

Alcohol and Trauma An Endemic Syndrome

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Injuries are a pervasive and costly problem, and alcohol use appears to be an important risk factor for injury. We examined the blood alcohol levels and selected demographic and epidemiologic variables recorded on trauma patients by 1 trauma center for a 28-month period. A total of 2,262 trauma patients were admitted to the trauma center during this period, of whom 75% were male and 72% were injured in vehicle-related incidents. Blood alcohol levels of 2,095 patients (93%) were measured, and alcohol was present in the blood of 855 (41%). Of those patients with a blood alcohol level done, 32% had a level higher than 100 mg per dl. We conclude that the level of alcohol involvement in trauma is high and that this involvement must be addressed by the medical community and the health care system.

(Meyers HB, Zepeda SG, Murdock MA: Alcohol and trauma—An endemic syndrome. *West J Med* 1990 Aug; 153:149-153)

Injuries are a major public health problem. They are the fourth leading cause of death in the United States, the leading cause of death between the ages of 1 and 44, the leading cause of physician contact, and they cost approximately \$100 billion each year.¹ A common factor in many types of injuries is the presence of alcohol in the blood of the injured. A growing body of literature is helping to clarify the role of alcohol consumption in both intentional and unintentional injuries.²⁻⁹ A history of trauma has been suggested as a means of identifying habitual, heavy alcohol use.¹⁰

An assessment of the extent of the alcohol-related injury problem has been limited in previous studies by small numbers of patients,⁵ by the population studied,⁷ by restricting the time of day studied,⁹ by including only one type of injury,^{5,6} and by biased sampling of blood alcohol levels.^{7,11}

Because of these limitations and the potential for geographic variability in alcohol use,¹² we studied the level of alcohol involvement in injuries at one trauma center in our county over a 2½-year period. The objectives included documenting the extent of alcohol involvement in serious injuries and identifying targets and strategies for prevention activities.

Our study was a cooperative effort of the County of Orange Health Care Agency and the University of California, Irvine, Medical Center (UCIMC). Orange County is predominantly urban and suburban, in southern California, and has a population of 2.2 million. The UCIMC operates the designated level I trauma center in Orange County and, as a matter of policy, has measured and recorded blood alcohol levels of nearly all adult trauma-designated patients since 1985.

Patients and Methods

A 500-bed acute care hospital, UCIMC is one of four trauma centers in Orange County. The trauma service maintains a computerized data base on all trauma patients. The Orange County Emergency Medical Service Administration has promulgated countywide trauma center triage guidelines for identifying trauma patients in the prehospital

phase (Figure 1). The trauma designation was based on the mechanism of injury, vital signs, and other clinical findings. The final designation was at the discretion of the base hospital physician, who directed care in the field through radio contact with the paramedics at the scene. Approximately 97% of trauma patients treated at the UCIMC trauma center were designated as such in the field by the base hospital physician. The other 3% were not brought in by paramedics or were reclassified on arrival. Drowning, near drowning, and burns were not included in the definition of trauma.

The computerized files contained data on trauma patients admitted to the UCIMC trauma center from January 1985 through July 1987. The data from three months of 1986—October, November, and December—had not been entered into the computer at the time of this study and are not included. Monthly totals were available for the three-year period from January 1985 through December 1987.

The following variables were tabulated from the data base: total number and median age of trauma patients; total number of trauma patients by month, day of the week, and hour of the day; number of male and female patients; age of trauma patients by five-year categories; type of incident (Table 1); distribution of patients by Injury Severity Score (ISS)¹³; number of patients admitted to the intensive care unit (ICU); and number of deaths. Each variable was cross-tabulated by the following categories of blood alcohol level: number of patients with blood alcohol levels determined, with alcohol in the blood (a "positive" test), and with blood alcohol levels greater than 100 mg per dl. The number of patients with a positive alcohol test, a positive toxicology screen, and both positive blood alcohol and toxicology screen was also tabulated.

The differences in blood alcohol levels between survivors admitted to the ICU and those who lived without being admitted to the ICU were compared with a χ^2 analysis. The χ^2 test was also used to compare the blood alcohol levels of those patients who died and those who survived.

The ISS and total hospital charges of patients with positive and negative blood alcohol tests were compared using the Student's *t* test.

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ABBREVIATIONS USED IN TEXT

ICU = intensive care unit
 ISS = Injury Severity Score
 UCIMC = University of California, Irvine, Medical Center

Results

Data were available for 2,262 trauma patients (Table 2). Of these, 2,095 (93%) had blood alcohol levels determined. A total of 855 patients (41% of those with their blood alcohol levels measured) had a positive blood alcohol test, and 678 of these (32% of those measured, 79% of positives) had blood alcohol values greater than 100 mg per dl. Of all 2,262 patients, 1,706 (75%) were male. Patients from 16 through 30 years of age accounted for 57% of cases, and the median age was 25 (Figure 2). Of the injuries, 72% were vehicle-related.

The final designation of any trauma patient is subject to base station physician interpretation. Variables for consideration include

- Mechanism of injury
- Age
- Prolonged extrication
- Fatalities involved in the event
- Glasgow Coma Score of 10 or less
- Penetrating wounds of the neck, chest, abdomen, or groin
- Major traumatic injuries resulting in cardiopulmonary distress and/or arrest
- Multiple systems trauma patients with Champion trauma score of 12 or less

Figure 1.—The Orange County (California) revised trauma triage guidelines (instituted February 1983) are used by the Emergency Medical Services for the identification of trauma patients before arrival at a hospital.

Data on the ISS were used only after 1985 because of a change in coding practices, leaving a total of 1,450 patients with data on injury severity. The median ISS was 6 with a range from 0 to 75.

Monthly totals of trauma patients were highest in May and August (Figure 3). The wide variation in monthly totals is partially correlated with the number of weekend days and holidays in each month during the three-year period.

Correlates for Measuring Blood Alcohol Levels

The number of incidents was greatest on Saturday and Sunday (Figure 4). Likewise, the number of patients with positive blood alcohol tests was highest on those two days. By the hour of the day, the total number of incidents increased steadily from 6 AM to 6 PM and remained high until 3 AM. The percentage of patients with positive blood alcohol tests peaked between 2 and 4 AM (Figure 5), with the highest number of intoxicated patients (blood alcohol level higher than 100 mg per dl) in the 2 to 3 AM period.

Having a blood alcohol level measured was significantly associated with the male sex (93.6% of men had a blood

TABLE 1.—Type of Incident Classification*

Auto/auto	Moped or bicycle
Auto/object	Fall
Motorcycle crash	Altercation
Auto/pedestrian	Industrial†
Gunshot wound	Others‡
Stabbing	

*Does not include drowning, near drowning, or burns.

†Does not include on-the-job motor vehicle-related injuries.

‡Includes many recreational injuries, injury due to falling objects, and the like.

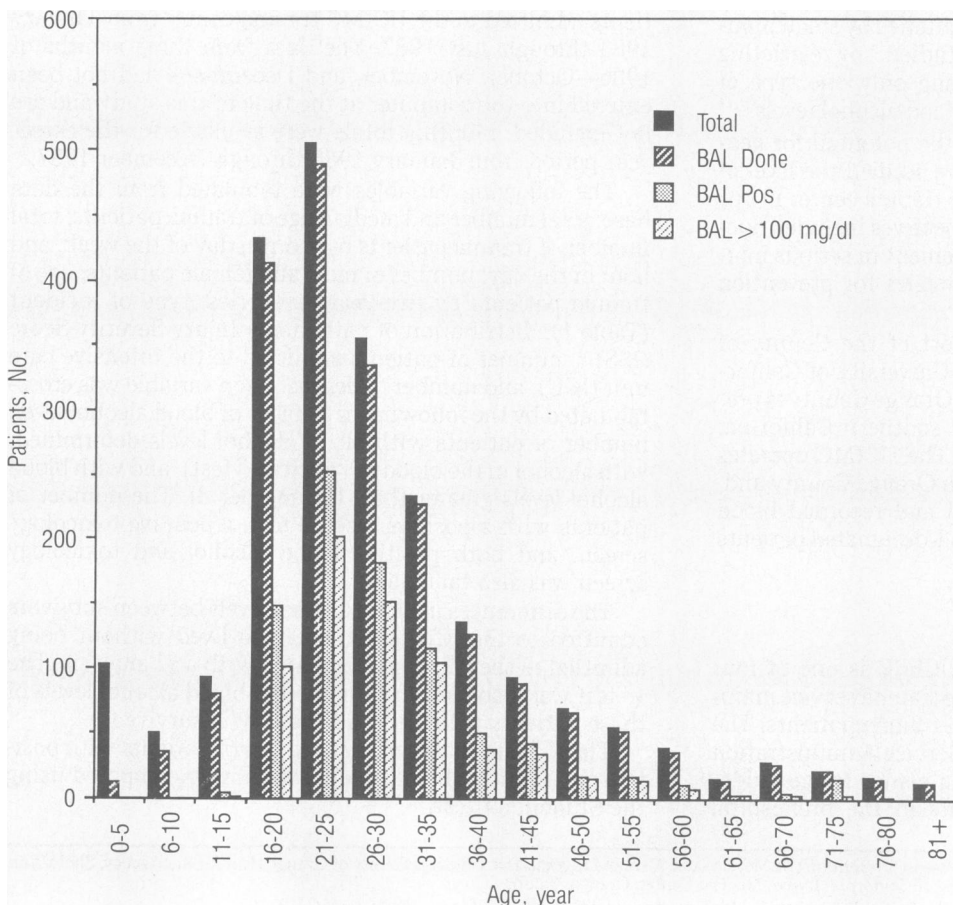


Figure 2.—The bar graph shows age in 5-year increments and blood alcohol levels (BALs) for 2,262 patients. Pos = positive

alcohol level measured versus 89.7% of women, $\chi^2 = 8.87$, $P < .025$) and with an age older than 15 years. Excluding patients 15 years old and younger leaves 2,017 (89%) patients from the original sample; 95.5% of these had a blood alcohol test done, 42.2% of those done were positive, and 33.6% of those levels were higher than 100 mg per dl.

Having a blood alcohol test done also varied by incident type (Figure 6), at least in part because children younger than 15 years old accounted for 36% of pedestrian and 28% of fall injuries. Patients with gunshot wounds may have been less likely to have a blood specimen drawn to test for alcohol because of the severity of injuries.

Although there was no correlation between the blood alcohol level and ISS, a blood alcohol test was not done on more than half (14 of 26) of the patients who were severely injured (ISS of 50 to 75); therefore, further analyses relating

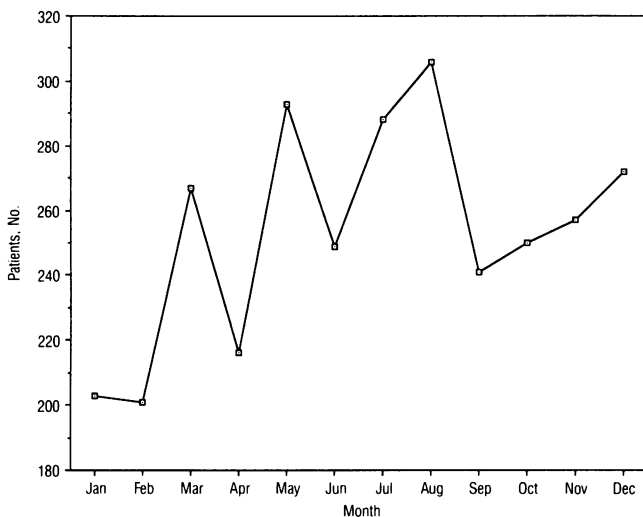


Figure 3.—The chart shows month of injury for 3,043 trauma patients seen at University of California, Irvine, Medical Center trauma center, January 1985 through December 1987.

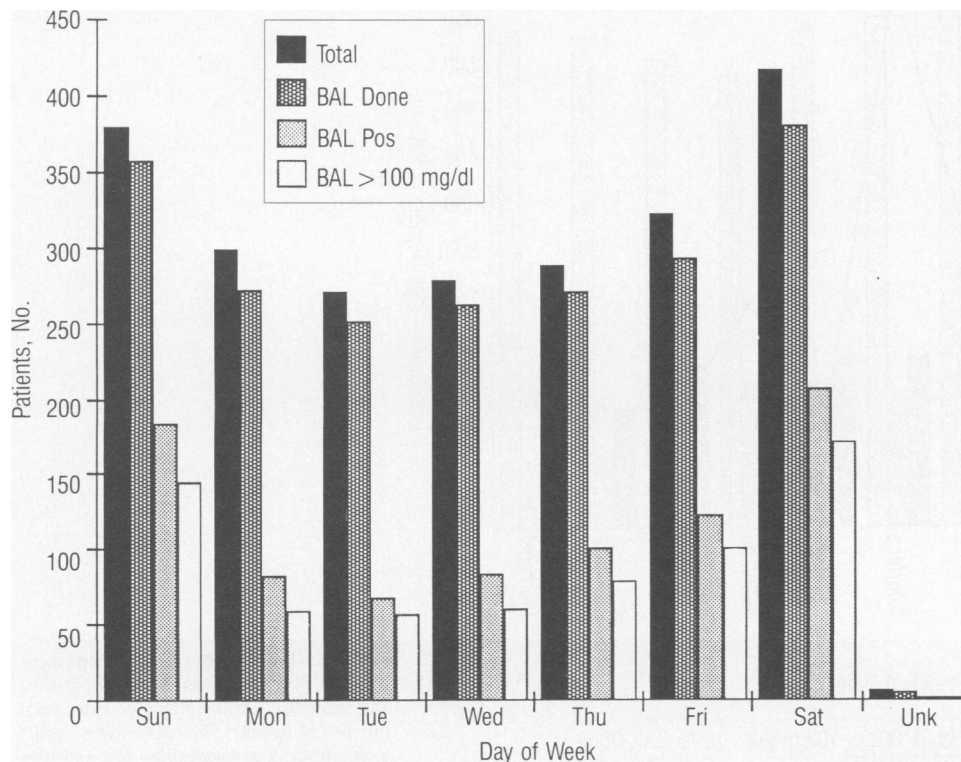


Figure 4.—The bar graph shows the distribution of 2,096 injured patients according to day of the week injury occurred and blood alcohol level (BAL). Pos = positive, Unk = unknown

blood alcohol levels to ISS were not done because of the potential for considerable bias. Blood alcohol levels tended not to be measured in severely injured patients because of difficulty in obtaining a blood specimen, because of attempts to move patients out of the emergency department as quickly as possible, or because the patient was dead or near death on arrival.

Correlates of a Positive Blood Alcohol Test

A positive blood alcohol test was associated with age, especially in the 21 to 35 years age group, and with the male sex (46.6% of all men versus 22.4% of all women).

The proportion of patients with a positive blood alcohol test varied with incident type (Figure 6). The highest percentage of patients with a positive blood alcohol test tended to coincide with violent causes of injury (specifically, stabbing at 49% and altercations at 52%) and single-auto crashes (47%). By contrast, for falls, 30% of patients admitted to the trauma center in whom blood alcohol levels were known were intoxicated. In this sample, none of the patients admitted because of an industrial injury showed evidence of alcohol ingestion; however, vehicular causes of industrial injury were not classified as industrial.

Comments

Despite a 93% rate of obtaining blood alcohol levels in 2,262 trauma-designated patients, our data have some limitations. The failure to measure the blood alcohol levels in more than half of the most severely injured patients invalidates any analysis of the relationship between blood alcohol level and severity of injury. Although there is some bias in doing blood alcohol tests, we think we have identified where bias occurs and the reasons for it.

The data available to us did not permit an assessment of interactions among the variables of age, sex, time of day, and incident type, which might have suggested intervention strategies. No attempt was made to assess the blood alcohol levels of a control, noninjured population, but self-reported intake of alcohol appears to be much lower than

the 41% positivity found in this series.¹⁴ Information on less severely injured patients is lacking. The blood alcohol levels obtained in the trauma center may, to varying degrees, underestimate or overestimate those at the time of

injury because of variations in transport time and the possibility that any given patient's blood alcohol level was rising or falling at the time of injury.

Our finding of a 41% rate of positive blood alcohol tests in trauma patients is similar to that found in several other studies. In fact, this similarity is striking in view of the diversity of samples represented—a US Army hospital in Stuttgart,⁷ a teaching hospital in Edinburgh,⁹ and patients with mild head injuries in a hospital in Belfast⁵ all reported similar rates of blood alcohol positivity. Two other studies reported lower (36%)¹¹ and higher (59%)⁸ levels of positivity.

The predominance of men in our series of patients may reflect risk-taking behavior, a greater frequency of alcohol use, a heavier use of alcohol, or, for certain types of trauma, greater risk exposure. Most likely a combination of these factors is involved.

Alcohol use has a pervasive presence in our emergency departments. We think it is important to measure the blood alcohol level in injured patients for several reasons. First, a falsely negative assessment of alcohol use occurs. One study found a false-negative rate of 23% in the clinical assessment of alcohol use in trauma patients (12.5% false-negative rate for patients with a blood alcohol level of greater than 100 mg per dl).⁵ Second, a knowledge of the blood alcohol level is important in the diagnosis and treatment of injured patients (because of the possible interaction of alcohol with anesthetic agents, alcohol can both cause an altered state of consciousness and affect the clinical course of a patient with an altered state of consciousness due to other causes) and as a portent of possible withdrawal symptoms in the early treatment period. Finally—and perhaps most important—trauma associated with documented alcohol ingestion signals either a serious alcohol problem or poor judgment in its use.

Clinicians have frequently avoided confronting their patients about habits detrimental to their patients' health, either because the situation is uncomfortable or because of

TABLE 2.—Blood Alcohol Data, Male Sex, and Vehicle-Related Injury Data for 2,262 Trauma Patients

Variable	Patients	
	No.	%
BAL measured	2,095	93
BAL positive	855	41
BAL greater than 100 mg/dl	678	32
Male	1,706	75
Vehicle-related injury	1,624	72

BAL = blood alcohol level

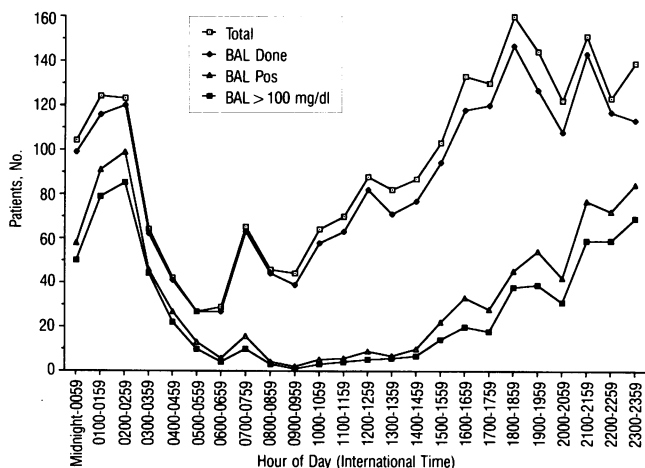


Figure 5.—Hour of day (in international time) and blood alcohol level (BAL) are shown for 2,096 trauma patients seen at University of California, Irvine, Medical Center, January 1985 through July 1987. Pos = positive

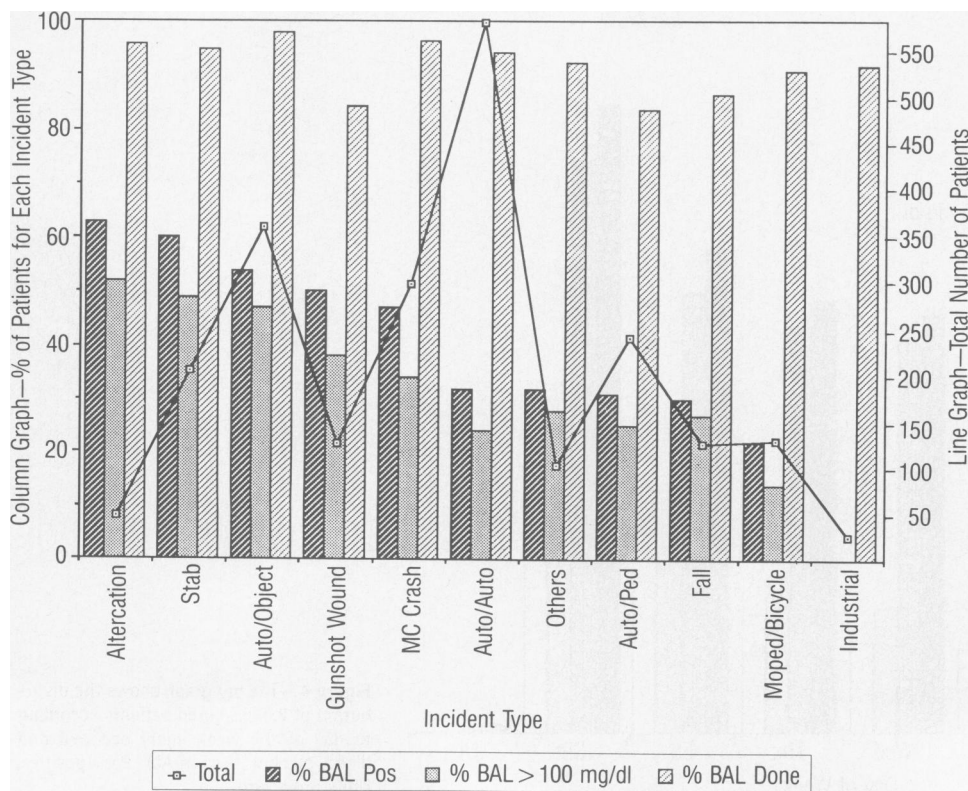


Figure 6.—The incident type and blood alcohol level (BAL) are given for 2,259 patients. The superimposed line graph indicates total number of patients for each incident. MC = motorcycle, Ped = pedestrian, Pos = positive

a perceived lack of confidence in their ability to change deleterious behavior. A survey of trauma centers in 1985 may have reflected this avoidance.¹⁵ In addition, there are concerns about liability and third-party payment when alcohol use is documented; these have not been borne out in the experience of UCIMC.

Changing behavior is notoriously difficult. We cannot predict what experience or thought causes someone to quit smoking, to diet successfully, or to stop drinking alcohol excessively. The aftermath of a serious traumatic injury may prove to be that moment when we have a chance to link a patient's alcohol use with his or her injuries and to trigger a change in behavior. The emergency department is a crucial place for detecting the problem, but detection without a system of appropriate referral and follow-up accomplishes little. At UCIMC, a process for the referral of injured patients with positive blood alcohol tests is being developed.

It is the responsibility of the health care system to treat known risk factors, just as we would treat an elevated cholesterol level. The alcohol-trauma syndrome is an endemic problem with tragic and costly consequences. It should not be overlooked or neglected any longer.

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