Cognitive and Pragmatic abilities in children with Brain Tumor: Assessment using the Assessment Battery for Communication

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Introduction

Acquired Brain Injuries (ABIs) encompass a range of cerebral insults due to heterogeneous etiologies, such as Traumatic Brain Injuries (TBIs) and Brain Tumors (BTs). In childhood, tumors of the central nervous system are the most common solid tumor [1,2]. In BTs, the lesions are caused by neoplastic masses, leading to an increase in intracranial pressure and reduced blood supply in some brain regions. Furthermore, it is important to consider the adverse effects of radiotherapy and chemotherapy over a long period of time and the possible impact of relapses [3].

In childhood, the brain has a high degree of plasticity, but neuropsychological consequences, like impaired social functioning and pragmatic communication, remain long-term after a paediatric ABI [4,5]. In a multimodal perspective, pragmatic consequences encompass both verbal and non-verbal communication, referring to different and complementary means of expression [6].

In addition, ABIs often lead to impaired cognitive functions such as attention, memory, Executive Functions (EFs) and Theory of Mind (ToM) [10–15]. EFs are based on frontal brain areas and enable the modulation of complex cognitive processes [13], while ToM refers to the ability to understand one's own mental state and that of others [14]. The role of these deficits in determining the pragmatic difficulty of children with ABIs is not yet entirely clear. However, in adults with ABIs [18,19], EFs and ToM are associated to some degree with pragmatic performance without a complete overlap.

A lack of validated instruments to assess pragmatic ability in children with ABIs has been reported in the literature [5,20]. The existing tools mainly investigate the linguistic component without exhaustively assessing other means of expression [9,21,22].

The aim of this study is to provide a comprehensive assessment of pragmatic ability and cognitive skills in children with BTs.

Methods

The study is cross-sectional and involves a clinical group of 20 children with BTs (5 girls) matched by age and sex with a control group of Typically Developing (TD) children (8 girls) aged 6 to 16 years (BTs: M = 9 years 9 months; SD = ± 2.6; TD: M = 9 years 9 months; SD = ± 2.1). Independent samples t-tests confirm that the two groups do not differ significantly in terms of age (U = 242.00; z = .292; p = .770) and IQ (U = 278.00; z = 1.231; p = .218).

Inclusion criteria are: Italian monolingual, with an Intelligence Quotient (IQ) ≥80 [21,22]. For the clinical group, at least six months from the event should have passed since the Neuro-Surgery and/or the end of chemo/radio therapies. Exclusion criteria are a diagnosis of aphasia and/or apraxia and severe sensory difficulties that prevent the use of standardized assessment tools, the presence of developmental disorders.

Cognitive and pragmatic abilities are assessed by the following:

- Assessment Battery for Communication (ABaCo, [23–25] child version), a validated tool

consisting of 5 scales that assess a wide range of pragmatic phenomena, both comprehension and production, through various means of expression;
- Visual attention and word learning tasks - Batteria di Valutazione Neuropsicologica (BVN 5-11 [26] or BVN 12-18 [27], depending on age);
- Tower of London (ToL [28]) to assess planning;
- Wisconsin Card Sorting Test (WCST [29]) to assess flexibility;
- Reading the Mind in the Eyes (RME [30]) and Strange Stories [31] to assess different aspects of ToM.

Results

To analyse participants' performance on the ABaCo total score, we performed Mann Whitney U test, which reveals a significant statistical difference between the two groups, with the BTs group performing worse than the TD group (U = 346.00; z = 2.831; p = .005).

The same analysis was run considering composite ABaCo scores for comprehension and production abilities separately, revealing a statistically significant difference between the two groups for both comprehension (U = 320.50; z = 2.220; p = .026), and production (U = 317.50; z = 2.139; p = .032).

To analyse subjects' performance on each ABaCo scale, we conducted different Mann Whitney U tests. Tests showed a statistically significant difference between the performance of the BTs and the TD group in the extralinguistic (U = 312.00; z = 2.005; p = .045), paralinguistic (U= 361.00; z = 3.252; p = .001) contextual (U = .336.50; z = 2.892; p = .004) and conversational scales (U = 307.00; z = .536; p = .011), but not in the linguistic scale (U = 265.00; z = .866; p = .386).

As for the cognitive skills, Mann Whitney U test showed that the two groups are similar in terms of visual attention (U = 281.00; z = 1.561; p = .213). The groups show a statistical significant difference in direct (U = 319.00; z = 2.948; p = .003) and reverse span (U = 325.00; z = 3.105; p = .002) and in immediate memory (U = 361.50; z = 3.203; p = < .001), with BTs' children performing worse than the controls, but not in delayed memory (U = 294.00; z = 3.105; p = .002).

In terms of EFs, the analysis revealed no statistically significant difference between the two groups on WCST (U = 252.50; z = 1.029; p = .304), but it does reveal a difference on ToL (U = 296.50; z = -3.470; p = < .001), with the BTs performing worse than the TD group.

As for the ToM tasks, Mann Whitney U tests showed a statistically significant difference between the two groups on both RME (U = 371.00; z = 3.877; p = <.001) and Strange Stories (U = 343.00; z = 3.201; p = .001).

Conclusions

Preliminary results confirm the presence of pragmatic difficulties in children with BTs [5]. In particular, the difficulties on the extralinguistic, paralinguistic, contextual and conversational scales, but not at the linguistic underline the need to assess pragmatics using different means of expression. This will allow to more accurately detail strengths and difficulties of children with BTs and to design a more efficient rehabilitation program. In addition to pragmatic difficulties, children with brain tumors also show difficulties in ToM. On the other hand, only some executive functions seem to be affected (e.g. planning). These children also show difficulties in attention and short-term memory, while they have good long-term memory skills. A further perspective, ongoing in our study, regards the investigation of possible correlations among the above-mentioned abilities.

Keywords: Pragmatic, Acquired Brain Injuries, Childhood

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