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Alcohol and Postural Imbalance*

A Force Plate Study

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Summary. A total of 16 normal, medium sized persons were given 20 g of alcohol every hour for 4–5 h. This yielded blood alcohol concentrations between 0.1 mg/ml and 1.7 mg/ml (0.1–1.7‰) during the 4–5 h of testing.

By use of a computer-assisted force plate system, objective measurements of postural imbalance were performed each hour. An increasing postural imbalance was found at blood alcohol concentrations above 0.6 mg/ml (0.6‰).

The results illustrate the risk of intake of alcohol by people highly dependent on a safe standing position.

Key words: Alcohol, postural imbalance – postural imbalance, alcohol

Zusammenfassung. Eine Gruppe von 16 mittelgroßen Personen erhielt neben einer leichten Mahlzeit 20 g Alkohol, was zu Blutalkoholkonzentrationen zwischen 0,1 bis 1,7 Promille in den folgenden 4–5 h führte.

Unter Verwendung einer Computer-kontrollierten Druckplatte wurde eine objektive Messung der Standfestigkeit stündlich durchgeführt. Bei Blutalkoholkonzentrationen über 0,6 Promille wurde eine steigende Verschlechterung der Standfestigkeit beobachtet.

Die Ergebnisse lassen das Risiko für Menschen, die auf eine sichere Standposition angewiesen sind, bei Alkoholaufnahme erkennen.

Schlüsselwörter: Alkohol, Standunsicherheit – Standfestigkeit, Beeinträchtigung durch Alkohol

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Introduction

Intake of alcohol is considered to cause an unsteady standing position.

To evaluate the extent of this observation, a quantitative Romberg's test was performed on a group of young normals following intake of 20 g alcohol.

Patients and Methods

Nine females and seven males age 20–29 years (average: 24 years) participated in the study.

The criteria for inclusion of the persons in the study were: (1) No daily intake of alcohol; (2) No intake of alcohol for the last 24 h; (3) No regular intake of medicine for the last month; (4) No intake of medicine at all for the last week; (5) No suffering from diseases of the cardiovascular or neurological system nor from diseases of the back or lower limbs.

The Quantitative Romberg's Test

The indicator of postural imbalance or body sway, was the fluctuations of the centre of pressure imposed by the standing person's feet on the ground [1]. The force plate was placed in the floor of the laboratory. The ground reaction forces were registered by strain gauges placed in each corner of the force plate. The measurements were recorded by a LYREC-TR-86 analogue, multichannel tape recorder. Further calculations were performed by a PDP 11/10 computer. The signals of the strain gauges were added into a sagittal and transversal vector. Then, the position of the centre of pressure in the two directions was calculated for 60 s of the test. The areas between the mean position of the instantaneous positions of the centre of pressure were integrated and divided by the sampling time. In this way the average values of the transversal sway (S_t) and the sagittal sway (S_s) were found. The expression was compressed into $\sqrt{(S_s)^2 + (S_t)^2}$ = the common sway vector which was used as the indication of sway and the statistic of the sway test.

The Romberg position was defined as a standing position with arms hanging aside, the feet parallel with 1 cm interspace. After adaption to the test situation for 20 s the person was asked to close his eyes and stand as still as possible, while sway was recorded for 3 min. Measurements registered from the 15th to the 75th second were used for the calculations.

Procedure

The series of tests started with a reference measuring for each person. Then a light meal was served together with one beer (12.0 ml alcohol) and 30 ml of liquor (12.0 ml alcohol). Sequential tests were performed at an interval of 1 h, for the next 4–5 h. One beer and 30 ml of liquor was served after each test. The participants were free to stop for further tests at any stage of the study.

Blood samples for alcohol measurements were taken immediately after each test through an i.v. catheter. Blood alcohol concentration (BAC) was determined by a spectrographic method [2].

The correlation between log BAC and the increase of sway was evaluated by the least squares method.

The results were evaluated by use of a two-sided Pratt-signed rank statistic for paired data [3].

The persons were grouped at intervals according to the BAC. In case of one person having more than one measurement within one interval, the measurement representing the lowest BAC was used for the calculations.

Results

The alcohol curves followed the ordinary well-known patterns. Figure 1 indicates the median increase in postural imbalance with increasing BAC, while in Fig. 2 the

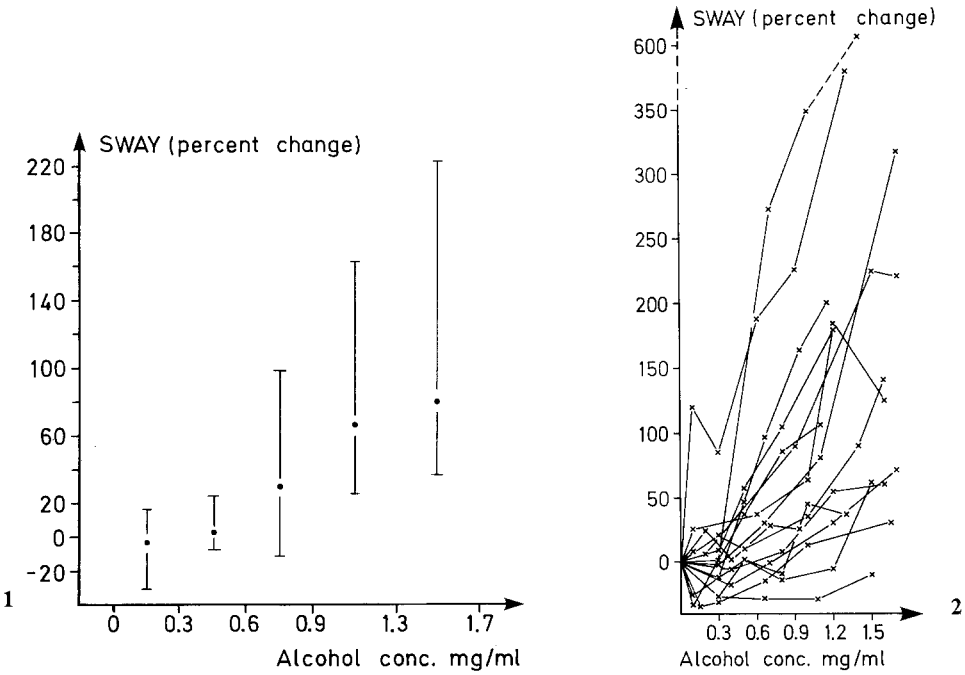

Fig. 1. Percent change of postural imbalance by increasing blood alcohol concentrations; median value shaded by quartiles

Fig. 2. Postural imbalance in 16 persons by increasing blood alcohol concentrations. Absolute figures

Table 1. Comparison of postural imbalance in 16 persons, grouped with reference to blood alcohol concentration

Alcohol mg/ml (‰)	0.00–0.29	0.30–0.59	0.60–0.89	0.90–1.29	1.30–1.70
Comparison to reference measurement	n.s.	n.s.	$P<0.05$	$P<0.01$	$P<0.01$
Comparison to previous interval	n.s.	n.s.	$P<0.01$	$P<0.01$	$P<0.05$

n.s. = not significant; $P>0.05$

16 individual curves are shown. The corresponding levels of significance are given in Table 1.

The correlation between log BAC and the percent increase in postural imbalance for the individual persons was found within the range 0.08–0.98. The mean value was 0.70.

All 16 persons went through four of the alcohol tests while only 13 wanted to participate in the fifth test. The persons body weight ranged from 52 kg to 93 kg (mean: 67 kg).

None of the persons fell during the registration period of 75 s. Two persons fell before the entire 3 min Romberg's test was finished. Their blood alcohol concentrations was 1.4 and 1.6 mg/ml (1.4–1.6‰).

Discussion

Although the study comprised few test persons, it is of interest that the increase of sway is significant at a BAC of more than 0.6 mg/ml (0.6‰) (Table 1). This finding is emphasized by the considerable scattering among the observations (Fig. 2).

In addition, is found that increasing BAC above 0.6 mg/ml (0.6‰) causes a still increasing postural imbalance. The range of the individual correlation quotient between BAC and increase in sway is so wide that it is uncertain to predict the sway at a given BAC. This must be ascribed to a considerable variation in susceptibility to alcohol.

Increase in sway after intake of a single dose of alcohol has earlier been demonstrated by Franks et al. [4]. In this study no increase was found after alcohol intake of 0.54 g/kg body weight while increase was found after intake of 0.75 and 1.0 g/kg. Other types of psychomotor performance tests describe a similar detoriation of performance after intake of alcohol [5, 6].

Among 1,012 non-traffic accident victims admitted to hospital, Harkanen et al. [7] found alcohol to be present in 37%. The finding that postural imbalance is increased at a BAC of over 0.6 mg/ml (0.6‰) might be of vital interest to people highly dependent on a safe standing position in exposed situations.

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