

Lack of Effect of Intravenous Hypertonic Glucose on the Intensity of Alcohol Intoxication Induced Experimentally and Observed in Patients of an Emergency Room¹

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Abstract. In the present paper, two experiments are performed to test the efficacy of the intravenous administration of hypertonic glucose (25 or 50%) in alcoholic intoxication. In a first experiment, 10 healthy, nonstarved volunteers, received 15 min after the ingestion of 1.0 g/kg alcohol, 40 ml of 25% glucose i.v., the same volume of 0.9% NaCl or no injection. According to evaluations performed at several time intervals up to 2 h after alcohol ingestion, no difference among the 3 conditions was observed either in the intensity of alcohol intoxication or on blood alcohol levels. In a second experiment, blood glucose and alcohol levels were evaluated in 80 alcoholized patients in an emergency room. The mean glycemic value was 94 mg/100 ml. No difference was found by comparing this value with that presented by nonalcoholized patients. The 80 patients were distributed in two groups of 40 each: one of them was intravenously administered 40 ml of glucose 50% while the other was injected with saline. About 20-30 min later the patients of both groups were clinically evaluated by the physician on duty, being considered equally improved regardless of the injection. The self-evaluation by the patients provided similar results.

The description of several cases of ethanol-induced hypoglycemia can be found in the literature [1, 6, 9, 12]. Hyperglycemia is

also described, suggesting that the influence of alcohol on blood glucose levels is dependent on the nutritional state [2, 7, 16-19]. Hypoglycemia is generally attributed to the ethanol-induced inhibition of gluconeogenesis which is an important source of glucose in starved organisms [10, 23]. As a consequence the administration of fructose or glucose in acute alcohol intoxication has been proposed, a procedure which was also thought to

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accelerate the metabolism of ethanol [5, 14, 20, 22, 25]. In respect to this last assumption, the studies with glucose provided mainly negative results [20, 26], while conflicting data can be found in relation to fructose [5, 15, 20].

Usually, sugars are either administered orally or intravenously by infusion of 5–10% solutions [3, 5, 14, 15, 20]. Alternatively, there is the possibility of injecting intravenous hypertonic solutions in order to promptly reach a high glycemic peak. This procedure is favored in several Latin-American countries, e.g. Brazil, where as routine, 20–40 ml of a 25 or 50% solution of glucose is intravenously administered in states of alcoholic intoxication [4, 8, 11, 18]. However, there is a lack of information regarding the efficacy of such procedures, mainly when double-blind studies are considered. Therefore, the present experiment provides data on this subject.

Study Groups

Volunteers

10 healthy male medical students, aged 20–25 and weighing between 64 and 84 kg, participated in the experiment. They were occasional drinkers (no abstainers or heavy drinkers), with similar patterns of alcohol habits.

In a preliminary phase, the subjects received, 1 week apart, different doses of ethanol in a randomized order in such a way that every subject received all doses. The purpose was to observe whether the scale used for assessing alcohol intoxication would be sensitive enough to allow, in a second phase, to detect the eventual effects of glucose. Alcohol was administered as vodka (42% v/v) mixed in a soft drink, in doses of 0.2, 0.4, 0.8 and 1.0 g/kg, 250 ml always being the final volume. The subjects ingested the beverage within 10 min at a constant speed. The experimental sessions began at 2 p.m. when smoking, food and water ingestion were not allowed. The subjects were

instructed to have a light breakfast in the morning and a standard lunch 2 h before the beginning of the session. They were asked not to consume alcoholic beverages or other drugs 24 h before the experimental days.

The subjects were asked to rate symptoms which are related to feeling intoxicated through periodical interviews at 15, 30, 60, 90 and 120 min after alcohol ingestion, rating themselves from 0 to 2 points in relation to the following symptoms: dizziness, restlessness, elation, floatation, visual, speech and hearing alterations, drowsiness, motor incoordination, nausea, general malaise. The maximum number of points that a volunteer could score was, therefore, 22 points. Evaluations were performed through a double-blind procedure, as both the interviewer and the subject were not aware of the concentration of alcohol ingested.

In the second phase of the experiment, the subjects received 1.0 g/kg ethanol in two sessions, 1 week apart. The same procedure as described above was followed with the difference that in this phase, following the 15-min interview, either a 40-ml 25% glucose or a 0.9% NaCl solution of equal volume was intravenously administered according to a cross-over, randomized double-blind design. In this phase, at the beginning of each interview, the blood alcohol level (BAL) was obtained through a pocket-size breathalyzer [13].

Results

Table I shows the intensity of alcohol intoxication following the different doses of ethanol. The data were statistically analyzed through the Kruskal-Wallis analysis of variance, followed by the Mann-Whitney U test. The dose of 0.4 g/kg differed from 0.2 g/kg at the times 15, 30 and 60 min ($p < 0.05$); 0.8 g/kg differed from 0.2 and 0.4 g/kg in all time intervals ($p < 0.02$), while 1.0 g/kg differed from 0.2 g/kg at all time intervals and from 0.4 from time 60 min on. No difference was found between 0.8 and 1.0 g/kg.

Table II compares the intensity of the intoxication when no injection, placebo or glucose were administered. No significant difference was observed (Kruskal-Wallis analysis

Table I. Self-rating of alcohol intoxication (median scores) after different doses of alcohol

Dose g/kg	Scores of intoxication at several time intervals after alcohol ingestion, min				
	15	30	60	90	120
0.2	1.0	2.0	1.0	0.0	0.0
0.4	5.5 ¹	4.5 ¹	2.5 ¹	0.0	0.0
0.8	7.5 ^{1,2}	8.0 ^{1,2}	7.5 ^{1,2}	6.5 ^{1,2}	4.0 ^{1,2}
1.0	7.0 ¹	7.0 ¹	7.5 ^{1,2}	7.0 ^{1,2}	7.0 ^{1,2}

¹ Significantly different from 0.2 g/kg.

² Significantly different from 0.4 g/kg (Kruskal-Wallis analysis of variance followed by the Mann-Whitney U test).

Table II. Self-rating of alcohol intoxication (median scores) after intravenous administration of 40 ml of 25% glucose or placebo 15 min after the ingestion of 1.0 g/kg ethanol

Injection administered	Scores of intoxication at several time intervals after alcohol ingestion, min				
	15	30	60	90	120
- ¹	7.0	7.0	7.5	7.0	7.0
Placebo	5.5	5.0	5.0	6.0	4.5
Glucose	4.5	5.5	6.0	7.5	6.5

¹ The values when no injection was administered are the same as those indicated in table I. The injections were administered immediately after the 15-min interview. No significant differences were detected among the groups (Kruskal-Wallis analysis of variance).

of variance), that is, the administration of either glucose or placebo did not alter the intensity of the alcohol intoxication.

Concerning BAL, no difference was found comparing the glucose with the placebo

group (Student's t test), being the maximal blood concentration reached at the 60-min interval, with values of 108 and 104 mg/100 ml, respectively.

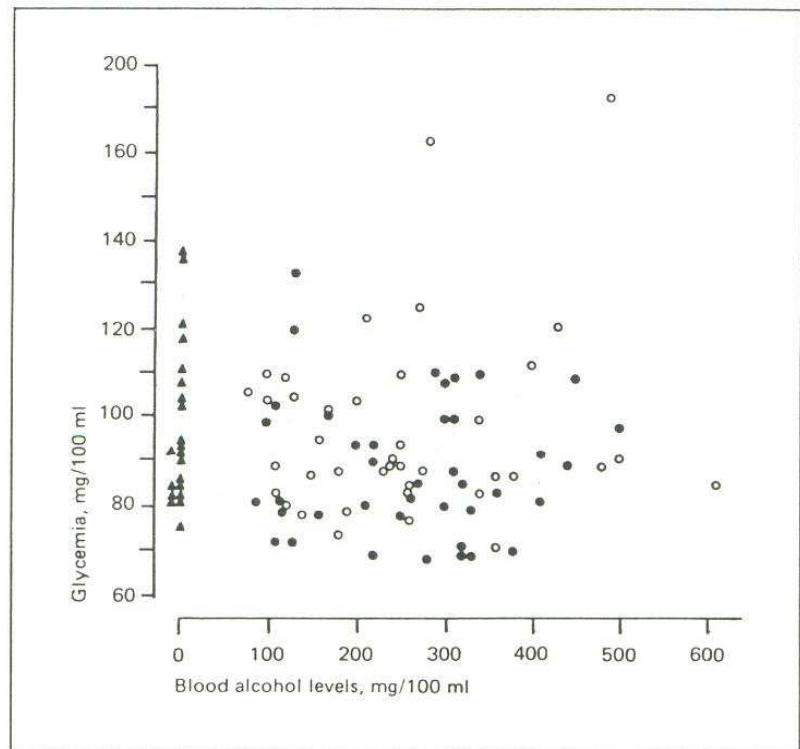
Patients in an Emergency Room

The study group consisted of 80 subjects which were brought to a public emergency room for treatment of acute alcohol intoxication. Half of the patients were randomly assigned either to glucose or to placebo administration. Both groups did not differ in relation to age, sex and ethnicity, each consisting of 34 men and 6 women, with a median age of 30 and 29 years for the glucose and placebo groups, respectively.

Routinely, in the emergency room where the study was performed, all alcohol intoxicated patients receive an intravenous injection of 40 ml of a 50% glucose solution. The experiment was designed in such a way that the staff (physicians and nurses) was informed that the patients would receive either glucose or placebo (0.9% NaCl), as determined by one of the two investigators present in the emergency room. This determination was based on a random design, with the exception of possible cases in which glycemia would be below 70 mg/100 ml, when glucose should be administered. This occurred with only 1 patient who had 69 mg/100 ml.

The clinical condition of the patients was initially assessed by the physician on duty, according to the routine, which did not include standardized physical or neurological examinations. This was followed by glucose and alcohol blood level determinations performed by one of the investigators. Glycemia was determined through the glucose oxidase reaction using a Dextrometer reflectance colorimeter, a digital version of the Dextrostix-Eyetone system [21] while alcoholemia was estimated through the same breathalyzer described above. For unconscious patients, nose tubes were employed. The same investigator provided the staff with ampoules of glucose or placebo indistinguishable in appearance. Approximately 20–30 min after the injection the same physician who provided the initial clinical impression stated whether, according to his opinion, the condition of the patient could be considered unaltered, improved or much improved. When the patient condition allowed, he was asked by the second investigator, who was also unaware of the solution administered if he considered his condition as unaltered, improved or much improved.

Fig. 1. Individual glycemie BAL values of patients at the entrance of the emergency room before receiving either intravenous hypertonic glucose (●) or saline (○). The blood glucose levels of 21 nonalcoholized patients are also represented (▲).



Immediately after, a second determination of glycemia and alcoholemia was performed. As a control group for the initial blood glucose levels, 21 nonalcoholized patients (alcoholemia zero), brought to the emergency room with minor physical complaints had their glycemia determined.

Results

The individual initial values of blood glucose and BAL are represented in figure 1. No correlation was found between blood glucose and alcohol levels ($r = 0.01$; Pearson correlation coefficient). The initial glycemia of the patients assigned to the placebo and glucose groups was 99 ± 23 and 90 ± 16 mg/100 ml (mean \pm SD), respectively, while the value of the nonalcoholized control group was 99 ± 19 mg/100 ml. An analysis of variance performed among the 3 groups showed no statistical difference ($F_{2,98} = 2.54$). The glucose and placebo groups also showed similar ini-

tial levels of alcoholemia, the values being 263 ± 108 and 256 ± 128 mg/100 ml (mean \pm SD), respectively.

The intravenous injection of glucose induced a significant increase in the glycemia levels, which reached 184 ± 42 mg/100 ml, when compared to the placebo group, whose value at the second assessment was 96 ± 20 mg/100 ml ($p < 0.001$; Student's *t* test). At the second breathalyzer assessment the alcoholemia values of the glucose and placebo groups were 218 ± 95 and 216 ± 116 mg/100 ml, respectively. Again, no statistical difference was observed.

The medical and patient evaluations after glucose or placebo injections are shown in figure 2. As can be seen, the great majority of the patients was considered as improved by both the medical and the self-evaluations. Only a small proportion of the patients was

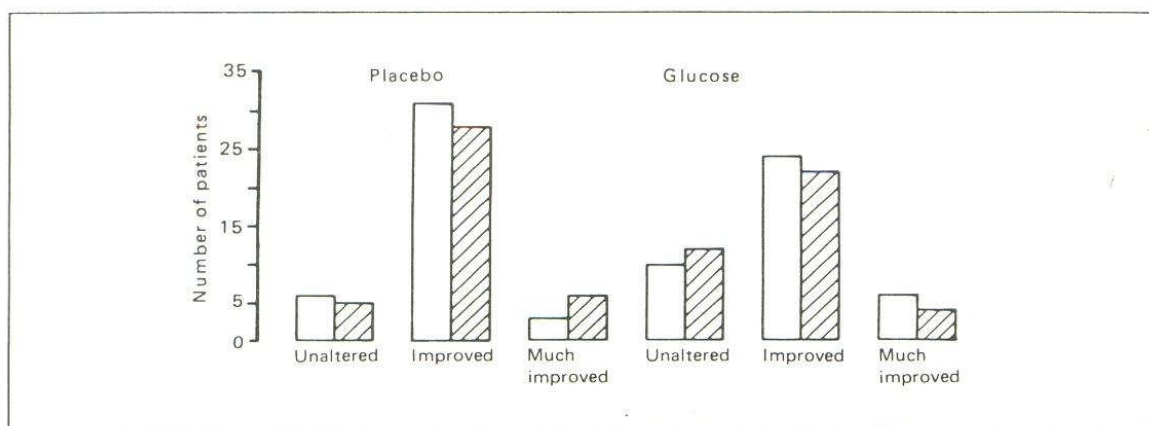


Fig. 2. Medical (open columns) and self-evaluation (hatched columns) on the improvement of the alcohol intoxication state, after intravenous administration of hypertonic glucose or saline.

considered by themselves or by the physician as either unaltered or much improved. No difference in the improvement assessment could be detected between the glucose and placebo groups (Chi square test).

4 of the 80 patients studied were brought in an unconscious state, that is, they were unable to walk and to answer questions. Their initial glycemia varied from 82 to 96 mg/100 ml, while their breathalyzer values varied from 120 to 220 mg/100 ml. These relatively low alcoholemia levels could be a consequence of the lack of precision of the nose tubes that had to be employed. Glucose was administered to 3 of them; 2 were medically evaluated as unaltered, while the third was considered as improved. The fourth patient, who received placebo, was considered as improved by the medical evaluation.

Discussion

A question which deserves initial discussion is related to the methodology employed to evaluate blood glucose and alcoholemia as

its precision could be questioned. In relation to the Dextrostix-Dextrometer method, *Preece and Newall* [21], comparing it with the orthotoluidine method, found a high correlation. Concerning the breathalyzer, previous reports show a good correlation with an automated enzymatic (alcohol dehydrogenase) microdistillation technique [13]. *Tennant* [24], comparing the results between breath and blood alcohol determinations in 18 patients, observed a considerable variation between both measures in only 2 cases. Thus, the data in the literature consider adequate the use of the breathalyzer. However, it is possible that some of our measures lack precision, as for instance the values of 600 mg/100 ml detected in 1 conscious patient. Conversely, the low values observed in the unconscious patients could be due to an error induced by the nose tubes employed.

The data obtained in the experiment with volunteers shows that the intravenous administration of glucose did not alter the experimentally induced alcohol intoxication, as the volunteers when receiving it did not differ from when receiving either placebo or no

injection. The negative results found could be due to several factors, one of them being the seemingly low level of intoxication reached with 1.0 g/kg ethanol, insufficient to evidence an improvement by glucose. Another factor could be related to the small time interval between the ingestion of alcohol and the glucose administration (15 min). Most probably, this interval is longer in the emergency room. Also, it has to be considered that the volunteers were not fasted, as commonly occurs in alcoholized patients. However, against the above considerations is the fact that in the experiment performed in the emergency room the same negative results were obtained, that is, no difference in the intensity of alcohol intoxication was detected in the patients after they received either placebo or glucose.

Ylikahri et al. [26] in a study with volunteers reported that the oral administration of glucose had no significant effect either on the rate of ethanol elimination or on the intensity of alcohol intoxication. In the present report it is shown that the same negative effects are seen when hypertonic glucose is administered intravenously. The fact that the blood glucose levels at the entrance of the emergency room were, at their great majority, within the limits of normality and comparable to a control group (nonalcoholized patients) deserves attention. In this respect, *Ylikahri et al.* [26] showed that ethanol caused no alteration in the blood glucose concentration during the intoxication period, but hypoglycemia (≤ 45 mg/100 ml) was detected in 4 out of 14 subjects only during the hangover. Thus, the possibility exists that our patients, if tested a few hours later, could have lowered blood glucose levels. Taking this point into consideration the administration of glucose given during the intoxication period could prevent

a future hypoglycemia. This possibility is not supported by the data of *Ylikahri et al.* [26] as they reported that the hypoglycemia observed during the hangover was the same regardless of whether the volunteers received glucose or not, simultaneously with ethanol.

It has to be considered that the administration of glucose during alcohol intoxication is based on the description of hypoglycemic states following the ingestion of ethanol [1, 6, 9, 12]. Our data obtained from 80 patients, acutely intoxicated, do not support this contention. Furthermore, our results also show the ineffectiveness of glucose administration in alleviating the symptoms of alcohol intoxication in two experimental conditions. However, although presenting negative data concerning both, low glycemic levels and interference of glucose on the intensity of alcohol intoxication, the possibility that our sample size was not enough to detect possible cases of hypoglycemia cannot be precluded.

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