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DEFICITS OF COMMUNICATION IN CHILDREN WITH A CEREBELLAR LESION

The cerebellum has been associated with motor control, but more recent studies have extended its role in other functions, such as modulation of emotions, behavioral organization or language. Cognitive and emotional functions were studied in 39 children who had undergone surgery for cerebellar astrocytoma pilocyticum at the Depatrment of Neurosurgery, Children's Memorial Health Institute. Communication disorders, such as problems in speech initiation and carrying on a conversation were noticed in these children. Disturbances in nonverbal contact were also observed. These have caused setbacks and helplessness such children often experience in social relations. Such difficulties may seriously endanger the development of children with cerebellar lesions.

Introduction

The classical triad of cerebellar symptoms is composed of hipotonia (decrease in muscle tone), dysequilibrium and ataxia (lack of coordination of movements). Dysarthia, speech disturbances described in patients with cerebellar dysfunction can also be interpreted as a special form of ataxia. This is a difficulty in speech production resulting from lack of coordination of the speech apparatus – the speech of cerebellar patients is slow, monotonous and scanned. Therefore, the cerebellum has been associated with motor control, which has been known since the ninteenth century, but the past twenty years have brought a modification of the traditional view of cerebellar function. In 1997 Schmahmann and Sherman described cognitive and behavioral disturbances observed in adult patients with cerebellar lesions and called it "the cerebellar cognitive affective syndrome". The syndrome is characterized by:

- personality change and deficit in affect regulation – blunting of affect, disinhibited, inappropriate behavior;
- disturbed executive function;
- visual-spatial disorganization;
- difficulty with interpreting and producing logical sequences;
- language difficulties – poor verbal fluency, agrammatism, anomia, dysprosodia (Schmahmann and Sherman, 1997).

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Other studies have confirmed the contribution of the cerebellum to many functions such as modulation of emotions, behavioral organization and language in its diverse, not only motor, aspects. For example, participation of the cerebellum in verb generation and word selection has been described (Fiez et al., 1992; Fiez & Raichle, 1997; Desmond & Fiez, 1998; Marien et al., 2001).

In children, cerebellar lesions are relatively frequent and some are due to neoplasms. Cerebellar tumors are characteristic of the pediatric population – 50-55% of brain tumors in children are located in the posterior fossa (Pollack, 1994). Nevertheless, there are only rare descriptions of psychological disturbances following cerebellar tumors in children. In two studies the authors described deficits in cognitive and emotional functions in children who have undergone surgery of cerebellar tumors and concluded that the cerebellar cognitive affective syndrome can also be observed in children (Levisohn et al., 2000; Riva & Giorgi, 2000).

Subject and methods

Thirty-nine patients who had undergone surgery for cerebellar benign tumors at the Department of Neurosurgery, Children's Memorial Health Institute in Warsaw, were psychologically examined. To exclude other factors possibly influencing psychological outcome (radiotherapy, chemotherapy), the author studied a homogeneous group of children treated exclusively surgically for cerebellar astrocytoma pilocyticum. Demographic characteristics of the examined group:

- 20 boys and 19 girls;
- age from 4 to 17 years (mean 10,8);
- age at surgery from 1,5 to 16 years (mean 6,5);
- time from surgery to psychological exam from 1 to 10 years (mean 4,5);
- six children presented a cerebellar syndrome with ataxia, dysequilibrium and dysarthia, restricting their independence.

A psychologist met individually with all the children and their parents. Information about their child, his/her development, problems and successes was obtained from the parents. A conversation was conducted the topic to a certain extent chosen by the child. In the psychological examination different tests were used according to the child's age and abilities.

The intellectual function of most children (86%) was found to be normal, but even in children with average and high intellectual performance, deficits in executive functions were noticed. They were characterized by problems in shifting strategies of established responses and correcting mistakes using the examiner's feedback. Parents reported problems with affect regulation: disinhibitition, impulsivity, irritability and, in some cases, aggressive behavior difficult to control.

Deficits of communication observed in the examined group

Meetings and psychological examinations have shown that children with cerebellar lesions due to benign tumors have special problems with contact and communica-

tion. Most of the children were glad to participate in the examination and conversation with the psychologist. They related spontaneously events, conflicts and problems important to them, but the psychologist got the feeling that there wasn't real contact. One boy said: *Psychologist should hear me, because nobody wants to.* The sentence expresses some truth – these children need a listener but not a partner to contact. They spoke in monologues, didn't react to signals from the participant, didn't answer questions or answered by single words, and continued their own stories. The utterances were not changed, when the listener showed interest for some thread. The children gave the impression that they didn't expect to be listened to attentively and to get reaction to their words. They wanted only to be permitted to speak and not to be interrupted. But listening was not easy for the participant. The children spoke monotonously, without voice inflection. There were many repetitions and stereotyped phrases in their speech. Sometimes naming disorders were observed as well (15 patients - 38%), but the children – unlike aphasic patients - didn't try to recall missing words by signal or gestures. The children continued their stories with missing words and only short breaks.

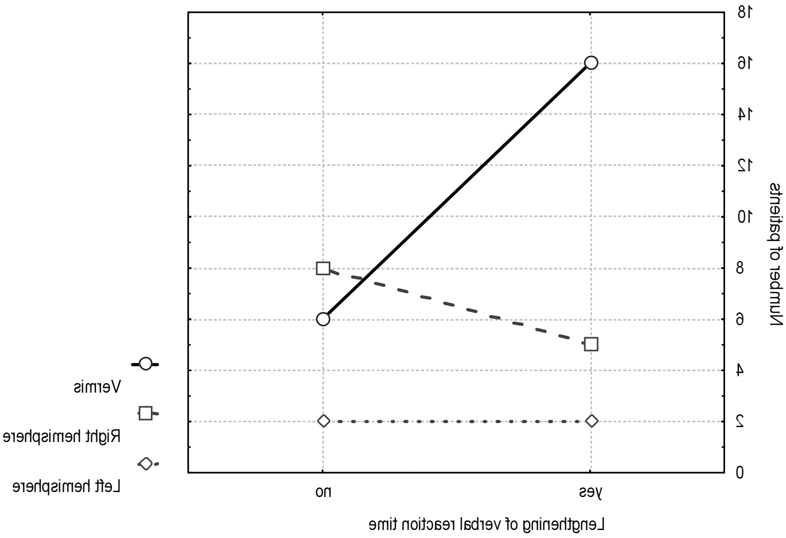
Conversation initiated by another person produced other difficulties. The children manifested slow verbal reaction (23 patients - 59%). Time of speech response after a question could extend to two minutes in some cases, which made a dialogue nearly impossible. After such a pause, the person who had asked the question could not remember what he or she had asked about.

During the psychological examination the same problems with speech onset were also observed. The psychologist asked a question and the child could be silent for one or two minutes, even when the question was easy and evident, and the child knew the answer very well. Finally the child would produce the correct answer. Reaction time was faster for arithmetic tasks – the answer appeared significantly quicker[1]. It was particularly marked in easy tasks, when the children didn't need much time for counting (for example: "A girl had five ribbons and has lost one. How many ribbons has she now?" for a ten-year-old child). Disparate reactions could be observed in the case of more difficult tasks too: facial expression, movement of fingers or mouth indicated that the children were thinking, while after non-arithmetic tasks the time lapse between question and answer was "unfilled" – the child sat motionless, with an empty look. When the patients were asked to repeat presented material – a sentence, short story, list of words or digits – a lengthy reaction time was not observed. The presented material could be treated as an impulse which released a reaction. It seems that the problem was not due to motor disturbances in the speech apparatus, but was associated with earlier stages of the answering process, since slow verbal reaction was observed in children without dysarthia as well.

The same function of "starter" was served by stereotypic phrases, which were repeated even though the sentence was incorrect and the utterance incoherent. For example, when giving successive answers in the test "Similarities" from the WISC-R,

[1] Lengthy time of initiating a reaction was also not observed in the case of a nonverbal task.

Figure 1: Lengthening of verbal reaction time in children with tumor localized in vermis and in cerebellar hemispheres.



the child would begin with the phrase "*both are*", although it was no longer appropriate: "*both are fruit; both are animals; both are... you drink them; both are... you bend them; both are... it's when you hear when somebody is speaking*". In another case, all answers started by: "*You can say...* ". Many children repeated the questions and then began to reply. All elements were used to initiate speech, as if they smoothed the way for the correct words.

Difficulties occurred in nonverbal communication as well. Speech problems could not be compensated for by nonverbal signals. The children's gestures and facial expressions were limited. A child might relate some difficult and painful event, but his\her face and voice didn't reflect the emotions – the look was empty and the voice distant. A moment later he might change the story and speak about something funny, but his\her expression did not change.

Children with cerebellar lesions had a specific rhythm of eye contact: a long gaze into the partner's eyes and then a long look "into space". The looks didn't harmonize with the conversation. The children looked into the partner's eyes all the time they started the answer and that could go on for two minutes. When they started speaking, they turned aside their gaze. These two minutes of silence and the gaze straight in the eye put a strain on the partner and increased the emotional tension.

Neuroanatomical links

The symptom described above was to some extent associated with localization of the tumor – it appeared mainly in patients with a lesion localized in the cerebellar vermis (Figure 1). Children who after surgery displayed the posterior fossa syndrome

had more severe problems with speech initiation. The posterior fossa syndrome is the sequel of resection of a tumor of the cerebellar vermis in children and is characterized by transient mutism, adynamia and emotional lability. Symptoms develop one to four days after surgery and resolve during several weeks. The syndrome could result from edema or hypoperfusion around the resection cavity, impairing the involved neural pathways (Pollack, 1997).

All emotional, cognitive and behavioral disturbances observed in patients with cerebellar lesions are linked, according to present interpretations, with the functional relevance of cerebrocerebellar circuits linking associative and paralimbic regions of the cerebral cortex with the cerebellum. The cerebrocerebellar circuit consists of the feedforward limb, composed of corticopontine and pontocerebellar projections, and the feedback limb, composed of cerebellothalamic and thalamocortical pathways (Schmahmann & Pandya, 1997). The role of the cerebellum in this functional system is to modulate functions. Schmahmann had proposed the concept of "dysmetria of thought". He had written: "…cerebellum detects, prevents, and corrects mismatches between intended outcome and perceived outcome of the organism's interaction with the environment. In the same way as cerebellum regulates the rate, force, rhythm and accuracy of movements, so might it regulate the speed, capacity, consistency and appropriateness of mental or cognitive processes." (Schmahmann, 1998, p. 367).

This theory can help to understand the deficits in communication observed in children with cerebellar lesion. Children had intact basic language and nonverbal capacities, but had problems with using them correctly because of disturbances of internal regulation.

Implications of communication deficits for development of children after surgical treatment of cerebellar tumors

The examined children showed some cognitive and emotional disturbances, but communication deficit seems to be the most important threat to their development. Experiences of the psychologist who participated in meetings with these patients[2] indicated that children with cerebellar lesions are really difficult to contact. After two hours spent with such a child, the psychologist feels emotionally and physically drained. If this reaction occurred in the psychologist involved in the contact and who spent with the child a relatively short time, one can imagine that the same was felt by other persons – family members, teachers, peers. These impressions are due to the specific form of language and nonverbal contact with these children. Monotonous unemotional speech, without reaction to signals from the participant, makes listening hard and arrests the natural need to draw attention. Incoherence of verbal and nonverbal communication and the specific rhythm of eye contact generates tension and annoyance. It induces one to avoid next contact, and if this becomes impossible, induces sometimes an outburst of irritation or anger. Persons, who "are stuck with the child", experience contradictory feelings and aims: to be with the child but to avoid contact.

[2] Sometimes a student assistant was present during meetings with children and their parents, or was the person who examined the child.

Their behavior may be inconsistent. For the child, the situation is unintelligible: reactions of partners do not result from the child's actions or emotions; explosion of annoyance occurs usually when the parent or participant loses patience.

The slow verbal reaction makes all conversation difficult and unsatisfying, both for the child and the participant. The child is unable to tell about his/her problems or to relate his/her own story: the partner, restless by waiting for the next sentence or answer, speaks for the child or finishes the child's utterance. This problem occurs in school, too. Children don't have enough time to answer the teacher's question and may be treated as unprepared for lessons. Such a situation happens frequently to children who have learned their lessons and are well prepared. In such cases, children can feel embittered or angry, and sometimes lose their self-control. Such behavior worsens their school life and such pupils are reputedly incapable of a normal education, as reported by some parents. On the other hand, some children are aware of their true potential and state of knowledge[3] and don't understand the reason for their academic failure.

As has been shown, children with cerebellar lesion often suffer setbacks and helplessness in social relationships. These negative experiences intensify the tendency to retire from social activity. Children start to isolate themselves from their peers, are passive and fearful in school. Emotional problems accumulate and intensify. As a result, children who have recovered from a cerebellar tumor, and have good intellectual ability, are incapable of normal functioning in the social environment.

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[3] In the examined group there were children of very high intellectual functioning and even they experienced some difficulties in school and other social relations.

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