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Research report

Accelerated post-glucose glycaemia and altered alliesthesia-test in Seasonal Affective Disorder

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Abstract

Background: Little is known about the link between mood, food and metabolic function in Seasonal Affective Disorder (SAD). *Methods:* We investigated this link in a combined glucose tolerance–alliesthesia test in eight SAD patients in winter before and after one week light therapy, and in summer. *Results:* SAD patients exhibited faster post-glucose glycaemic and insulin responses ($p < 0.05$), and increased hedonic ratings of high concentrated sucrose solutions ($p < 0.035$) when depressed in winter than when euthymic (one week after light treatment or in summer). *Conclusions:* The rapid glycaemic and insulin responses to an oral glucose load may be a result of accelerated gastric emptying. *Limitations:* The number of studied patients was rather small and no control group was studied in parallel. Clinical relevance: the more rapid post-glucose glycaemia may impair glucose homeostasis in depressed SAD patients. © 1999 Elsevier Science B.V. All rights reserved.

Keywords: Seasonal Affective Disorder; Glucose tolerance; Insulin; Alliesthesia; Carbohydrate craving

1. Introduction

It has long been recognized that symptoms of depression are more prevalent among patients with diabetes mellitus than in the general population and conversely, that affective disorders are significantly associated with poorer glucose control and increased reporting of diabetic symptoms (Eaton et al., 1996; Mueller et al., 1969). In Seasonal Affective Disorder (SAD) (Rosenthal et al., 1984) carbohydrates play a crucial role in different ways: carbohydrate (CHO)-rich food intake is characteristically increased during depressive episodes in winter, compared with the euthymic state in summer or with control subjects (Kräuchi and Wirz-Justice, 1992). Light therapy selectively reduces CHO intake concomitant with

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improvement in clinical state (Kräuchi and Wirz-Justice, 1992). Moreover, a high intake of sweets in the second half of the day is a good predictor of light therapy response (Kräuchi et al., 1993). With respect to behavioural eating style, SAD patients show higher ''emotional'' and ''external'' eating behaviour than controls, similar to bulimic and anorexic patients, but do not exhibit the ''restraint'' eating characteristic of these eating disorders (Kräuchi et al., 1997). They are more easily steered by external stimuli – the sight, smell, amount and availability of food, and the lack of clearly recognised internal signals of hunger and satiation (Kräuchi et al., 1997). We therefore investigated the link between mood, food and metabolic function in a combined glucose tolerance–alliesthesia test situation (Cabanac, 1971).

2. Methods

SAD patients were diagnosed as suffering from a major depression with seasonal pattern (American Psychiatric Association, 1987; Rosenthal et al., 1984), and began the study in winter when depression ratings (Hamilton, 1967) were ≥ 12; these ratings together with the atypical items score (Rosenthal and Heffernan, 1986) were combined to give the SIGH–SAD score (Williams et al., 1988). In parallel, self-ratings with the von Zerssen depression scale (DS; von Zerssen and Koehler, 1976) were carried out. The study was completed by seven women and one man (BMI: 22.5±1.8, S.E.M., range: 18.7–34.9; age: 40.5±3.2 years, range 28–60; covering a period from Nov 1990 until Feb 1994). All patients gave their written informed consent and were unmedicated during the trials. Patients entered the chronobiology laboratory on three occasions: in winter when depressed (SIGH–SAD score: 25.1±1.9; DS: 17.1±2.1, $N = 8$) and after one week of successful morning light treatment (1 h 5000 lux, between 7–9 a.m.; SIGH–SAD: 6.5±1.8; DS: 7.9±2.0, $N = 8$), and again in summer when euthymic (DS: 4.0±1.1, $N = 7$). One patient who had a clear prospectively validated SAD diagnosis was unfortunately under strong working stress during the study week in summer which induced depressive symptoms (DS: 17.5). However, one week later he had recovered. Thus, we excluded his data from the summer comparisons, but not for the light therapy effect in winter. Body mass was similar in all three test periods. Patients slept overnight in the laboratory until 07:45 h; from 09:00–12:30 h the following measures were continuously registered: indirect calorimetry, rectal and skin temperatures and heart rate (data not shown). Plasma blood samples were collected by indwelling catheter in the forearm vein 10 min before and six times half-hourly after an oral glucose load (100 g/250 ml water at 09:30 h), and analysed by standard methods in the University Hospital Laboratory. In the alliesthesia test, six graded sucrose solutions (concentrations: 2.5% to 40%) were presented for hedonic ratings in randomised sequence 45 min before and 1 h after glucose intake. Hedonic ratings were made on a five-point Lickert-scale ranging from very disagreeable (-2) to very pleasant ($+2$). Data were analysed by two-way ANOVA for repeated measures with Huynh–Feldt statistics to adjust the covariance matrix for violations of sphericity. Duncan's multiple-range post-hoc tests were applied to locate significant differences between the means.

3. Results

There was no significant difference in the basal levels of glucose and insulin between the three treatment conditions (Fig. 1). When glucose was given during the winter depressive state, the plasma levels of glucose and insulin rose more rapidly (higher plasma levels 30 min and 60 min, respectively, after glucose load, $N = 8$ subjects, $p < 0.05$) than after one week light therapy (WL) and in summer (SU, $N = 7$ subjects). For both plasma glucose and insulin levels, no significant differences were found between WL and SU. Separate analyses of the individual maximum levels, glucose and insulin response area under the curve, and glucose/insulin ratio revealed no significant differences between the treatment conditions.

Independent of whether or not a glucose load had been administered, the alliesthesia test revealed that depressed SAD patients in winter perceived high sucrose concentrations (10, 20 and 40%) as more pleasant than when tested after WL [Fig. 2; condition × sucrose conc.: $F(5,35) = 2.74$, $p < 0.035$; main effect condition and all other interaction terms containing the factor condition: n.s.]. A com-

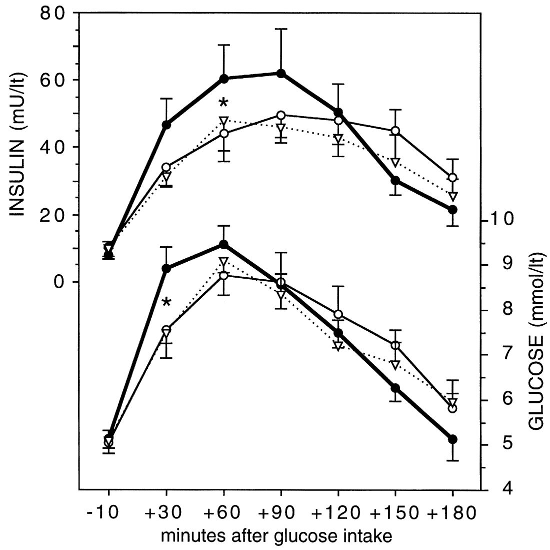

Fig. 1. Mean (±S.E.M.) time course of blood glucose (lower panel) and insulin (upper panel) 10 min before and six times half-hourly after a 100 g oral glucose load, measured in eight SAD patients during their winter depressive state (filled circles), after one week successful light therapy (open circles) and in summer ($N = 7$, open diamonds). Glucose: ANOVA for repeated measures, winter before vs. winter after light therapy, $N = 8$; condition: $F(1,7) = 0.01$, n.s.; time course: $F(6,42) = 20.94$, $p < 0.0001$; condition × time course: $F(6,42) = 2.63$, $p < 0.032$. ANOVA for repeated measures, winter before vs. winter after light therapy vs. summer, $N = 7$; condition: $F(2,12) = 0.11$, n.s.; time course: $F(6,36) = 33.34$, $p < 0.0001$; condition × time course: $F(12,72) = 1.90$, $p < 0.08$. Insulin: ANOVA for repeated measures, winter before vs. winter after light therapy, $N = 8$; condition: $F(1,7) = 0.38$, n.s.; time course: $F(6,42) = 14.6$, $p < 0.0001$; condition × time course: $F(6,42) = 2.81$, $p < 0.022$. ANOVA for repeated measures, winter before vs. winter after light therapy vs. summer, N = 7; condition: $F(2,12) = 0.24$, n.s.; time course: $F(6,36) = 14.33$, $p < 0.0001$; condition × time course: $F(12,72) = 1.90$, $p < 0.08$. An asterisk indicates significant differences ($p < 0.05$) between winter before light therapy vs. winter after light therapy (and summer).

parison between WL and SU ($N = 7$) showed no significant differences in hedonic ratings when euthymic.

4. Discussion

Compared with euthymia after (one week light treatment, or spontaneously in summer), depressed SAD patients in winter exhibited a faster post-prandial plasma glucose increase together with a faster

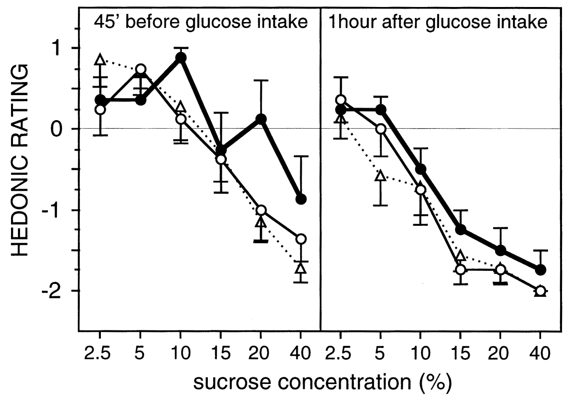

Fig. 2. Hedonic ratings (mean±S.E.M.) of sucrose solutions 45 min before (left panel) and 1 h after a 100 g oral glucose load (right panel) measured in eight SAD patients during winter depressive state (filled circles), after one week successful light therapy (open circles) and in summer ($N = 7$, open triangles). Independent of whether or not a glucose load was previously administered, SAD patients experienced higher sucrose concentrations (10, 20 and 40%) as more pleasant during their winter depressive state than after successful light therapy in winter ($p < 0.05$).

secretion of insulin. However, in all individuals the baseline and 2 h post-prandial plasma levels of glucose and insulin were within the non-diabetic range. Allen et al. (1992) have reported that insulin sensitivity improved after light therapy in a patient with both SAD and insulin-dependent diabetes mellitus. Taken together, these findings underlines the important role of glucose homeostasis in SAD.

It is well known that the glycaemic response to food is determined by different factors e.g., gastric emptying, small intestinal absorption and sensitivity of the pancreatic β-cells, time of day, season, exercise, activity, food frequency and diet (cited in Kräuchi and Wirz-Justice, 1992). Which of these factor(s) are responsible for the altered glycaemic response in winter depressed SAD patients remains to be evaluated.

No significant differences between the treatment conditions in the individual maximum levels, glucose and insulin response area under the curve, and glucose/insulin ratio were found, indicating no differences in insulin sensitivity per se. The difference between winter depressive and euthymic states in the rate of glycaemic and insulin response to an oral glucose load (and not areas under the curve) resembles the difference in the glycaemic and insulin responses to carbohydrates with fast and slow absorption rates (Mourot et al., 1988). Therefore, we favor the explanation that changes in gastric emptying with subsequent changes in glucose absorption rates are responsible for the different glycaemic and insulin responses to an oral glucose load found in this study. The more rapid post-glucose glycaemia may impair glucose homeostasis in depressed SAD patients.

Furthermore, In this study we have shown that during the euthymic state hedonic ratings change in parallel with mood. Another study has shown that SAD patients exhibit a higher sweet taste detection threshold when depressed in winter than during their euthymic state in summer, or than controls, and this threshold remains unchanged after two weeks successful light therapy (Arbisi et al., 1996). Our state-dependent finding indicates that a change in taste detection threshold is not the primary cause for the changes in hedonic ratings. Based on these results it can be postulated that a real ''metabolic demand'' for glucose underlies the characteristic CHO-craving in SAD patients during their winter depression. Their increased CHO consumption can be therefore considered as an attempt at self-medication.

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