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Symptoms following mild head injury: expectation as aetiology

Wiley Mittenberg, Diane V DiGiulio, Sean Perrin, Anthony E Bass

Abstract
An affective, somatic, and memory checklist of symptoms was administered to subjects who had no personal experience or knowledge of head injury. Subjects indicated their current experience of symptoms, then imagined having sustained a mild head injury in a motor vehicle accident, and endorsed symptoms they expected to experience six months after the injury. The checklist of symptoms was also administered to a group of patients with head injuries for comparison. Imaginary concussion reliably showed expectations in controls of a coherent cluster of symptoms virtually identical to the postconcussion syndrome reported by patients with head trauma. Patients consistently underestimated the premorbid prevalence of these symptoms compared with the base rate in controls. Symptom expectations appear to share as much variance with postconcussion syndrome as head injury itself. An aetiological role is suggested.

Postconcussion syndrome (PCS) is a cluster of symptoms that includes complaints of memory difficulty, headache, vertigo, depression, anxiety, concentration difficulty, blurred vision, fatigue, irritability, photophobia, and hyperacusis.1 PCS is a persistent phenomenon5,6 that is resistant to current treatments. The causes of PCS are controversial. Binder6 reviewed neuropsychological, neurophysiological, and neuropathological evidence that the primary cause of PCS is cerebral dysfunction. Elsewhere, it has been argued that although PCS may initially have an organic basis, it persists because of psychological factors or is primarily psychogenic in origin.7,8 The incidence of the syndrome appears to be inversely related or unrelated to severity of head injury or neuropsychological status.11-13

The presentation of the PCS cluster of symptoms across samples of patients with head injuries is remarkably consistent, although the reported incidence varies widely across studies.9,10,12-15 The high frequency and universality of PCS subsequent to head trauma has suggested that the underlying common denominator, cerebral insult, is the principal cause.9 However, these same symptoms may occur with equal frequency in uninjured individuals.12,13,16

Benign emotional and physiological symptoms may be misinterpreted by patients as the results of brain injury. Individuals ascribe cognitive meaning to symptoms by examining the context in which they occur and in terms of the ideas they have about the symptoms.17-19 This study was designed to determine whether symptoms of mild cerebral trauma could be related to what patients believe to be the likely symptoms that occur after head injury.

Method
SUBJECTS
The control group consisted of 223 volunteers [mean (SD) age, 30.2 (9.9) years; mean (SD) education, 14.6 (2.3) years], who were recruited by canvassing local businesses, apartment complexes, shopping centres, evening or weekend adult education classes, and a local community college. Twenty eight per cent were students, homemakers, or retirees. Predicted mean (SD) IQ for the group was 107.2 (6.8) as estimated from demographic variables.20 Subjects who reported a history of head injury or who knew a head injured individual well were excluded from the control group.

The comparison group was made up of a sample of 100 patients with head injuries [mean (SD) age = 33.4 (13.1); mean (SD) education = 13.5 (3.1)]. The subjects were consecutive outpatient referrals for neuropsychological examination subsequent to head trauma. They were seen either at the outpatient clinic of a hospital neurology department, a university neuropsychology clinic, or the private offices of a neurologist. The group thus constitutes a sample of patients with postconcussion complaints or suspected complications rather than a random sample of individual with head injuries. Fifteen per cent were employed in professional and technical occupations, 26% held management, administration, clerical, or sales positions, 20% were craftsmen or foremen, 17% were employed as service workers, farmers, or operatives, 1% were labourers or farm foremen, and 21% were homemakers, students, or retirees. Predicted IQ for the group was 103.2 (7.4) as estimated from demographic variables.20

Sixty four of the patients had sustained closed head injuries in motor vehicle accidents, eight were struck by blunt objects, and 28 had sustained head trauma in falls. Patients were
Symptoms following mild head injury: expectation as reality

Symptoms

SYMPTOMS

Comparison between normal base rates and patients' pre-morbid symptom estimates

If patients reattribute benign emotional and physiological symptoms to their head injury, they would be expected to underestimate the occurrence of these symptoms before trauma. To examine this possibility, the base rate of concussion symptoms in normal controls was compared with retrospective patient accounts of their condition before trauma. Patients reported fewer pre-morbid symptoms overall, mean (SD) 2·0, (3·1) compared with normal controls, 4·9, (4·8), and this difference was statistically significant (z(321) = 6·35, p > 0·001).

Table 2 shows that patients with head injuries significantly underestimated the pre-morbid frequency of 21 out of 30 specific symptoms when compared to the base rates in normal controls. There was a non-significant trend in the same direction for seven of the nine remaining symptoms. Results suggest a tendency for patients with head injuries to attribute pre-morbid symptoms to head trauma.
Table 1  Incidence of Expected and Actual Postconcussion Symptoms

<table>
<thead>
<tr>
<th>Age</th>
<th>Time</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>chi-square</td>
<td>0-05</td>
<td>p = 0-95</td>
</tr>
</tbody>
</table>

Forgets who car was parked
Forgets keys
Forgets who entered a room
Forgets content of daily conversations
Forgets groceries
Forgets lost when driving
Forgets store locations in shopping centre
Forgets yesterday’s breakfast
Forgets appointment dates
Forgets wallet or pocketbook
Forgets items around the house
Forgets yesterday’s newspaper stories
Forgets recent telephone conversations
Forgets faces of new acquaintances
Forgets names of new acquaintances
Forgets who telephoned recently
Forgets who said they were on their mind
Forgets television news stories
Forgets where they went today

Note: chi-square *p < 0-05 **p < 0-01 two tailed.

Table 2  Normal Base Rates and Patients' Premorbid Estimates of Postconcussion Symptoms

<table>
<thead>
<tr>
<th>Frequency in Controls (n = 223)</th>
<th>Premorbid Frequency Estimate Patients (n = 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forgets where car was parked</td>
<td>32-0%</td>
</tr>
<tr>
<td>Loses keys</td>
<td>31-0</td>
</tr>
<tr>
<td>Forgets groceries</td>
<td>28-3</td>
</tr>
<tr>
<td>Forgets yesterday’s breakfast</td>
<td>26-9</td>
</tr>
<tr>
<td>Forgets why they entered a room</td>
<td>26-5</td>
</tr>
<tr>
<td>Forgets directions</td>
<td>24-2</td>
</tr>
<tr>
<td>Arr Manhattan</td>
<td>24-2</td>
</tr>
<tr>
<td>Forgets appointment dates</td>
<td>20-2</td>
</tr>
<tr>
<td>Forgets store locations in shopping centre</td>
<td>20-0</td>
</tr>
<tr>
<td>Depression</td>
<td>19-7</td>
</tr>
<tr>
<td>Loses items around the house</td>
<td>17-0</td>
</tr>
<tr>
<td>Forgets yesterday’s newspaper stories</td>
<td>17-0</td>
</tr>
<tr>
<td>Loses pocketbook or wallet</td>
<td>16-6</td>
</tr>
<tr>
<td>Forgets content of daily conversations</td>
<td>16-6</td>
</tr>
<tr>
<td>Forgets items of new acquaintances</td>
<td>15-0</td>
</tr>
<tr>
<td>Irritability</td>
<td>15-7</td>
</tr>
<tr>
<td>Sensitivity to bright light</td>
<td>13-9</td>
</tr>
<tr>
<td>Concentration difficulty</td>
<td>13-5</td>
</tr>
<tr>
<td>Fatigue</td>
<td>12-6</td>
</tr>
<tr>
<td>Headache</td>
<td>12-5</td>
</tr>
<tr>
<td>Forgets who said they were on their mind</td>
<td>12-1</td>
</tr>
<tr>
<td>Forgets television news stories</td>
<td>12-1</td>
</tr>
<tr>
<td>Forgets names of new acquaintances</td>
<td>10-1</td>
</tr>
<tr>
<td>Gets lost when driving</td>
<td>9-0</td>
</tr>
<tr>
<td>Forgets recent telephone conversations</td>
<td>8-5</td>
</tr>
<tr>
<td>Blurry or double vision</td>
<td>8-1</td>
</tr>
<tr>
<td>Dizziness</td>
<td>7-2</td>
</tr>
<tr>
<td>Trouble thinking</td>
<td>6-3</td>
</tr>
<tr>
<td>Forgets who telephoned recently</td>
<td>5-8</td>
</tr>
<tr>
<td>Forgets where they went today</td>
<td>4-9</td>
</tr>
</tbody>
</table>

Note: chi-square *p < 0-05 **p < 0-01 one-tailed.

Table 3  Correlations between reported symptom frequencies and demographic characteristics

<table>
<thead>
<tr>
<th>Patients</th>
<th>Controls</th>
<th>Patients</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of unconsciousness</td>
<td>- 0-02</td>
<td>- 0-15</td>
<td></td>
</tr>
<tr>
<td>Time since injury</td>
<td>- 0-04</td>
<td>- 0-08</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>- 0-09</td>
<td>- 0-13</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>- 0-09</td>
<td>- 0-02</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>- 0-10</td>
<td>- 0-09</td>
<td></td>
</tr>
</tbody>
</table>

Note: Pearson r *p < 0-05.
their retrospective accounts compared with the base rate reported by normal controls. This result suggests that patients may reattribute benign emotional, physiological, and memory symptoms to their head injury.

That an imaginary concussion will reliably elicit expectations of a coherent cluster of symptoms virtually identical to PCS implies that expectations share almost as much variance with the syndrome as head injury itself. A causative role is suggested.

The above arguments do not suggest that PCS reflects underlying personality disorder. Common expectations and experiences define reality rather than abnormality. Current evidence suggests that for at least some patients the aetiological sequence of PCS may begin with: 1) Activation of typical symptom expectations when mild head injury occurs. The concussion is inherently stressful and also normally induces autonomic/emotional arousal; 2) Symptom expectancies bias selective attention to internalized information; 3) Attentional bias and arousal augment symptom perception; 4) Which then elicits additional autonomic/emotional response, reinforcing expectations.

The aetiological role of expectations may also explain why persistent PCS is uncommon following mild head injuries sustained by children and in athletic competition. Children are less able to appreciate the health risks of head trauma, and are therefore less likely to appraise any minor injury as a potential source of persistent symptoms. Children are also less likely to have developed specific expectations of postconcussion headache, anxiety, depression, memory, or concentration impairment. Participants in boxing, football, and other contact sports are repeatedly observed to sustain minor head trauma without obvious persistent ill effects. Being "knocked out" or "dazed" in the context of an athletic event is therefore less likely to elicit anticipations of persistent postconcussion syndrome than identical experiences that occur in the context of a motor vehicle accident.

PCS symptoms occur frequently in the normal population, and at a rate that appears similar to their frequency of occurrence following head injury. Expectations about the symptoms of concussion would result in reattribution of these symptoms to the trauma, selective attention to the symptoms, and anxiety about their significance. Both selective attention and anxiety increase the subjective intensity of symptoms, eliciting further anxiety. This circular reinforcement of expectations may explain why PCS persists following mild head injury in the absence of impairment on formal neuropsychological examination, and why the syndrome appears to be inversely related or unrelated to the severity of head trauma.

Symptom expectations, selective attention, and anxiety can, under certain circumstances, interact to produce syndromes that mimic essentially any pathological process. This situation characterises "medical students' disease", which has a prevalence of approximately 70% in medical schools. Physician consultations are sought for cardiac, neurological, gastrointestinal, musculoskeletal, and psychiatric diseases from which the students believe they suffer. Symptom expectations for the various ailments are learned in the classroom. Selective attention to and reattribution of symptoms that frequently occur in the normal population results. Anxiety about the illness, the situational stress of medical school, and an erosion of belief in personal invulnerability produced by treating patients enhance illness perceptions. Medical students' disease resolves following reassurance, confirmation of the absence of illness by examination, and anxiety reduction. Like medical students' disease, PCS symptoms occur frequently in the normal population and in the context of anxiety arousing circumstances that challenge beliefs of personal invulnerability. The aetiology of both syndromes may also involve symptom expectations.

Expectations become salient when the patient lacks an obvious, immediate, and adequate alternative explanation for their symptoms. The incidence of PCS is higher when patients receive no explanation of their symptoms and are not provided treatment or encouragement. Supportive intervention consisting of education and reassurance of a favourable prognosis has been recommended. Supportive treatment appears to be effective, although adequate outcome studies are lacking. The current aetiological model also suggests that relaxation training and cognitive-behavioural therapies may be effective treatments for anxiety and depression in at least some PCS patients. However, studies addressing this issue are not available. Given the high rates at which PCS occurs and persists, and its resistance to current interventions, empirical treatment outcome studies appear to be necessary.

The extent to which these conclusions can be generalised may be limited by several methodological considerations. The head trauma group was drawn from consecutive outpatient referrals for neuropsychological examination rather than from consecutive hospital admissions for mild head injury. Current results may therefore characterise the responses of patients with prominent postconcussion complaints better than those of individuals with head injuries in general. Patients with head trauma were seen an average of 1-7 years after injury. The results may provide better clarification of the presentation of patients with persistent postconcussion syndrome. Many of the symptoms following mild head injury would have already resolved by this time, and this may have reduced the frequency of reported symptoms. Conversely, the use of a checklist of symptoms may have increased the frequency of reporting symptoms. Although this influence may affect the reports of both groups, the correspondence between the expectation and the experience of postconcussion syndrome would not be altered.

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