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Neuropsychological Functioning in Postconcussion Syndrome

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Abstract

In view of the paucity of literature on the subject, 18 patients suffering from postconcussion syndrome (PCS) following mild closed head injury were studied, with a view to understand the profile of deficits as elicited using conventional neuropsychological testing and visual information processing paradigms. With the exception of visual and verbal learning and memory deficits, there were no consistent deficits on neuropsychological assessment; visual information processing deficits were observed predominantly on paradigm demanding attention and concentration. It is concluded that organic deficits are present in PCS following even mild head injury and suggested that the identified deficits underlie the aetiopathogenesis of PCS.

Key words -

Head injury,
Post Concussion Syndrome,
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Neuropsychological deficits
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Post concussion syndrome,
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Trauma to the cranium predictably results in cerebral insults [1]. When severe, deficits abound in the neurological [2], neuropsychological [3], [4], psychophysiological [5], and psychosocial [4] spheres amongst others. Despite occasional reports to the contrary [6] in the last decade it has been generally accepted that mild head injury also has the potential to result in cerebral dysfunction, demonstrated by using conventional neuropsychological tools [7], [8] or sophisticated information processing paradigms [9], [10], [11].

Post concussion syndrome (PCS) is a constellation of symptoms following head injury; its neurosis-like clinical profile and course have long biased clinicians towards ascribing psychosocial mechanisms to its aetiopathogenesis [1]. In recent years, however, it is being recognised that the syndrome has both organic and psychosocial origins [12], [13] and in fact, it has been suggested that the symptoms directly stem from the organic deficit [14], [15]. This notwithstanding, PCS has been shown to be partly independent of factors related to severity of head injury [1], [12], [13], [16] thus establishing the necessity to study it as distinct from unselected head injury.

While there is a paucity of literature describing the clinical profile of neuropsychological deficit in PCS following closed head injury, specific information processing paradigms have been studied in our laboratory. Nayak [17], comparing patients with head injury - those with and without PCS - as well as a group of normal controls found the PCS group to be significantly impaired in serial and parallel visual information processing as compared with the other groups; the capacity to withstand distraction was also poorer in the PCS group. Gangadhar et al [18] found that PCS patients but not anxiety neurotics (without head injury) or normal controls exhibited deficits in serial and parallel information processing. Both studies underline the supposition that PCS is neither 'head injury' nor 'neurosis' alone, but an entity meriting independent recognition. Rao et al [9] and Rao et al [15] obtained largely similar results; serial and parallel visual information processing was impaired in PCS patients as compared with normals; complex response programming (impairment) but not simple response programming successfully identified the PCS group.

In view of the necessity to study the PCS as an independent entity and in view of the paucity of literature on the subject, we decided to address the following questions in a prospective study.

1. What is the profile of deficits on conventional neuropsychological testing in PCS following mild closed head injury?
2. What is the profile of deficits in visual information processing paradigms in this group?

Material and Methods

The sample was derived from the Post Trauma Clinic in the Department of Neurosurgery at the NIMHANS. All patients of both sexes who gave consent for participation and who fulfilled the following criteria were induced into the study.

1. Uncomplicated, closed head injury with post-traumatic amnesia of less than 6 hours duration.
2. Development of at least 3 of the following symptoms following the head injury: headache, dizziness, [18].
3. Absence of confounding neuropsychiatric or pharamacotherapeutic variables.

Patients were tested between 6 to 18 months after head injury. They were tested in 2 sessions to avoid the fatigue effect. The neuropsychological assessment comprised the administration of the NIMHANS neuropsychological battery [19], [20] comprising oral, paper and pencil and performance tests designed to evaluate cerebral lobe functions. This battery is routinely used for assessment in our Neuropsychology Unit. The information processing battery included the following tests of simple and complex response programming and of serial and parallel processing: simple reaction time (SRT), choice reaction time (CRT) (80 msec exposure), recognisition threshold (with and without random noise distraction), span of apprehension and continuous performance test (CPT). Excepting the last mentioned, these tests have been described in an earlier paper [9]. The CPT requires the subject to make a specific response (using the same experimental set up as in the previous tests) if the numeral 3 appears on the monitor after the numeral 2, the appearance of other numerals requires a nonspecific response. The number of correct specific responses is computed.

Results

The sample comprised 16 males and 2 females with ages ranging from 19-58 (mean 31.56 ± 10.00) years tested 6 to 18 (mean 6.76 ± 4.67) months after the head injury.

An idiometric analysis (taking into consideration the patients age, education, occupation, premorbid functioning and relative performance on the other tests in the battery) based on established norms yielded the following results in patient's performance on the NIMHANS Neuropsychology battery. 9 patients (50%) had deficits in verbal learning and memory and 11 (61%) had deficits on visual learning and memory. Only 3 patients (17%) had non-memory related deficits- these were predominantly fronto-temporal in localization, comprising impairments in scanning, kinetic melody, abstraction and ideational fluency, complex verbal and visual learning and delayed response learning. No patient had diffuse impairment. Time of testing and age were not related to test performance.

Table 1 - Performance of PCS patients on the recognition threshold test

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The results of the information processing battery are as follows: On the SRT paradigm, mean reaction time was 387.3 (SD 255.6 msecs) while on the CRT paradigm mean reaction time was 805.9 (SD 349.5) msecs.

On the recognition threshold test, results were as indicated in Table 1.

On the Span of Apprehension test, the average number of numerals seen by the patients over 40 trials was 56.32%. On the CPT, all but one subject scored over 75% of the correct responses.

The interpretation of these results was based upon norms established by Rao, S L (unpublished). 3 patients (16.7%) were imparied on SRT and 2 (11.1%) on CRT. 3 patients (16.7%) showed deficits on the recognition threshold test without noise distraction; under distraction circumstances, 10 patients (55.6%) were impaired. Only one patient (5.6%) showed impairment on CPT. 14 patients (77.8%) had an impaired span of apprehension.

As a group, subjects showed impairment on 1-5 of the 6 information processing tasks.

Discussion

On the information processing test battery, the percentage of patients showing impairment varied from 5.6% to 77.8% depending upon the paradigm studied. Only recognition threshold with noise distraction (deficit group - 55.6%) and span of apprehension (deficit group 77.8%) were associated with high percentage of impairment in the population studied. Both tests are demanding, calling for undivided attention and concentration on the part of the subject. It thus appears that these tests are the most sensitive of the information processing battery.

Previous studies [9], [15], [17], [18] had documented more extensive dysfunction on identical paradigms, as reviewed earlier; the modest dysfunction in the present sample can be explained on the basis of selection of only those cases of PCS which followed mild head injury. It is however significant that even in such a cohort every patient showed deficits in at least one task and some in upto 5 tasks. Each patient was impaired on a mean of 2 tasks.

On neuropsychological testing only memory functions, subserved by the temporal lobe seemed to be consistently affected. This is in accordance with the clinical truism that the temporal lobes are most vulnerable to damage in head injury [21].

While both organic and functional disorders could lead to the profile of neuropsychological and information processing deficits observed in this study, the findings of a previous study [18] suggests that such deficits in PCS are not related to neurotic symptomatology; indeed the organic basis of these deficits is emphatically substantiated by the literature on cerebral deficits following even mild head injury [7], [8], [10], [11].

Since attention/concentration and memory deficits are reliably demonstrable in PCS following even mild head injury, it may safely be hypothesized that these are among the core (organic) deficits of the disorder. A further hypothesis may be advanced - the symptoms of PCS may be largely due to these organic deficits as has already been suggested [14], [15] and to the psychological repercussions of these organic deficits. Thus, the aetiological model of PCS is constituted of an organic component - the organic deficits that result from the head injury (eg., headache, dizziness, memory dysfunction) for which varied organic aetiologics have been suggested in literature, and a second component - the psychological reaction to the head injury, to the psychosocial concomittants and most important to the organic deficits. While experiential literature [1], [22], [23] is in support of such a model, empirical evidence is needed for its validation.

1.Lishman W A, *Organic Psychiatry 2nd Edn Blackwell Scientific Publications, London*1987
2.Gilroy J & Meyer J S, *Medical Neurology MacMillan Co New York*1979
3.Heiden J S, Small R, Caton S, Weiss M H & Kurze T, Severe head injury and outcome: A prospective study. In Popp A J (Ed)
*Neural Trauma Raven Press, New York*1979
4.Oddy M, Coughlam T, Tyerman A & Jenkins D, Social adjustment after closed head injury: a further follow-up 7 years after injury
Journal of Neurology, Neurosurgery & Psychiatry Page: 48:564-568, 1985
5.Anderson D C, Bundlie S & Rockswold G L, Multimodality evoked potentials in closed head trauma
Archives of Neurology Page: 41: 369-374, 1984
6.Gentilini M, Nichelli P, Schoenhuber R, et al, Neuropsychological evaluation of mild head injury
Journal of Neurology, Neurosurgery & Psychiatry Page: 48: 137-140, 1985
7.Barth J T, Macciocchi S N, Giordain B, Rimel R, Jane J A & Boll T J, Neuropsychological sequelae of minor head injury
Neurosurgery Page: 13: 529-533, 1983
8.Stuss D T, Ely P, Hugenholtz H et al, Subtle neuropsychological deficits in patients with good recovery after closed head injury
Neurosurgery Page: 17: 41-47, 1985
9.Rao S L, Gangadhar B N & Hegde A S, [Information processing deficits in Post concussion syndrome]
NIMHANS Journal Page: 3:141-146, 1985
10.Gronwall D & Wrightson P, Memory and information processing capacity after closed head injury
Journal of Neurology, Neurosurgery & Psychiatry Page: 44: 889-895, 1981
11.MacFlynn G, Montgomery E A & Fenton G W, *Measurement of reaction time following minor head injury Personal Communication*1984
12.Rutherford W H, Merett J C & McDonald V R, Sequelae of concussion caused by minor head injuries
Lancet Page: 1: 1-4, 1977

13.Keshavan M S, Channabasavanna S M & Narayana Reddy G N, Post traumatic psychiatric disturbances. Patterns and predictors of outcome
British Journal of Psychiatry Page: 138: 157-160, 1981
14.Gronwall D & Wrightson P, Delayed recovery of intellectural function after minor head injury
Lancet Page: 2: 995-997, 1974
15.Rao S L, Gangadhar B N, Keshavan M S, Hegde A S & Nardev G, Reaction time deficits in post traumatic syndrome
Indian Journal of Psychiatry Page: 27:63, 1985
16.Taylor, Postconcussional sequeale
British Medical Journal Page: 3: 67-71, 1967
17.Nayak N, Attentional and information processing deficits in post-traumatic syndrome
*Dissertation (M. Phil in Medical and Social Psychology submitted to NIMHANS), Bangalore University, Bangalore*1984
18.Gangadhar B N, Rao S L & Hegde A S, [Information processing deficits and PCS: Role of symptoms]
NIMHANS Journal Page: 3: 147-150, 1985
19.Mukundan C R, Murthy V N & Hemalatha M, Battery of tests of learning and memory functions for assessing temporal lobe involvement
*Paper presented in the 10th All India Convention of Clinical Psychologists at the National Institute of Mental Health & Neuro Sciences India*December 1979
20.Mukundan C R & Murthy V N, Lateralizing and localizing cerebral lesions by a battery of neuropsychological tests
*Paper presented at the 10th All India Convention of Clinical Psychologists at the National Institute of Mental Health & Neuro Sciences India*December 1979
21.Gurdijian E S & Gurdijian E S, Cerebral contusions: Re-evaluation of the mechanism of their development
Journal of Trauma Page: 16:35, 1976
22.Kelly R, The post traumatic syndrome
Journal of Royal Society of Medicine Page: 74: 242-244, 1981
23.Wood F, Novack T A & Long C J, Post-concussion symptoms: Cognitive, emotional and environmental aspects
International Journal of Psychiatry & Medicine Page: 14: 277-283, 1984