LETTERS

Regional cerebral glucose metabolism in akinetic catatonia and after remission

K L Kahlbaum published in 1874 the first recorded description of catatonia. Akinetic catatonia is now defined as a neuropsychiatric syndrome principally characterised by akinesia, mutism, stupor, and cataplexy. Even if some advances have been made in the recognition of catatonia, in particular by the development of different rating scales, the pathophysiology of this syndrome is not clearly established.

A right handed 14 year old girl presented with akinetic catatonia during an episode of depression in the context of a bipolar type I disorder. Her catatonic status was characterised by akinesia with brief episodic stereotyped movements, mutism, no spontaneous oral intake, cataplexy, waxy flexibility, and stupor with brief occasional eye contacts. This corresponded to a total score of 19 on the Northoff Catatonia Scale. Electroencephalogram performed one day after onset of symptoms showed diffuse theta activity with sporadic diffuse delta activity. Cerebral magnetic resonance imaging was normal. Brain positron emission tomographies (PET) were obtained on a CTI-Siemens HR+ tomograph. A first PET (PET1) using [18F]fluorodeoxyglucose (FDG) was performed on day 2 in a drug free state. Thereafter, intramuscular injection of 2 mg of lorazepam induced rapid clinical remission of the akinetic phase. Oral lorazepam was then given (3.75 mg/day) during five days. On day 8, a second PET with FDG was performed while the patient was treated by olanzapine (15 mg/day) and presented hyperactive gesticulation, incontinence, and disinhibition characterised by uncontrolled social interactions and physical contacts. Neuropsychological testing performed some days after remission revealed no apraxia or language disturbances but dysfunction of executive tasks manifested in the revised Wisconsin card sorting, the Tower of London, Stroop, and Trailmaking tests.

Voxel based analyses comparing patient’s cerebral glucose metabolism with that of 29 right handed healthy controls (16 women and 13 men, mean age 32) were performed using Statistical Parametric Mapping (SPM99) (Wellcome Department of Cognitive Neurology, London, UK). Data from each subject were normalised to a standard stereotactic space and then smoothed with a 12 mm full width half maximum isotropic kernel. The analysis identified brain regions where glucose metabolism was significantly changed in each patient scan compared with the control group. All results presented are significant at p<0.05 corrected for multiple comparisons over the entire brain volume. In regions where we had a priori hypothesis—that is, regions implicated in awareness and motor control—we also considered results significant at p<0.05 after small spherical volume correction (radius 20 mm). PET2 analysis showed a relative decrease of metabolism in the precuneus, lateral parietal cortices (Brodmann area 40) and in the right superior frontal circumscription (Brodmann area 6), see table 1. As PET2 was conducted after akinetic catatonia remission, it was used for an exclusive masking analysis of PET1 in order to search for metabolic changes characteristic of the akinetic catatonic state. This showed that a large area of the prefrontal cortex (mostly on the left side) including anterior cingulate, medial prefrontal, and dorsolateral cortices presented a relative decrease of metabolism in comparison with the control group (fig 1). This analysis also revealed relative hypermetabolism of the primary motor cortex, the rostral part of the striatum, and the vermis (fig 1). PET1 analysis also revealed that the precuneus and the left lateral parietal cortex (Brodmann area 40) presented a relative decrease of metabolism (table 1).

In our opinion, these results might shed some light on the pathogenesis of akinetic catatonia. Indeed, exclusive masking analysis allowed us to determine in this case the metabolic changes characteristic of akinetic catatonia. Prefrontal cortical areas like anterior cingulate, dorsolateral, and medial prefrontal cortices are implicated in the planning, initiation, generation of voluntary movements and executive functions in general. Hypofunction of these brain areas, as demonstrated in our patient, could therefore explain symptoms such as akinesia, mutism, and absence of spontaneous oral intake, which are usual features of akinetic catatonia. Moreover, the increased activity in primary motor cortices, the rostral part of the striatum and the vermis, associated with the deficit of internal initiation and generation of voluntary movements, might account for some particular motor features of catatonic states. These are

Table 1 Results of SPM analysis of PET1 and 2

<table>
<thead>
<tr>
<th>PET</th>
<th>Hypermetabolism</th>
<th>Hypometabolism</th>
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<tr>
<td></td>
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<td></td>
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<td>2</td>
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<td>0.004*</td>
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<tr>
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<td>0.016</td>
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<td></td>
<td>0.001</td>
<td>0.005</td>
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*After small spherical volume correction (radius 20 mm).
the occurrence of episodic spontaneous stereotyped movements and the prolonged maintenance of posture (cataplepsy). Previous functional cerebral imaging studies have reported the implication of the vermis in the maintenance of standing postures. The high metabolic activity observed in the motor cortex could be related to reduced neuronal inhibition. Indeed, reduced density of inhibitory GABA receptors in this area has been reported in catatonia. Previous imaging studies found dysfunctional posterior lateral parietal cortex in the catatonic state. PET1 analysis showed hypermetabolism of this left region which persisted after clinical remission. So, this regional dysfunction is not sufficient to lead to akinetic catatonia but it might have participated in the disturbance of executive tasks planning.

Patients with akinetic catatonia are classically unresponsive to their environment. This symptom characterises the stuporous state encountered in this syndrome. The exclusive masking analysis demonstrated reduced activity in the medial prefrontal cortex in conscious awareness. PET2 analysis showed decreased density of GABA-A receptors in the left sensorimotor cortex in akinetic catatonia: a combined study of PET/Biomedical Cyclotron Unit, Erasme Hospital, Free University of Brussels, Brussels, Belgium; xde tiege@hotmail.com

**References**


**Mirth and laughter arising from human temporal cortex**

Laughter and mirth are essential in our enjoyment of daily life and in facilitating communication. Various studies have been done relating to the emotional processing that takes place in the human cerebral cortex, but few have explored the cerebral origins of mirth. Some reports on pathological laughter have implicated the hypothalamus, brain stem, and temporal lobe. As part of the presurgical evaluation of patients with epilepsy, electric cortical stimulation is used to delineate the functional cortical areas, and sometimes this elicits various emotional responses. However, only two stimulation studies have been conducted with a focus on mirth and laughter. Arroyo et al suggested that the motor act of laughter and the processing of its emotional content were separately represented in, respectively, the anterior cingulate area and the basal temporal area (the fusiform gyrus or parahippocampal gyrus, or both). Fried et al suggested not only that laughter and mirth were represented in the presupplementary motor area, but also that there was close linkage between the motor, affective, and cognitive components of laughter. We report a patient in whom electric cortical stimulation applied to the inferior temporal gyrus produced mirth alone or laughter preceded by mirth, depending on the intensity of the stimulation.

**Case report**

A 24 year old right handed woman with medically intractable complex partial seizures underwent implantation of subdural grid electrodes on the cortical surface of the left temporal lobe. An intracarotid amobarbital test revealed the dominance of language and memory in the left hemisphere. The seizures started with an epigastric rising sensation, followed by loss of awareness combined with hand and arm automatisms. Laughter or the feeling of mirth was not seen during the patient’s habitual seizures. Video/EEG monitoring showed that the epileptogenic focus was in the left mesial temporal cortex (A1, 2, 9, and 10) (yellow electrodes in fig 1). Electrical cortical stimulation (50 Hz, alternate polarity of square pulses) was done to delineate the functional areas, with special emphasis on language function.

Stimulation of the basal aspect of the inferior temporal gyrus between A4 and A12 (yellow electrodes in fig 1) at low intensity and short duration (5 mA, 1 s) consistently produced mirth without laughter, and it was always accompanied by a melody that she had heard in a television programme in her childhood. The duration and intensity of the mirth increased in proportion to the duration and intensity of stimulation (15 mA, 3 s), and she eventually smiled during the latter part of a 5 second stimulation. The patient said that the tune appeared funny to her and made her feel amused, but only during the electrical stimulation, and we were able to confirm this. When maximum intensity at longer duration (15 mA, 5 s) was applied, it disrupted a variety of language tasks, but neither alternating hand and foot movements nor vocalisation was disrupted. During this maximum stimulation condition, the patient felt mirth, but the performance of various language tasks obscured apparent laughter. Stimulation of the adjacent pairs of electrodes (A3–A11, A6–A13, and B2–4) (blue electrodes in fig 1) affected only language tasks but was not consistently accompanied by a feeling of mirth.

**Comment**

Our observations suggest that mirth is represented in a relatively small distinct area in the temporal neocortex (the basal surface of the inferior temporal gyrus), which is in part consistent with the observations of Arroyo et al.
Our study clearly showed that mirth was represented in the inferior temporal gyrus, and was closely linked with a particular context (a certain tune in this patient). This association with a specific event was not observed in the patients reported by Arroyo et al.1 Because the temporal lobe is involved in memory function in humans, it is reasonable that both the context of the mirth and laughter and the induced mirth and laughter are represented. In the present case, we could not identify any site where the electric stimulation elicited laughter without mirth. Importantly, the fact that the stimulation with higher intensity and longer duration elicited mirth with laughter might suggest different thresholds for mirth and laughter: postulating a hierarchical organisation or serial processing of mirth and laughter in the human temporal cortex. Laughter might be situated at a higher order of mirth, at least in the temporal neocortex. It is possible that laughter might be caused by further activation of the frontal motor cortices, including the anterior cingulate gyrus, through corticocortical projections, such that electrical cortical stimulation could elicit laughter without mirth.3

With regard to the characteristics of induced mirth in this patient, the melody which made her feel funny was not amusing by itself in the absence of electrical stimulation, raising the possibility that stimulation changed the internal standard of her amusement through an undetermined process.

Although it should be taken into account that the mirth elicited in the present case might not necessarily have reflected the representation of mirth and laughter in the normal brain, no mirth was seen during the stimulation with higher intensity and longer duration elicited mirth with laughter. This might suggest different thresholds for mirth and laughter, postulating a hierarchical organisation or serial processing of mirth and laughter in the human temporal cortex. Laughter might be situated at a higher order than mirth, at least in the temporal neocortex. It is possible that laughter might be caused by further activation of the frontal motor cortices, including the anterior cingulate gyrus, through corticocortical projections, such that electrical cortical stimulation could elicit laughter without mirth.3

In the present case, mirth is represented in the temporal lobe and may be stored together with the context inducing mirth in the same area, suggesting a close relation between mirth and memory function. As far as the temporal neocortex in the present patient is concerned, laughter seems to be situated at a hierarchically higher order than mirth.

High how valid is the clinical diagnosis of Parkinson’s disease in the community?

In a population based study on the prevalence of Parkinson’s disease in London, Schrag et al1 reported on the data of a long term clinical evaluation of 202 patients. The initial diagnosis of probable Parkinson’s disease was later confirmed in 83%, plus 2% each with atypical features and possible Parkinson’s disease. In 15% the initial diagnosis was later rejected, while 19% of patients not diagnosed as Parkinson’s disease were later found to have the disorder. Their conclusion was that in 15% of the cases the clinical criteria of Parkinson’s disease were not followed, in accordance with previous retrospective clinico pathological studies of parkinsonism, in which the rate of false positive diagnosis ranged between 22–24%4 and 15–18%.5 Using more strict diagnostic criteria by movement disorder experts, this figure could recently be further reduced to around 10%, with a positive predictive value (PPV) for idiopathic Parkinson’s disease of 96.8%, and for other parkinsonian syndromes 71.4%—for example, for multisystem atrophy (MSA), 85.7%, and for progressive supranuclear palsy (PSP), 80%.6–7

Referring to these data, Schrag et al showed that at least 10% of the patients with a final clinical diagnosis of Parkinson’s disease may have other disorders.5 In patho logical series, the incidence of atypical parkinsonism is substantial; for example, PSP is found in 6–22% of necropsy cases, MSA in 5–11.4%, vascular parkinsonism in 2–3%, and Alzheimer’s disease in demented Parkinson’s disease patients in 2–6%8 (see table 1).

Although samples from brain banks and specialised institutions are considered to overrepresent atypical disorders owing to the referral bias inherent in such samples, these data are, at least in part, confirmed by a large consecutive clinico pathological study of 260 elderly patients with a clinical diagnosis of parkinsonism derived in the years 1989 to 2001 from three large community hospitals in Vienna, two with acute and one with chronic care facilities (table 1). The concordance of the clinical diagnosis with the neuropathological diagnosis in this cohort was much better than in previous series1 (table 2), which, unfortunately, was not considered or quoted by Schrag et al. In our recent necropsy series, the mean incidence of Lewy body disease, including Parkinson’s disease, was 78%; of other neurodegenerative disorders masquerading as Parkinson’s disease (for example, PSP, MSA, and so on), around 12%; while other disorders referred to as secondary parkinsonism (essential tremor, drug induced parkinsonism) accounted for 8.4% (table 1). The initial rate of misdiagnosis in the overall group of 750 cases was around 17%, and, owing to more precise diagnostic criteria, this finally fell to 11.5% (table 2).

A review of the clinical and pathological diagnoses of 160 non-demented patients with parkinsonism (85 men, 75 women; mean (SD) age, 76.6 (8.3) years, range 52 to 96)—the majority of whom had been examined in hospitals by neurologists experienced...
in movement disorders over a 12 year period from 1990 to the end of 2001—gave the following results: 129 were clinically diagnosed as probable idiopathic Parkinson’s disease without severe dementia, and 21 as diagnosed as probable idiopathic Parkinson’s disease with severe dementia. The sensitivity for idiopathic Parkinson’s disease was vascular parkinsonism, 66.7% (4/6). The sensitivity for MSA, 57.1% (4/7); and for postencephalitic parkinsonism, 21% which, owing to improved neuropathological methods, now represents the gold standard for the final diagnosis which, even after examination of the patients by very experienced clinicians, may differ by around 10% from the final clinical diagnosis. Improvement in the clinical consensus criteria and expert panels may further reduce the rate of false clinical diagnosis of these devastating disorders—a possible basis for further improvements in treatment strategies.

Table 2

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<td>n (%)</td>
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<tr>
<td>Alzheimer’s disease</td>
<td>6 (6.0%)</td>
<td>2 (5.0%)</td>
<td>2.6 (0.9%)</td>
<td>5 (1.9%)</td>
<td>7 (5.0%)</td>
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<td>Vascular encephalopathy</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>3.5 (1.0%)</td>
<td>2 (0.8%)</td>
<td>0 (0.0%)</td>
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<td>Progressive supranuclear palsy</td>
<td>8 (8.0%)</td>
<td>0 (0.0%)</td>
<td>1.8 (0.5%)</td>
<td>3 (1.1%)</td>
<td>3.0 (2.1%)</td>
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<tr>
<td>Multiple system atrophy</td>
<td>5 (5.0%)</td>
<td>10 (2.4%)</td>
<td>2.2 (0.6%)</td>
<td>3 (1.1%)</td>
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<td>Nigral atrophy (unclassified)</td>
<td>2 (2.0%)</td>
<td>2 (0.5%)</td>
<td>0.5 (0.1%)</td>
<td>1 (0.4%)</td>
<td>0.4 (0.3%)</td>
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<tr>
<td>MIX encephalopathy (AD+VaD)</td>
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<td>0 (0.0%)</td>
<td>0.5 (0.1%)</td>
<td>0.4 (0.1%)</td>
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<td>Lewy body dementia</td>
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<td>0 (0.0%)</td>
<td>3.6 (1.0%)</td>
<td>12 (4.6%)</td>
<td>8.7 (6.1%)</td>
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<td>Pick’s disease, corticobasal degeneration</td>
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<td>0 (0.0%)</td>
<td>0.2 (0.1%)</td>
<td>0 (0.0%)</td>
<td>0.4 (0.3%)</td>
</tr>
<tr>
<td>Normal (essential tremor)</td>
<td>1 (1.0%)</td>
<td>0 (0.0%)</td>
<td>0.3 (0.1%)</td>
<td>2 (0.8%)</td>
<td>0.8 (0.6%)</td>
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<tr>
<td>Others (pallido-nigral degeneration, toxic, etc)</td>
<td>4 (4.0%)</td>
<td>0 (0.0%)</td>
<td>0.3 (0.1%)</td>
<td>0 (0.0%)</td>
<td>0.4 (0.3%)</td>
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<tr>
<td>Postencephalitic parkinsonism</td>
<td>0 (0.0%)</td>
<td>1 (0.0%)</td>
<td>0.4 (0.1%)</td>
<td>0 (0.0%)</td>
<td>0.4 (0.3%)</td>
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<td>Total</td>
<td>24 (22.0%)</td>
<td>22.0 (52.4%)</td>
<td>15.3 (4.0%)</td>
<td>30 (11.5%)</td>
<td>15.2 (10.5%)</td>
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Values are % unless stated.

References

Smoking and cognitive change from age 11 to age 80

Age related cognitive decline affects people’s quality of life and the ability to live independently.1 A recent review stated, “We are aware of no studies on the relationship between smoking and cognitive decline associated with normal aging or studies of the effect of smoking on cognition in normally aging individuals.” Some previous studies examined smoking in relation to pathological cognitive aging, but lacked cognitive data before the initiation of smoking, and used crude clinical cognitive assessments.2 Among middle aged subjects, current smoking was associated with poorer cognitive performance on tasks of psychomotor speed and cognitive flexibility.3 Smoking has been identified as a possible risk factor for accelerated cerebral degenerative changes, cognitive decline, and dementia.4 Here we show that smoking contributes to normal cognitive change from age 11 to age 80.

Participants, methods, and results

The Scottish Mental Survey of 1932 (SMS1932) tested mental ability in people born in 1921 (n = 87498). The SMS1932’s Moray House test (MHT) was validated against the Stanford Binet test and includes verbal reasoning, numerical, spatial, and other items. From 1999 to 2001 we traced and retested 530 people from Edinburgh who were born in 1921 (the Lothian birth cohort 1921). All lived independently. We excluded people with mini-mental state examination scores below 24 and those with known dementia. We traced their scores on the MHT from SMS1932, readministered the MHT using the same instructions and time limit as the SMS1932, and collected information on smoking. In all, 470 people (194 men) provided full data. We examined the effect of smoking on cognitive change from age 11 to age 80 using general linear modelling (analysis of covariance; SPSS version 11). Age corrected MHT score at age 80 was the dependent variable, smoking (never (n = 205); current (n = 34); ex-smoker (n = 231)) and sex were between subject variables, and age corrected MHT score at age 11 was a covariate. Among the current smokers the mean (SD) age at starting smoking was 18.9 (5.5) years (range 9 to 40). The ex-smokers’ mean age at starting smoking was 18.2 (5.2) years (range 7 to 60), and the mean age at stopping smoking was 49.6 (16.1) years (range 19 to 79 years). Only six of these ever-smokers (current and ex-) began smoking before the age of 11. The mean (SD) MHT scores for each smoking related subgroup at age 11 and age 80 are shown in table 1. MHT scores at age 11 had a large effect on scores at age 80 (F10,205 = 332.2, p < 0.001, η1 = 0.418). There was a significant, independent effect of smoking (F1,204 = 3.5, p = 0.039, η1 = 0.041), but not of sex

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The sex by smoking interaction was not significant ($F_{5,612} = 1.7$, $p = 0.17$, $\eta^2 = 0.007$). Current smokers had significantly lower MHT scores at age 80 than never smokers ($p = 0.013$; mean difference $= -5.2$, 95% confidence interval (CI) $−9.4$ to $−1.1$) and ex-smokers ($p = 0.016$; mean difference $= -5.0$, 95% CI $−9.0$ to $−0.9$). These group comparisons remained similar in effect size and significance after entering years of full time education to the model.

Comment
Smoking affects cognitive change detrimentally from age 11 to age 80, with an effect that is similar in size to other contributors, such as the e4 allele of the APOE gene. An advantage of this study is that the initial cognitive assessments were made when only a tiny percentage of the subjects had begun smoking. This finding adds to those of a previous study which found that, among middle aged participants, current smokers had reduced cognitive performance when compared with never smokers. In the present study, a history of having smoked and then given up smoking was not associated with any lowering of cognitive scores in old age. At age 80 there are survivor effects on cohorts owing to factors—such as death and illnesses—that are related to smoking. It might be expected that smokers in our cohort would be biased toward being especially fit and cognitively able. Thus selection bias could lead to our underestimating the effect of smoking on cognitive aging. The effect of smoking on cognitive aging might be direct, associated with, for example, biochemical factors such as antioxidant defences; neuropathological changes including acceleration of perfusional decline, cerebral atrophy, and leucoaraiosis and leucoaraiosis (thinning of grey and white matter densities, respectively); or smoking related disease—though smoking did not explain the effect of cardiovascular disease on cognition in the Rotterdam study, nor unequivocally in the Zutphen study. It might also be indirect, being an indicator of a general tendency toward healthy lifestyle choices and responsiveness to health education. These possibilities notwithstanding, our data add to the reasons for giving up smoking, irrespective of age.

Acknowledgements
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References
Mirth and laughter arising from human temporal cortex

T Satow, K Usui, M Matsuhashi, J Yamamoto, T Begum, H Shibasaki, A Ikeda, N Mikuni, S Miyamoto and N Hashimoto

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