, straight line, finger-nose test
4	slurred speech	difficulty enunciating words distinctly, single or multiple word errors
5	change in speech volume	low to high, deviation from normal pattern
6	decreased alertness	difficulty paying attention to conversation or following commands
7	sweating	excessive perspiration
8	slow or shallow respiration	discernible deviation in respiratory pattern from normal
9	sleepiness	drowsiness out of the ordinary for time of day
10	pace of speech	changes in rate, slow to fast, fast to slow
11	red eye	injected sclerae and conjunctivae

TABLE 2—*Sex and ages of patients.*

Males, Ages	Females, Ages
19	27
28	30
31	31
32	35
35	51
35	72
37	81
39	
42	
42	
44	
46	
60	
65	

effects of trauma, central nervous system disorder, or other drugs could not be differentiated. Patients with cervical spine immobilization were also excluded. Patients with severe pain were excluded since a response to pain itself could give an unreliable ASC score. The majority of the patients in this study came to the emergency department seeking alcohol detoxification, complaining of drinking too much, or asking to see a counselor.

Results

The scores (mean ± standard deviation [SD]) for ASC and PAC obtained for the 21 patients were 2.62 ± 1.24 and 299 ± 95 mg/dL, respectively. The data reveal an extreme range of PACs for the ASC scores (Table 3). Best-fit linear regression analysis of each individual scorer's data as well as the entire data (Fig. 1) revealed r values of 0.182, 0.202, and 0.200 with a composite r value of 0.235 (Table 4). No correlation was found individually or collectively between the PAC and ASC score in this study.

Discussion

Our subjects exhibited remarkably low scores for their high PACs. Teplin and Lutz, who developed the ASC, reported that patients with PAC greater than 100 mg/dL had scores between 4 and 6. Our average patient had a PAC of 299 with an ASC score of 2.62. This low score is attributable to the fact that most of our patients were chronic alcohol abusers with high tolerance to the visible effects of alcohol. Other reports of persons appearing sober or slightly intoxicated with PACs much greater than 100 mg/dL corroborate our study [*12–15*]. These results indicate that some individuals may appear to function with a PAC much greater than the accepted thresholds for the alcohol concentration element of driving under the influence (DUI) offenses in some states. Also, these chronic drinkers could appear "sober" to a bartender, a law enforcement officer, or a health care professional. In our experience, it is not a matter of simple observation that one can determine sobriety versus intoxication in all alcohol users.

However, this appearance of sobriety does not translate to safe operation of a motor vehicle or complex equipment. Driving a motor vehicle involves as many as 1500 behavioral actions and interactions including perception, reaction time, sensory and motor coordination, information processing, divided attention, tracking, steering, speed maintenance, and braking [*16–20*]. Low concentrations of plasma alcohol have variable effects on these perfor-

TABLE 3—*Individual data points of PAC versus ASC for the 21 patients.*

PAC	ASC
410	4
250	2
350	3
450	2
280	2
172	3
253	2
340	4
300	1
320	3
239	3
410	2
360	2
224	2
108	1
429	1
200	4
450	6
249	4
240	2
244	2

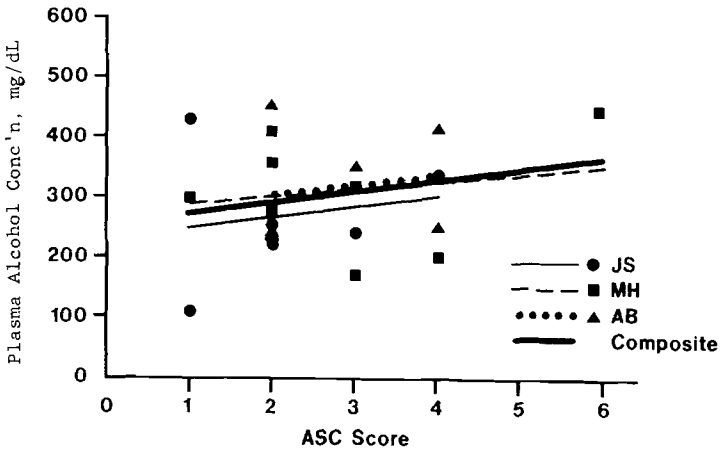

FIG. 1—*Best-fit linear regression analysis of each individual scorer's data.*

TABLE 4—*Linear regression analysis data.*

Data Set		*r*-Squared	*r*	Slope	*Y*-integral
1	6	0.033286	0.182	17.0488	228.561
2	8	0.041209	0.202	12.5333	275.467
3	7	0.039841	0.200	18.7105	262.500
4	21	0.055071	0.235	17.9508	251.938

mance items. Studies of multiple variables involved in maintaining speed, car following, divided attention tasks, steering performance, and braking have been demonstrated to be significantly impaired at PACs well below 100 mg/dL [*18-20*]. As the plasma alcohol concentration rises to 100 mg/dL and above, the relative probability of causing an accident rises geometrically [*21*].

Conclusion

The difficulty of recognizing intoxication using gross observation alone is evident from this investigation and others [*12-15,22*]. At plasma concentrations well in excess of 100 mg/dL, experienced alcohol drinkers may not appear intoxicated to very experienced observers. However, this appearance of sobriety does not translate to safe operation of a motor vehicle or complex machinery, in which cases very low plasma alcohol concentrations produce impaired performance.

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