Habituation of the orbicularis oculi reflex in dementia and dyskinetic states

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SUMMARY The habituation index is a quantitative expression of the ability of the orbicularis oculi (blink reflex) to adapt to a series of electrical stimuli applied to the supraorbital region. This parameter has been studied in a group of normal control subjects, and the results compared with those in cases of idiopathic and drug-induced Parkinsonism, states of dementia, and dyskinesias such as Huntington's chorea and senile chorea. Patients with Huntington's chorea showed a tendency for the reflex to habituate readily in contrast to patients with dementia caused by cortical atrophy and those with Parkinson's disease. Younger patients with Huntington's chorea had indices within the normal range. It seems unlikely that this test will prove of value in the detection of clinically unaffected relatives. Where dementia was associated with a reversible intracranial lesion, the habituation index was studied before and after treatment. Failure of habituation in this condition appears to be due to the release of a primitive protective reflex.

Failure of the blink reflex to adapt to a series of taps on the forehead has long been recognised as a useful clinical sign in Parkinson's disease (Garland, 1952). Habituation of the blink reflex can be observed electromyographically as a gradual diminution of the amplitude of the second component (R2). The level of habituation depends on the nature of the stimulus and, in particular, the strength and rate of presentation (Thompson and Spencer, 1966). Distraction from the stimulus reduces habituation (Gregoric, 1973). The blink reflex has an early (R1) and late (R2) response—R1 is oligosynaptic and R2 polysynaptic (Kugelberg, 1952). Habituation is considered to be confined to the R2 response (Gregoric, 1973) but Boelhouwer and Brunia (1977) have observed a systematic decrease in amplitude of R1 during repetitive stimulation.

Pearce and his colleagues (1968) reported a failure of the blink reflex to habituate in a group of patients with progressive dementia associated with cerebral atrophy. They suggested that in Parkinson's disease, failure to habituate represents an enhanced avoiding response whereas in cerebral atrophy it is the release of a primitive reflex caused by cerebral damage. In Parkinsonism habituation may be enhanced by levodopa and amantadine but not by anticholinergic therapy (Klawans and Goodwin, 1969; Penders and Delwaide, 1971; Messina et al., 1972).

In contrast to these changes, enhanced habituation has been reported in patients with Huntington's chorea with the suggestion that this might provide a method for identifying cases before clinical signs were evident (Esteban and Giménez-Roldán, 1975). Similar findings related to habituation of the R2 response and changes in the excitability cycle of R1 have also been described (Caraceni et al., 1976).

A quantitative expression of the adaptation of the blink reflex to repetitive electrical stimuli is the habituation index which has been defined by Penders and Delwaide (1971), and we have used this to study habituation in patients with Parkinson's disease, dementia, Huntington's chorea and senile chorea in comparison with a group of healthy control subjects.

Subjects and methods

The blink reflex was evoked by electrical pulses


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using surface electrodes applied to the skin overlying the emerging supraorbital nerves. Similar recording electrodes were placed on both lower eyelids.

A Medelec electromyographic system recorded the responses, and the pulses were generated by a Devices Stimulator.

Paired stimuli (interstimulus distance 5 ms) were of fixed duration (1.0 ms) and variable intensity (50–75 volts). The minimal intensity required to evoke an R1 response was determined in each subject and it then remained fixed for the rest of the test.

Groups of five pulses were administered beginning with a frequency of one every 8 seconds and increasing gradually until habituation was achieved. The habituation index is defined as the fastest stimulation frequency at which the fifth stimulus of a series still evokes an R2 response with an amplitude of at least 20% of the first response (Penders and Delwaide, 1971).

The amplitude of the maximal positive and negative deflections of the polyphasic R2 response were measured directly using planimetry. Other workers have used an automatic integration technique (Penders and Delwaide, 1971).

The habituation index was assessed in 50 normal control subjects, and in 29 patients with idiopathic and 14 with drug-induced Parkinsonism. We also studied the reflex in 10 patients with dementia, 11 with Huntington’s chorea, and five with senile chorea. Three cases of reversible dementia were also examined. All subjects were studied under similar physical conditions.

Results

The control group (mean age 49 years range 17–95 years) had a mean habituation index (HI) of 3.07 (Table and Fig. 1). It was observed that anxious subjects tended to have lower values while those involved directly with the project had high values. There was no correlation of the index with age (Fig. 2).

In patients with Parkinson’s disease without therapy, the habituation index (mean value 1.14) was significantly lower than in the control group (Fig. 1). There was no statistically significant difference between this untreated group and a different population with Parkinsonism receiving

![Graph showing habituation index scores in normal subjects, untreated patients with Parkinsonism, and patients with dementia. Parkinsonism and dementia groups show similar results.](http://jnnp.bmj.com/)

Table Statistical analysis of the habituation index and mean age in the seven groups of patients studied. Each group is compared with the control population.

<table>
<thead>
<tr>
<th></th>
<th>Mean age (yr)</th>
<th>SD</th>
<th>Number</th>
<th>Mean habituation index</th>
<th>SD</th>
<th>Comparison with control subjects P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control subjects</td>
<td>49</td>
<td>22.60</td>
<td>50</td>
<td>3.07</td>
<td>1.67</td>
<td></td>
</tr>
<tr>
<td>Parkinsonism without treatment</td>
<td>64</td>
<td>7.06</td>
<td>29</td>
<td>1.14</td>
<td>0.39</td>
<td>0.001</td>
</tr>
<tr>
<td>Parkinsonism with treatment</td>
<td>67</td>
<td>7.11</td>
<td>18</td>
<td>1.56</td>
<td>1.49</td>
<td>0.001</td>
</tr>
<tr>
<td>Drug-induced Parkinsonism</td>
<td>49</td>
<td>12.39</td>
<td>14</td>
<td>1.50</td>
<td>2.02</td>
<td>0.005</td>
</tr>
<tr>
<td>Huntington’s chorea</td>
<td>58</td>
<td>11.00</td>
<td>11</td>
<td>4.70</td>
<td>3.05</td>
<td>0.02</td>
</tr>
<tr>
<td>Senile chorea</td>
<td>69</td>
<td>9.36</td>
<td>5</td>
<td>1.32</td>
<td>0.55</td>
<td>0.025</td>
</tr>
<tr>
<td>Dementia</td>
<td>62</td>
<td>7.33</td>
<td>10</td>
<td>1.37</td>
<td>1.82</td>
<td>0.01</td>
</tr>
</tbody>
</table>
As Fig. 4 shows, there was a highly significant difference between patients with Huntington's chorea and those with Parkinsonism (P<0.001), and a small but significant difference between the groups with Huntington's chorea and the control group (P<0.02). There was a correlation between Huntington's chorea and age with enhanced habituation in older subjects (Fig. 5). The patients with senile chorea had indices in the same range as those with Parkinsonism (Fig. 6). Ten demented patients with evidence on computerised axial tomography of cerebral atrophy had a mean HI of 1.37 similar to the Parkinsonism group (Fig. 1).

Fig. 2 Habituation index scores according to age in 50 normal control subjects. Correlation coefficient $P=0.5$ (not significant).

treatment (Table). Neuroleptic drug-induced Parkinsonism gave indices similar to the idiopathic variety (Fig. 3). These results tended to be unaffected by anticholinergic therapy. Four patients in this group had tardive dyskinesias and minimal signs of Parkinsonism. Their habituation indices were $<0.5$.

Fig. 3 Habituation index scores for patients with idiopathic and those with neuroleptic drug-induced Parkinsonism.

Fig. 4 Habituation index in patients with Huntington's chorea and those with Parkinsonism (Student's t test $P<0.001$).

Fig. 5 Habituation index scores in Huntington's chorea group according to age. There is a tendency for habituation to increase with age (and duration of disease) although correlation coefficient—$P=0.06$.37 similar to the Parkinsonism group (Fig. 1).
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Three patients with dementia reversed in part by treatment were also studied. Case 1 had a frontal meningioma and signs of primitive reflex activity—a grasp and suckling reflex. Case 2 had a communicating hydrocephalus which improved after ventriculo-peritoneal shunting. Case 3 had an inoperable Grade IV astrocytoma whose signs were reversed partially by radiotherapy and dexamethasone. The results of serial habituation studies are summarised in Fig. 7.

Discussion

The habituation index is a quantitative electrophysiological expression of the glabellar tap sign. The results in our control subjects indicate a wide range of indices (Fig. 1). We found no correlation between habituation and age in contrast to the finding of Penders and Delwaide (1971) who observed that the index tended to fall with advancing age.

The test was of diagnostic value in three patients with minimal signs of Parkinsonism, whose indices were less than 0.5. They responded well to levodopa, and the indices returned to the normal range. In the neuroleptic-induced Parkinsonism group who had similar results to those with the idiopathic variety of the disease, anticholinergic medication did not affect the habituation index although the extrapyramidal signs improved. Penders and Delwaide (1971) observed a similar pattern in their idiopathic group.

In Parkinsonism the reduction in blink reflex habituation may be related to a failure of dopaminergic inhibition of an interneuronal pool controlling the excitability of facial motoneurones.

Fig. 6 Habituation index in Huntington's chorea and senile chorea.

Fig. 7 Habituation indices before and after treatment in three cases of partially reversible dementia: (a) case 1—parasagittal frontal meningioma with signs of primitive reflex activity treated by surgical removal of tumour; (b) case 2—communicating hydrocephalus treated by ventriculo-peritoneal shunt; (c) case 3—grade IV astrocytoma treated with radiotherapy and dexamethasone decompression.
Enhancement of these inhibitory pathways would account for facilitated habituation in Huntington’s chorea (Caraceni et al., 1976). The dementia associated with Huntington’s chorea is unlikely to be responsible for the altered blink reflex pattern, because our dementia group associated with cortical atrophy showed a marked reduction in habituation. However, not all dyskinetic states demonstrate enhanced habituation. The senile chorea group and four patients with tardive dyskinesia had habituation indices similar to the patients with Parkinson’s disease.

While the number of patients with senile chorea was small and the differentiation of senile from Huntington’s chorea difficult, it is of interest that the findings in this small group were distinct and different suggesting that this may be a disorder with a different pathological mechanism. It may, therefore, be misleading to consider that the concept of hypersensitivity versus overinhibition of striatal dopaminergic receptors is applicable to all types of movement disorders (Klawans, 1970; Klawans et al., 1970).

Although most patients with Huntington’s chorea showed a definite tendency for the reflex to habituate readily, younger patients with this disorder had indices within the normal range. Thus the test is unlikely to be of value in the detection of subclinical cases.

Pearce and his colleagues (1968) demonstrated a failure of blink reflex habituation to repetitive tapping on the forehead in a group of demented patients. This indicated that the sign was not specific for Parkinsonism. It was suggested that this was due to the emergence of a primitive reflex similar to the grasp, suckling, and blepharospasm reflexes seen in infants. This feature is well illustrated in our three cases of reversible dementia.

References


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