

ORIGINAL ARTICLE

Alcohol related falls: an interesting pattern of injuries

J J E Johnston, S J McGovern

Emerg Med J 2004;21:185–188. doi: 10.1136/emj.2003.006130

See end of article for authors' affiliations

Correspondence to:
Mr J E Johnston, Accident and Emergency Department, Newcastle General Hospital, Westgate Road, Newcastle upon Tyne NE4 6BE, UK; jeremyjohnston@doctors.org.uk

Accepted for publication
26 July 2003

Objective: To discover if there is a significant difference in the pattern and severity of injury sustained during falls in patients who have consumed alcohol and those who have not. To determine how pattern and severity of injury correlates with blood alcohol concentration.

Method: A prospective quasi-randomised controlled study between November 2001 and July 2002. All healthy adults between 16 and 60 years who had fallen from standing height were included. A systematic history and examination permitted calculation of injury severity scores as per abbreviated injury scale update 1998. Blood alcohol concentrations were obtained from intoxicated patients with consent.

Results: 351 healthy adult patients were included in the study, there were 238 in the no alcohol group, 113 had consumed alcohol and blood alcohol intake were obtained for 47. The alcohol group had a higher incidence of head injuries (46 (48%) versus 22 (9%)) with a lower incidence of limb injuries (39 (39%) versus 183 (76%)) than the no alcohol group. There was a significant difference in the pattern of injury between the alcohol and no alcohol groups (χ^2 , $p < 0.001$) and there was a significant difference in the injury severity scores ($p < 0.001$, $Z = -2.5$). In the alcohol group severity and pattern correlated with alcohol concentration at the time of injury. Patients with an alcohol concentration < 2 g/l had mostly soft tissue limb injuries (58%), 2–2.5 mostly significant limb fractures (55%), and > 2.5 mostly significant head injuries (90%).

Conclusions: Alcohol related falls are more often associated with severe craniofacial injury. The severity of both limb and head injury is greater and correlates directly with blood alcohol concentration.

Alcohol is the cause of many accidental falls presenting to the emergency department. There has been little research on this group, which represent a substantial proportion of the total attendance. Review of the literature demonstrated a Finnish study by Honkanen¹ and an American study by Hingson² investigating alcohol related falls although there has been more research on the effect of alcohol on general brain injury.

This study compares the pattern and severity of injury in those that have taken alcohol with those who have not. The study compares pattern and severity of injury with blood alcohol concentration within the alcohol group.

METHOD

This study was designed to provide prospective data on falls in a healthy adult population presenting to The Ulster Hospital, a large district general hospital in Dundonald, Northern Ireland, with a total catchment population of 300 000, about 65 000 new attendances per annum in a mixed urban/rural environment.

The study period was for eight months from the 1 November 2001 to 30 June 2002. During this period all patients attending the department between the ages of 16 and 60 years with falls, simple slips or trips were identified at triage when JJEJ was on duty. Only patients who had fallen from a standing position to the ground were included in the study. Patients falling from a height, being pushed, not actually making contact with the ground with a body part higher than the ankle, and falls from horses, motorbikes, bicycles, sports, etc, were excluded from the study. All the patients were assessed by the same doctor (JJEJ), whose history and examination was standardised, to avoid intra-observer error.

Special regard was given to several details in the history, which included the following points.

- Exact mechanism of injury
- Exact time of the incident
- Alcohol consumption amount and time
- Degree of intoxication
- Details of all injuries

Special regard in the examination was given to Glasgow coma scale, a precise anatomical description of injuries, results of investigations and treatment were recorded. The purpose of the study was explained and consent obtained from patients who appeared on examination to have ingested alcohol recently and a blood alcohol concentration was obtained if they were agreeable. The blood alcohol concentration at the time of injury was estimated using the time of injury, the time the blood sample was taken, and the blood alcohol concentration; 1.8 mg/l was added for each hour from the time of injury to the time the sample was taken.

Injury severity score (ISS) was calculated using the abbreviated injury scale 1998 update booklet.³ The injuries for each patient were coded individually; abbreviated injury scales were obtained and used to calculate the injury severity score.

The χ^2 test was used to compare the distribution of injury in the alcohol and no alcohol groups, the Mann-Whitney U test was used to compare the ISS, with a p value of < 0.05 considered to be significant.

RESULTS

During the study period 113 patients who had fallen had consumed alcohol (A), there were 238 patients in the no alcohol (NA) group.

In the (A) group head injuries were the commonest injuries, there were 46 (48%) patients of whom 33 (72%) had wounds, which required sutures or staples and one required internal fixation for a displaced maxillary fracture. The most

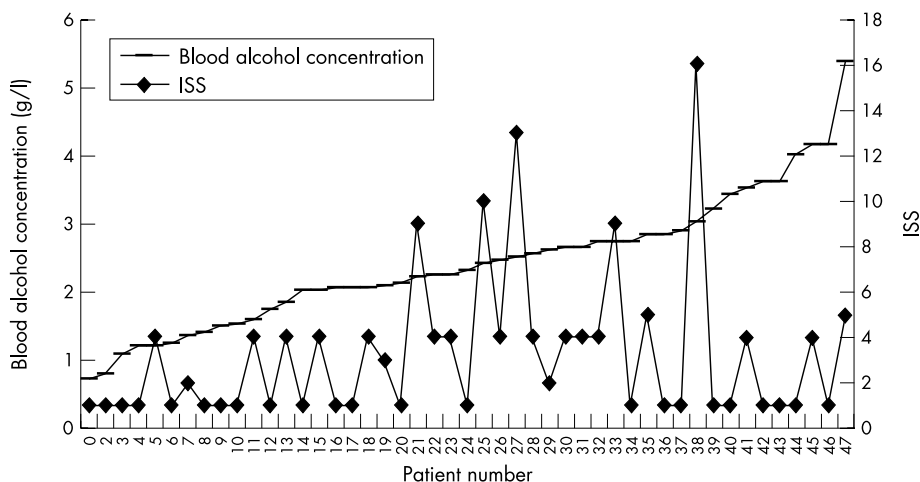


Figure 1 Correlation of blood alcohol concentration and injury severity score (ISS).

severe trunk and limb injuries were also in this group with 11 (10%) of these patients requiring internal fixation for their injuries. The group included a patient with both a dislocated elbow with a comminuted radial fracture, a radial head fracture, a thoracic vertebral crush fracture, three patients with significantly displaced radial fractures, four patients with severely displaced ankle fractures, and two with displaced/comminuted finger fractures. In this group many of the patients came to the department the next day after having recovered from the effects of the alcohol. Four patients refused to give consent to phlebotomy because of needle phobia but we were able to record blood alcohol concentration for 47 patients who had evidence of recent alcohol consumption at the time of assessment.

There was a significant difference between the ISS of the (A) and (NA) groups with $p < 0.001$ and Z score -2.5 .

Figures 1 and 2 and tables 1 and 2 show:

- < 2 g/l injury pattern is mostly soft tissue limb injury.
- 2–2.5 mostly severe limb fractures requiring admission with internal fixation with an increasing number of more severe head injuries.
- > 2.5 g/l mostly severe head injuries.

Alcohol diffusely depresses central nervous system activity, effect varies from person to person depending on metabolism but a useful guide to levels is given below.

- 300 mg/l impaired motor skills
- 800 mg/l legal limit for driving
- 1.5 g/l gross motor impairment
- 2 g/l amnesia
- 2 g/l coma

In the (NA) group the pattern of injuries was different with a total of 23 patients with head injury of which only eight had wounds, which required sutures or staples. The commonest injuries in this group were ankle/foot sprains 67, soft tissue wrist sprains 34, soft tissue knee injuries 29, musculoskeletal back injury 19, and musculoskeletal chest wall injuries 19. There were only 13 patients in this group who had sustained fractures or dislocations. The fractures were comparatively simple only two required internal fixations. The most common mechanism of injury was a slip on stairs or steps, accounting for 59 falls in the (NA) group and 18 falls in the (A) group.

DISCUSSION

This study shows different pattern and severity of injury in alcohol related falls. In alcohol related falls there was a

greater incidence of craniofacial injury and a greater severity of injury. These differences can be accounted for by the inhibition of protective reflexes. In the intoxicated patient, the inability to put the outstretched hand to break the fall resulted in a lower incidence of limb injury and a greater force being transmitted to the head when it strikes the ground.

All the patients were seen by the same doctor to ensure assessments would be systematic and comparable although this has limited the size of the study. Patients were only recruited to the study when this doctor was on duty, the sample would have been larger if several doctors had been involved in the assessments. The sample was quasi-random as the assessing doctor was working shifts on a rolling rota. In this department nurse practitioners working mostly on daytime shifts see many patients with simple limb injuries as a result of falls so these are likely to be under-represented. The study depended on the diligence of the triage nurse to identify and direct the appropriate patients. The average person metabolises alcohol at a rate of 180 mg/l/h so 180 mg was added to the alcohol level for every hour of presentation after the fall.⁴⁻⁶ This is an estimate, as metabolism will vary within the population. We used serum alcohol concentrations to avoid sampling error but near patient testing with breath alcohol concentration may be easier and quicker with reliable results.

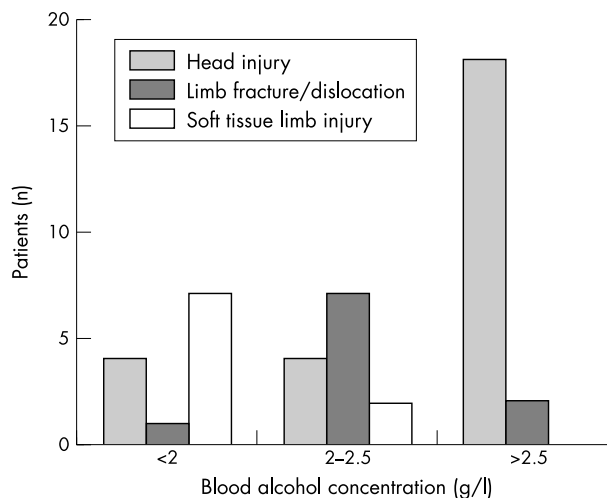


Figure 2 Injury type and blood alcohol concentration.

Table 1 Correlation of blood alcohol concentration (g/l) and pattern of injury

Alcohol concentration (mg/l)	<2	2-2.5	>2.5
Head injury (HI)	4 (30%)	4 (29%)	18 (90%)
HI with stitches/staples	2 (50%)	3 (75%)	18 (100%)
Average no stitches/staples	3.5	10.3	8.4
Limb fracture/dislocation (LF/D)	1 (8%)	7 (50%)	2 (10%)
LF fractures requiring open reduction with internal fixation	0	5 (36%)	1 (50%)
Soft tissue limb injury	7 (54%)	2 (14%)	0
Total number of patients	13	14	20

Injuries were not coded unless the appropriate information was available in the notes. The injury severity scores tended to underscore head injuries. Abbreviated injury scale guidelines state that there must be a clear history of loss of consciousness with evidence that it is directly attributable to brain injury rather than toxins, for example, alcohol. Our study emphasises that the injury is greater because of greater force involved as quantified by physical examination and radiological examination of injuries.

There has been research on the effect of alcohol on brain injury. Tate *et al* demonstrated that blood alcohol concentration was predictive of poorer function with reduced verbal memory over time and poorer visual and spatial functioning.⁷ Bombardier *et al* also showed neuropsychological impairments for up to one to two months after the traumatic brain injury, which directly correlated with blood alcohol concentration.⁸

Several animal studies have attempted to show that alcohol has long term neural protective or adverse effect for any given force applied to the brain. Studies by Kelly *et al*⁹ and Janis *et al*¹⁰ both on rats concluded that low to moderate alcohol levels at the time of injury provides a neural protective effect.

Kelly *et al* demonstrated that this effect was lost at high blood alcohol concentration, this may have been attributable to cardiovascular or respiratory depression. Janis *et al* demonstrated less cerebral damage in the intoxicated group.¹⁰

Other animal studies by Biro *et al* demonstrated no neural protective effect.¹¹ A study by Zink *et al* demonstrated an adverse effect on both traumatic brain injury and haemorrhagic shock, cerebral tissue perfusion was shown to be worsened.¹²

Cooke *et al* used clinical parameters and neurological scores at presentation and at one hour in a group of intoxicated patients but were unable to predict which had intracranial injuries as evidenced by computed tomography.¹³

The literature is inconclusive on the neural protective or adverse effect of alcohol on the brain function and further research is required. Further research to find a correlation of blood alcohol with mechanism of injury as a predictor of intracranial injury, using magnetic resonance or computed tomography would be worthwhile. The intoxicated head injured patient has been classified at moderate risk of

intracranial injury in current guidelines that indicate skull radiological investigation. As with all head injuries there has been a change of emphasis to investigate the underlying brain injury rather than the bony injury and the trend in United Kingdom with an increasing use of computed tomography rather than skull radiography is reflected in the new NICE guidelines.

In guidelines published last year by Servadei *et al*, the Neurotraumatology Committee of The World Federation of Neurosurgical Societies added patients with drug or alcohol consumption to the high risk group, independent of the clinical presentation and recommended computed tomographic investigation.

A Finnish study by Honkanen *et al* studying impact of alcohol intoxication in non-fatal trauma showed positive correlation between the severity of injury with the alcohol intoxication for car occupants and those injured in falls from stairs, but negatively in unspecific falls or falls at the same level.¹⁵ An earlier study by Honkanen¹ studying a similar age group had shown that alcohol had been involved in 37% of accidents, falling was the commonest cause in this group. Some 47% in this group had head injuries, only 25% upper extremity injuries, tibia and ankle fractures were often associated with alcohol intake. Studies have shown that at blood alcohol concentrations over 1 g/l results in a significant swaying, decreased attention, visual acuity, and adaptation to brightness and glare.²

The commonest mechanism of injury was the simple slip or trip on stairs and steps. It has been shown that more than 10% of the 4000 deaths in the UK from home accidents resulted from falls on stairs.¹⁶ This could be reduced by addition of handrails to the side of the stairs. Of the national UK estimate (1999) of approximately 394 713 falls attending the emergency department in the 15-64 years age groups about 8% are attributable to stairs.

Emergency medicine physicians should be careful in the assessment of the intoxicated head injured patient. Subsequent injury is likely to be much greater than expected for a given mechanism and correlates with blood alcohol concentration; this is especially important as intoxicated head injured patients who are very difficult to assess. Guidelines both of investigation and subsequent management are changing, with more respect being given to this. Our study demonstrates that a blood alcohol of greater than 250 mg/% at the time of injury indicates a high force impact.

Authors' affiliations

J J E Johnston, S J McGovern, Accident and Emergency Department, The Ulster Hospital Dundonald, Northern Ireland

REFERENCES

- Honkanen R, Visuri T. Blood alcohol levels in a series of injured patients with special reference to accident and type of injury. *Ann Chir Gynaecol* 1976;65:287-94.
- Hingston R, Howland J. Alcohol and non-traffic unintended injuries. *Addiction* 1993;88:877-83.

Table 2 Pattern of injuries (number of injuries and as a percentage of total)

	(A) Alcohol group	(NA) No alcohol group
Head	46 (48)	22 (9)
Truncal	13 (13)	35 (15)
Upper limb	19 (19)	82 (34)
Lower limb	20 (20)	101 (42)

There was a highly significant difference ($\chi^2 = 100$ at 3 df) in the pattern of injury with a $p < 0.001$.

- 3 **Association for the Advancement of Automotive Medicine.** *The abbreviated injury scale 1990 revision, update 98.* Des Plaines, IL: Association for the Advancement of Automotive Medicine, 1990.
- 4 **Knight B.** *Forensic pathology.* 2nd edn. London: Arnold, 1996:544–5.
- 5 **Holdford N.** Clinical pharmacokinetics of ethanol. *Clin Pharmacokin* 1987;**13**:273–92.
- 6 **Kleeman WJ, Siebert M, Tempka A, et al.** Arterial and venous alcohol elimination in 10 polytrauma patients. *Blutaalkohol* 1995;**32**:162–73.
- 7 **Tate PS, Freed DM, Bombardier CH, et al.** Traumatic brain injury: influence of blood alcohol on patients' acute cognitive function. *Brain Inj* 1999;**13**:767–84.
- 8 **Bombardier CH, Thurber CA.** Blood alcohol level and early cognitive status after traumatic brain injury. *Brain Inj* 1998;**12**:725–34.
- 9 **Kelly DF, Lee SM, Pinanong PA, et al.** Paradoxical effects of acute ethanolism in experimental brain injury. *J Neurosurg* 1997;**86**:876–82.
- 10 **Janis LS, Hoane MR, Conde D, et al.** Acute ethanol administration reduces the cognitive deficits associated with traumatic brain injury in rats. *J Neurotrauma* 1998;**15**:105–15.
- 11 **Biros MH, Kukielka D, Sutton RL, et al.** The effects of acute and chronic alcohol ingestion on outcome following multiple episodes of mild traumatic brain injury in rats. *Acad Emerg Med* 1999;**6**:1088–97.
- 12 **Zink BJ, Stern SA, Wang X, et al.** Effects of ethanol in an experimental model of combined traumatic brain injury and haemorrhagic shock. *Acad Emerg Med* 1998;**5**:9–17.
- 13 **Cooke LS, Levitt MA, Simon B, et al.** Identification of ethanol-intoxicated patients with minor trauma requiring computed tomography scans. *Acad Emerg Med* 1994;**1**:227–34.
- 14 **Servadei F, Teasdale G, Merry G, et al.** Defining acute mild head injury in adults: a proposal based on prognostic factors, diagnosis, and management. *J Neurotrauma* 2001;**18**:657–64.
- 15 **Honkanen R, Smith GS.** Impact of acute alcohol intoxication on the severity of injury: cause-specific analysis of non-fatal trauma. *Injury* 1990;**21**:353–7.
- 16 **Roys MS.** Serious stair injuries can be prevented by improved stair design. *Applied Ergonomics* 2001;**32**:135–9.