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Lower CSF Taurine Levels in Male Pathological Gamblers than in Healthy Controls

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Amino acids were determined in CSF obtained from 10 males fulfilling the DSM-III-R criteria for pathological gambling. On comparing with seven healthy male controls, the mean CSF level of the inhibitory amino acid taurine in the third (13–18 ml) CSF fraction, was significantly lower in gamblers ($p < 0.05$). Furthermore, the CSF taurine concentration was significantly influenced by height, but differently in gamblers and controls. There were no differences between gamblers and controls regarding other amino acids. The results might indicate that pathological gamblers have a functional disturbance of the disposition of taurine in the CSF. Whether this is due to a reduced entry of taurine across the blood–brain barrier, increased elimination from the CSF, a disturbed CSF circulation or a combination thereof, needs to be clarified.

KEY WORDS — pathological gambling; CSF; amino acids; taurine

INTRODUCTION

Pathological gambling is an impulse control disorder (American Psychiatric Association, 1987) associated with psychosocial decay, alcohol abuse, depression, anxiety and an altered state of consciousness (Bergh and Kühlhorn, 1994a,b). Gamblers have a significantly higher centrally produced fraction of the noradrenaline (NA) metabolite HMPG in the cerebrospinal fluid (CSF) and a greater urinary output of NA than controls (Roy *et al.*, 1988). These findings imply that pathological gamblers may have a functional disturbance of the NA system. There is no evidence favouring the possibility that the serotonin system is involved in the aetiology of pathological gambling (Roy *et al.*, 1988).

To investigate further the effects of personality traits and biochemical markers in this disorder, we have conducted an exploratory study on pathological gamblers recruited from a previously described project (Bergh and Kühlhorn, 1994a,b). Here we report the results of CSF analyses of amino acids.

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MATERIALS AND METHODS

Twenty-one (18 male and three female) gamblers were included after having been fully informed of the project's design. All were medication-free and physically healthy according to the physical examination and blood laboratory tests.

Of the 18 male gamblers, 13 accepted lumbar puncture, which was successful in 10 of the patients. The punctures were performed using a standardized methodology (Bertilsson and Åsberg, 1984) at the L 4-5 level at 8 am after at least 8 h of fasting and strict bedrest. With the subject in a sitting position, CSF was drawn in three consecutive 6-ml fractions with a fine disposable needle (Mediplast 70 × 0·7 mm), from which the CSF was allowed to drip. Amino acids (aspartate, glutamate, aspargine, serine, glutamine, histidine, glycine, thyronine, citrulline, alanine, taurine, GABA, arginine, tyrosine, methionine, valine, tryptophan, phenylalanine, isoleucine, leucine, ornithine and lysine) in the third (13–18 ml) CSF fraction were analysed. The determinations were made by high-pressure liquid chromatography (HPLC) (Qureshi and Baig, 1993).

All patients gave their informed consent and approval for the study was given by the Ethics Committee of the Karolinska Institute.

Statistical programs from the StatView II (Abacus Concepts, Inc.) and Statistica (StatSoft) were employed. Relationships were sought by means of parametric statistics (Kleinbaum *et al.*, 1988). *Post-hoc* comparisons were made using Scheffe's *F* procedure.

RESULTS

On comparing basal data for gamblers and controls, age, height, body weight and atmospheric pressure at the time of the puncture were found not to differ significantly (Table 1).

Unexpectedly, we found that gamblers had significantly lower concentrations of taurine in the CSF (7·4±2·2 μM) than controls (10·9±3·4 μM) ($t = -2{\cdot}57$; $p < 0{\cdot}05$) (Figure 1). Covarying for age, height, body weight and atmospheric pressure, the difference between gamblers and controls became even more pronounced (Scheffe's F; $p = 0{\cdot}0043$).

On investigating the relationships between taurine in the CSF and, in turn, the independent variables, a significant influence was found for height and the interaction between height and diagnosis (gambler/control) turned out to be significant (Table 2, Figure 2). The results were confirmed in a multiple regression analysis. A control of residuals showed that all values were

Table 1. Basal clinical and biochemical data (means± SD) for 10 male pathological gamblers and 7 male controls. CSF fractions are denoted as I (0–6 ml) and II (7–12 ml)

	Gamblers	Controls	*t*-test
Age (years)	42·4±8·7	38·1±6·1	0·28
Height (cm)	181·6±9·2	181·6±7·2	0·99
Weight (kg)	79·2±17·9	74·6±5·8	0·52
Atmospheric pressure (hPa)	1018·2±14·7	1005·9±15·9	0·12

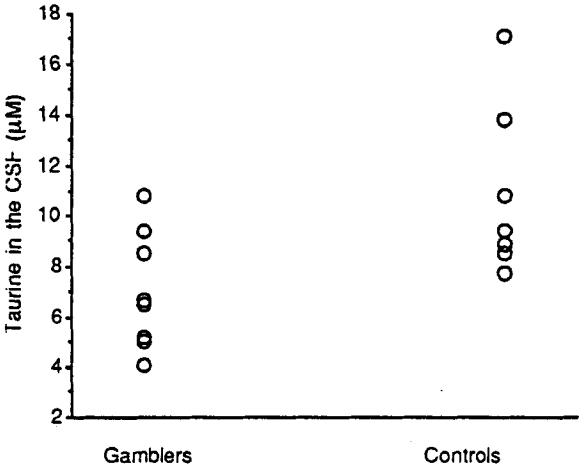

Figure 1. CSF levels of taurine in male pathological gamblers (left) and healthy male controls (right) ($t = -2{\cdot}57$; $p < 0{\cdot}05$)

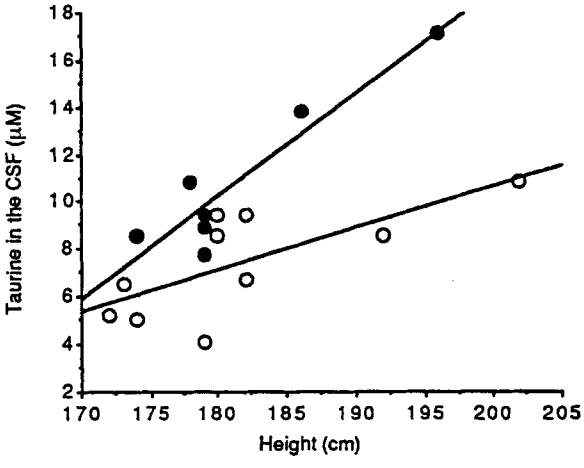

Figure 2. Correlation between taurine in the CSF and height of male pathological gamblers (○) and healthy male controls (●). The difference between slopes is significant ($F_{1:13} = 6{\cdot}27$; $p = 0{\cdot}0264$)

Table 2. ANCOVA table using taurine in the CSF as a dependent variable and height (H) as a regressor. Diagnosis (D) (gambler/control) was included as a nominal variable

Metabolite	Source	Mean square	*F*-value	Probability
HMPG	H	81·98	34·50	0·0011
	D	12·75	5·36	0·0375
	H (D)	14·90	6·27	0·0264
	Model summary: $R = 0{\cdot}90$; $F_{3:13} = 18{\cdot}47$; $p = 0{\cdot}0001$ Equation: taurine = −67·41 + 43·34 (gambler) + 0·43 (height) −0·26 (height; gambler)			

within ±2·0 standard deviations, implying that there were no outliers.

There were no differences between gamblers and controls regarding the other amino acids.

DISCUSSION

In animal experiments, taurine has been found to have anti-epileptic properties (van Gelder, 1972), but its usefulness in clinical studies on epileptic patients has turned out negatively (Durelli and Mutani, 1983). Furthermore, experiments using a taurine analogue, taltrimide, have not been successful either (Koivisto *et al.*, 1986; Keränen *et al.*, 1987).

Taurine is considered, however, to be an inhibitory neurotransmitter (Okamoto *et al.*, 1983), which might be of interest in discussions of the aetiology of pathological gambling and the associated lack of impulse control. Whether or not the altered state of consciousness in gamblers (Bergh and Kühlhorn, 1994a,b) has a connection with lowered taurine concentrations in the CSF is therefore an intriguing question.

The lower taurine levels in the CSF of gamblers might indicate that they have a functional disturbance in the disposition of taurine. Whether this is due to a reduced entry of taurine across the blood–brain barrier, increased elimination of taurine from the CSF, a disturbed CSF circulation or a combination thereof, needs to be clarified.

The significant difference between slopes in the regression analysis of taurine and height is notable since height did not differ between gamblers and controls. The importance of height for levels of compounds in the CSF is unclear, but it might have a connection with CSF circulation as previously discussed with regard to transmitter metabolites (Nordin *et al.*, 1993).

In conclusion, the present results are consistent with the hypothesis that the amino acid taurine might be involved in the pathogenesis of pathological gambling. Prospective studies are urgent.

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