

Case Report: The intersection of Neurology and neuropsychology: Diagnostic insights in visuo spatial dysfunction in TBI

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Abstract

The case report explains a case of TBI, bilateral frontal contusion in August 2024. The 24 years old gentle man, belonged to middle socio-economic status, working in co-operative bank, after completing his plus two. He had TBI with bilateral frontal lobe contusion, post traumatic transient amnesia. Apathy, Grade 2 diffuse axonal injury. The CT brain indicates few haemorrhagic contusions seen in subcortically bilateral frontal Lobe. He had nausea and head ache during admission.

His development was normal and had average academic performance. No history of psychiatric illness, behavioural issues. There was no family history of metabolic disorders. The case had been referred for neuropsychological evaluation after severity of clinical signs and symptoms of brain trauma had settled down. He had given an appointment 08 months later, and was referred for neuropsychological assessment. He was administered ACE (Addenbrookes Cognitive Examination Tests), RAVLT (Rey Auditory Verbal Learning Test), Wechsler -Visual Memory Tests (Immediate and Delayed), Trail Making Tests (Trail A and B), WCST (Wisconsin Card Sorting Test for assessing executive function tests), Visual Recognition of Faces (RMT-Faces), Visual Object Space Perception Test, Judgement of Line Orientation. The ACE score is used as a composite /collective score to keep baseline score for cognitive impairment in TBI.

Patient has deficits in verbal working memory intensified with retrieval deficit, impairment in visual recognition memory of faces, patient has significantly moderate impairment in space perception and line orientation.

Key words: Contussion, TBI, Cognitive Impairment, Visuo spatial dysfunction

1. Introduction

Cerebral contusions and concussions are considered disabling traumatic brain injury phenomenon. The severity of damage depends upon the trauma, its depth and causes. Causes can vary from small head bangs to severe injury due to road traffic accidents. It may include falls, severe physical assault, etc. Contusions can expand to haemorrhage also. These injuries can occur through coup and counter coup mechanism. Microvascular ruptures and endothelial injuries can lead to lesions. In the case of traumatic penumbra. there are activations of specificity protein 1 and nuclear factor kappa B. The nuclear factor kappa B leads

to apoptosis, whereas the specificity factor 1 causes vascular fragmentation. Progression usually occurs within the first 12 hours, but may also develop within 3 to 4 days after traumatic brain injury. (Khan et.al ,2025) Contusion progression occurs in 40–50% of cases and the highest risk is within first 24 h.

Factors like age, injury mechanism, coagulopathy, and contusion volume can guide decision-making regarding the impairments and disabilities in future. No consensus exists on optimal contusion management, but optimal level of accurate management is mandatory.

Further studies are essential for contusion management to avoid further worsening in the occasion of increased encephalitis and upcoming predictive models of internal and intracranial bleed management are highly appreciable.

Review of Literature

Frontal contusions have significant cognitive impairment which lead to functional impairment and dependency in activities of daily living (Wong,2018). The frontal lobe plays a critical role in cognitive processing, behavioural regulation, and emotional control, injury to

this region frequently results in varying degrees of cognitive impairment, including deficits in attention, memory, and executive function (Lengenfelder et al., 2015; Tandetnik et al., 2021).

Studies on diffuse axonal injury has significant role in treating brain related trauma. (Johnson VE,2013). Wilde, Boake, and Sherer in (1995) revealed that the TBI patients have memory retrieval problems. They have used the California Verbal Learning Test (CVLT) index to report the memory retrieval problems in TBI. Impairment of facial recognition was specifically associated with signs of concomitant hemispheric and brain stem injury. (Levin 1977). The neural basis of face perception includes the subcortical network, comprised of the amygdala, the superior colliculus, and the pulvinar. (Nagi C,2007).

Spatial orientation is a complex process involving vestibular sensory input and possibly cognitive ability. (Anson et.al ,2021).

The long-term effects of mild head injury on short-term memory for visual form, spatial location, and their conjunction in well-functioning university students is worse compared to controls. (Y M Lisa Chuah,2021) These observations suggest that impaired spatial navigation skills could be a marker of future clinical progression of dementias.

On a neurocognitive level, impairments in various cognitive processes can contribute to AD patients going missing including topographical memory, object recognition, as well as the modulation of visuospatial processing by working memory and executive functions.

The VOSP battery is a sensitive battery test for visuospatial deficits which is popularly used to assess visuo spatial perception. (Natalia Bazzera ,2013) The regions of the brain associated with the orienting and executive components of visuospatial attention may be most susceptible to neural damage resulting from mTBI.

TBI may have an enduring effect on the orienting system at both neural and behavioural levels. Alteration of spatial attention can be a major cause of disability; present findings suggest that m/sTBI survivors exhibit this loss of normal upward attentional bias.

For wayfinding, there were age effects in recalling landmarks, and recognizing environmental scenes. In the route learning condition, older adults evidenced difficulty with the location, temporal order and directional information of landmarks. In both conditions, there was evidence of age-related differences in the acquisition of configural knowledge. Wayfinding was associated with the hippocampus whereas route learning was associated with the caudate nucleus. (Natalia Bazzera, 2013) Patients with AD with vestibular impairment show more visual-spatial cognitive impairment.

Research progress on vestibular dysfunction and visual-spatial cognition in patients with Alzheimer's disease. (Joyce Bosman 2024) Visuospatial function is a critical aspect of cognitive abilities, encompassing visual perception, attention, memory, and adaptive responses to spatial changes. In the VOSP, the AD patients performed more poorly in all subtests examining object perception and in two subtests examining space perception (Number Location and Cube Analysis. (Natalia Bazzera, 2013). Patients evidenced memory and visuospatial deficits after TBI.

The most common impairments in the TBI sample were unilateral neglect and impairments of body scheme and constructional skills. Significantly higher incidences of agnosia, apraxia, unilateral neglect and impairments in body scheme and constructional skills were found in the TBI sample compared to the normative sample (Calzolari, 2020). The incidence of visual perceptual impairment in patients with severe traumatic brain injury is high. (Calzolari, 2020) The regions of the brain associated with the orienting and executive components of visuospatial attention may be most susceptible to neural damage resulting from mTBI

2. Results and Discussions

Discussion of the neuropsychological profile of Mr. A

The overall cognitive functions of Master A were normal, without segregating the test results in detail. The neuropsychological tests were selected to assess his memory of different types -visual memory, verbal memory, visual recognition of faces.

Patient has deficits in verbal working memory intensified with retrieval deficit, impairment in visual recognition memory of faces, patient has significantly moderate impairment in space perception and line orientation. It indexes that visuo spatial impairment can be an indication of mild cognitive impairment which may lead to memory disorders at a later stage.

He was administered ACE (Addenbrookes Cognitive Examination Tests), RAVLT (Rey Auditory Verbal Learning Test), Wechsler -Visual Memory Tests (Immediate and Delayed), Trail Making Tests (Trail A and B), WCST (Wisconsin Card Sorting Test for assessing executive function tests), Visual Recognition of Faces (RMT-Faces), Visual Object Space Perception Test, Judgement of Line Orientation. The ACE score is used as a composite /collective score to keep baseline score for cognitive impairment in TBI.

The total ACE score is 91 shows there is no global cognitive disability. The immediate verbal recall score in RAVLT is 02/15, and delayed recall score is 05/15. The recognition score was 14/15. The disparity in memory scores and recognition scores indicates retrieval deficit in verbal learning and memory. Very poor verbal logical memory scores indicate verbal memory impairment (Immediate Recall 16/47, Delayed Recall 13/47). The WMS digit span score (F – 06/12, B-05/12) correlates with frontal executive functions test (WCST -Wisconsin Card Sorting Test, with 06 passed categories) and Trial Making Tests (A within the allotted time of 47 seconds with zero errors, and B within allotted time of 03 minutes with zero errors. The patient had good scores in visual memory tests. The Ray Complex Figure Test (RCFT) scores (28/36, 22/36) indicate intact visual memory.

The patient has significantly moderate impairment in space perception and line orientation (respectively 08/20, 06/30) which is similar to patients in degenerative cognitive dysfunction. For spatial navigation measures, to our knowledge only questionnaire-based information has been used to predict the incidence of getting lost for patients. While younger age was reported as being a predictor of getting lost, the presence of a safety range (i.e., restricting navigation to very familiar places) was found to be a protector for getting lost recurrence in patient.

3. Conclusion

The evidence based cognitive impairment results through application of neuropsychological assessment tools will help the patients as well as clinicians to decide upon the illness prognosis, Treatment precautions and rehabilitation measures.

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Conflict of interest

None.

Ethical Consideration

The study is a community based one. Ethical standards on the basis of race, gender, minority, women etc are satisfied.

References

1. Wong GKC, Ngai K, Poon WS, Zheng VZY, Yu C. Cognitive Outcomes of Patients with Traumatic Bifrontal Contusions. *Acta Neurochirurgica Suppl.* 2018; 126:63-65.
2. Lengenfelder J, Arjunan A, Chiaravalloti N, Smith A, DeLuca J. (2015). Assessing frontal behavioural syndromes and cognitive functions in traumatic brain injury. *Appl. Neuropsychol. Adult* 227–15.
3. Johnson VE, Stewart W, Smith DH. Axonal pathology in traumatic brain injury. *Experimental Neurol.* 2013 Aug; 246:35-43.
4. Duchnick JJ, Vanderploeg RD, Curtiss G. Identifying retrieval problems using the California Verbal Learning Test. *J Clin Exp Neuropsychol.* 2002 Sep; 24(6):840-51.
5. Levin HS, Grossman RG, Kelly PJ. Impairment of facial recognition after closed head injuries of varying severity. *Cortex.* 1977 Jun; 13(2):119-30. doi: 10.1016/s0010-9452(77)80003-8. PMID: 16295956.

6. Nagai C. [Neural mechanisms of facial recognition]. *Brain Nerve*. 2007 Jan;59(1):45-51. Japanese. PMID: 17354378.
7. Muhammad M. Khan; Sunil Munakomi; Orlando De Jesus. (2025). *Cerebral Contusion* August 2, 2025
8. Padula, W. V., Capo-Aponte, J. E., Padula, W. V., Singman, E. L., & Jenness, J. (2017). The consequence of spatial visual processing dysfunction caused by traumatic brain injury (TBI). *Brain injury*, 31(5), 589-600.
9. Landon, J., Shepherd, D., Stuart, S., Theadom, A., & Freundlich, S. (2012). Hearing every footstep: Noise sensitivity in individuals following traumatic brain injury. *Neuropsychological rehabilitation*, 22(3), 391-407.
10. Mohammed M. Alnawmasi, Jacinta A. Walz .(2022). Deficits in visuospatial attentional cueing following mild traumatic brain injury. *Neuropsychologia* Volume 177
11. Steven H Rauchman , Jacqueline Albert , Aaron Pinkhasov , Allison B Reiss (2022). (mild-to-Moderate Traumatic Brain Injury: A.) Review with Focus on the Visual System . *Neurol International*, 30;14(2):453–470
12. Anson, E., Ehrenburg, M. R., Simon sick, E. M., & Agrawal, Y. (2021). Association between vestibular function and rotational spatial orientation perception in older adults. *Journal of Vestibular Research*, 31(6), 469-478
13. Chuah, Y. L., Maybery, M. T., & Fox, A. M. (2004). The long-term effects of mild head injury on short-term memory for visual form, spatial location, and their conjunction in well-functioning university students. *Brain and Cognition*, 56(3), 304-312.
14. Quental NB, Brucki SM, Bueno OF. Visuospatial function in early Alzheimer's disease--the use of the Visual Object and Space Perception (VOSP) battery. 2013 Jul 16;8(7)
15. Joyce Bosmans, Hanne Gommeren, Annick Gilles, Griet Mertens, Angelique Van Ombergen, Patrick Cras, Sebastiaan Engelborghs Luc Vereeck, Marc J W Lammers, Vincent Van Rompaey (2024). Evidence of Vestibular and Balance Dysfunction in Patients with Mild Cognitive Impairment and Alzheimer's Disease. 45(1):53-61
16. Elena Calzolari, Mariya Chepishcheva Rebecca M Smith,2020,. Vestibular agnosia in traumatic brain injury and its link to imbalance. *Brain* 144(1):128–143.