Original article

Extracting the communication profile of a patient who underwent right Fronto-Temporo-Parietal decompressive craniotomy post Traumatic brain injury

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Abstract

Traumatic brain injury is one of the leading causes for cognitive-linguistic impairments in individuals. Considering cerebral lateralization, the type of communication impairments does depend on the hemisphere that is damaged. The current study reports about a 26-year-old female who has underwent right fronto-temporo-parietal (FTP) craniotomy and evacuation of acute subdural hematoma, followed by left FTP decompressive craniotomy and conservative evacuation of the left temporal contusion. A detailed assessment focussing on the linguistic, cognitive, and speech skills were done using formal and informal measures.

Keywords: cognition, craniotomy, language, traumatic brain injury

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Introduction

The human brain is a complex organ consisting of two distinct hemispheres - right and left. The holistic right hemisphere controls the nonverbal and spatial skills; while the analytical left hemisphere regulates speech and language skills. The latter of which coordinates functions between its four lobes, all of which having distinct capacities. The frontal lobe controls the cognitive functions and voluntary movements; temporal lobe controls memory, speech, and comprehension; parietal lobe controls the abilities to read, write and spatial relationships; while the occipital lobe helps in processing visual information. Damage to the brain, such as traumatic brain injury (TBI), cerebro-vascular accidents, tumors, etc., can cause impairments in communication abilities varying in degree across the right and/or left hemispheres. Language disturbances post TBI revolves around cognitive-communication deficits (primarily in working memory and executive functions); while right hemisphere brain damage (RHBD) predominantly takes a toll on conversational and narrative abilities.[1] In addition to the manifested communication disturbances, individuals may have associated psychiatric disturbances emerging in the first year post injury.[2] The communication deficits that are highly pronounced in individuals with an acquired brain damage, particularly can occur in isolated conditions such as TBI and RHBD.[1] Here we present a complex case of a young female with RHBD as a result of a TBI.

Case report

A multilingual (Tulu, Kannada and English speaking) 26-year-old female (XYZ) presented with a complaint of limited speech output. She is a known case of right fronto-temporo-parietal (FTP) acute

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subdural hematoma and left temporal contusion sustained following a road traffic accident. She underwent right FTP craniotomy and evacuation of acute subdural hematoma, followed by conservative evacuation of the left temporal contusion after 12 months. Recent CT scan revealed CSF density areas in right basal frontal, right parietal, and bilateral temporal lobes, suggestive of chronic sequelae and gliosis due to resolution of intra and extra-axial haemorrhagic collections in view of history of trauma and atrophic changes. Evaluation done after two years reveals organic psychosis post head injury sequelae. Education history reveals that she has a graduate degree in accountancy. Her visual and hearing abilities were within normal limits. A detailed communication assessment was carried out on XYZ using standardized tests, and the results are mentioned below in Table 1.

Table 1: Assessment using different tests and their interpretation.

Tests administered	Domain	Indications
MMSE	Cognitive	Mild to moderate cognitive impairment
MMCLA	Cognitive-linguistic	Severe impairment in perception, short term memory, working memory, decision, judgement, reasoning, and problem solving skills.
WAB – Kannada version	Linguistic	Wernicke's Aphasia
LPT		Deficits in semantics and morphosyntax
Daly's checklist of cluttering	Speech	No evident features of cluttering. * Speech is sometimes intelligible to strangers, exhibiting fast rate of speech.

Note: MMSE- Mini Mental State Examination; MMCLA- Manipal Manual of Cognitive Linguistic Abilities; WAB: K - Western Aphasia Battery - Kannada version; LPT- Linguistic Profile Test.

Based on the formal and informal tests (as mentioned in Table 1) done on XYZ, table 2 does portray the assessed linguistic (primary and secondary) skills, the type of task administered, and the corresponding responses generated.

Table 2: Details regarding the type of skills and tasks administered on XYZ and the corresponding responses.

A. **Primary language**		
Skills	**Tasks**	**Responses**
Phonology	• Phonemic discrimination • Phonetic expression	Full score obtained
Semantics	• Synonymy • Antonymy • Homonymy • Semantic anomaly • Syntagmatic relations • Visual confrontation naming	Scored 0 Able to name items predominantly using orthographic cues
Morphosyntax	• Morphophonemic structures • Plural forms • Tenses • PNG markers • Case markers • Transitives • Intransitives and causatives • Sentence types • Predicates • Conjunctions • Comparatives and quotatives • Conditional clauses and participial constructions.	Scored 0
Pragmatics	• Picture description	- Good topic initiation skills - Poor topic maintenance and topic termination. - Predominantly uses gestures and facial expressions to complement the pictures.
B. Secondary language		
Reading	• Reading comprehension • Reading commands • Written word stimulus-object choice matching • Written word stimulus-picture choice matching • Picture stimulus- written word matching • Spoken words- written word choice matching • Spelled word recognition and spelling.	Full score obtained
Writing	• Writing on request • Written output • Writing to dictation • Writing of dictated or visually presented words • Alphabets and numbers • Dictated letters and numbers • Copying of words and sentences	Fair writing skills.

Discussion

The communication abilities portrayed by patient XYZ is a result of the complex interplay between her residual neural systems and networks of both hemispheres. Considering the extent of damage suffered by XYZ's right hemisphere, the results does reveal difficulties she faced when it came to pragmatic processing which is known to have a bilateral and diffused representation in the brain. Though XYZ exhibited good topic initiation skills, it was observed that she had considerable difficulties in topic maintenance and termination which is an inter-hemispheric skill.[3] Patient XYZ could decipher contextual cues during a picture description task, although having undergone a right FTP craniotomy, which does indicate the influence of the left hemisphere as well,[4] against the traditional assumption of right hemisphere being the major contributor in contextual understanding. The speech act comprehension of XYZ does indicate the use of her bilateral brain (residual) areas which is implicated on her good perspective taking skills.[4] However, XYZ exhibited poor construction and maintenance of coherent representations of discourse, which is regarded as an ability which is a result of inter-hemispheric interaction.[3] The results from the LPT test does indicate dysfunctions in XYZ's semantic (lexical retrieval) and morpho-syntactic (grammatical judgements) components, which are aspects that are controlled by the left fronto-temporal networks.[5] Though the production of language is a coordinated effort of left and right hemisphere, the micro-linguistic (semantic and morpho-syntactic aspects) control is guided by the left hemisphere, with the right hemisphere engaging in handling the macro-linguistic aspects.[6] Surprisingly, XYZ's phonological processing skills were good, suggesting a good residual function of the left perisylvian cortex. Being diagnosed as having Wernicke's Aphasia as per WAB:K, XYZ however managed to use orthographic cues [orthographic-to-phonology (OP) and orthographic-to-semantic (OS)] to her advantage in performing the lexical retrieval tasks. The neural processing of OP and OS systems does rely on a common left ventral occipito-temporal region[7] which may have been spared in the case of XYZ, which might have ultimately resulted in her good phonological processing abilities as observed in the LPT. Patient XYZ's over reliance on the use of gestures and facial expressions to complement her verbal expression, could be due to the coordinated residual functions of her motor areas. Patient XYZ's verbal expression was manifested with a fast rate of speech, which was however not evident formally through the use of Daly's checklist. However, the occurrence of an increased rate of speech in XYZ have also been evidenced in other patients with a RHBD.[8]

With the neural substrates for reading skills being well preserved, XYZ performed exceptionally well in this skill. Her motoric act of writing was relatively well preserved, with a coordinated function of the left parietal lobe, along with contributions from left sensorimotor cortex and prefrontal regions which are generally involved for this function.[9] However predominant errors persisted in terms of substitutions, simplifications, omissions of diacritic markers and geminates. Though inconsistent, there were mixing of Kannada and English graphemes. In addition to these, a RHBD resulting in prosodic and attentional disorders, along with an overlay of organic psychosis must have exemplified the manifested communication deficits in XYZ. The multi-systemic deficits observed in XYZ, had taken a toll on her lifestyle, with her major communication with family members being limited to need based communication. Not only has she found difficulty in engaging in social gatherings and events; but also her emotional and physical relationship with her husband has been at stake.

The overall difficulties in communication encountered by the current patient may be attributed to her reduced cognitive abilities which was evident in MMSE and MMALA. As observed in XYZ, associations between communication and cognitive abilities have been intricately associated with each other.[1] However, considering a cause-consequence relationship between the two may be unwarranted.

Conclusion

The occurrence of cognitive-communication difficulties post TBI has been widely studied with its impact majorly on the quality of life of the patient. The current study does highlight one such case of an individual with RHBD (fronto-temporo-parietal) post TBI manifesting deficits in semantics and morpho-syntax, along with a mild-to-moderate cognitive impairment. The cognitive-linguistic profile of the

patient has been discussed based on the affected and residual neural substrates and networks of the patient. The importance of hemispheric lateralization has also been highlighted in this study.

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