

CENTRAL HEARING DISORDERS AND THE RISK OF DYSLEXIA AMONG 6-YEAR-OLD CHILDREN

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Abstract

Aim: The aim of this study was to detect the risk of dyslexia and central hearing disorders in a group of six-year-old children.

Material and methods: The group consisted of 14 children, 7 boys and 7 girls. The duration of the investigation was about 40 minutes per person. Before each test the examined child was acquainted with the instruction to the test and then presented with examples to make sure that he/she understood the command. The following tests were used to diagnose the risk of dyslexia: dyslexia risk scale by Bogdanowicz, tests for diagnosis of central hearing disorders: FPT, DPT by Senderski, the test of dichotic listening of words by Kurkowski, the test of speech understanding in noise in the form of the multimedia program, "I hear...", and the test pitch differentiation carried out with the device "Audiometer S".

Results: We have detected five symptoms that indicate the risk of dyslexia and central hearing disorders. Children had difficulty with the differentiation of sounds, hearing words in noise, with understanding longer commands, they also had problems with attention and phonation. In the group where no symptoms suggesting subsequent occurrence of dyslexia were found, problems with central auditory processing also appeared.

Conclusions: The research has confirmed that the number of children with central auditory disorders and risk of dyslexia is increasing. These children, despite generally good intelligence, require regular assistance during the educational process. It is necessary to modify the methods of teaching in schools and at home, apply training tools based on computer programs or use traditional exercise methods available.

Key words: central hearing disorders • risk of dyslexia • school education • test of dichotic listening of words • FPT and DPT tests • test of speech understanding in noise • test of pitch differentiation

Background

There is a group of children who are considered to be intelligent, talented and healthy, having proper environmental and educational conditions, but the commonly used methods of teaching fail in their cases. These children face serious difficulties of both specific and selective nature in learning to read and write. The difficulties they face do not apply to all skills which are taught at school, but rather to those associated with reading and (or) writing [1]. Specific difficulties are diagnosed only among children with proper development [2].

Children with specific difficulties in reading and writing, namely "Dyslexic Children" [1], can mask their deficiencies in reading and writing, so that the developmental dyslexia is discovered too late, even though it has accompanied a student from the beginning of the school education and has frequently led to secondary symptoms. In many cases learning difficulties, problems with reading and writing and, often co-existing with them, emotional disorders result from problems with the analysis of sounds at the central level [3]. Numerous studies have shown that central auditory disorders occur in 2–3% of the population among children aged 6–14 years. The frequency of occurrence of this phenomenon is worth mentioning, namely the fact

that it happens twice as often among boys than among girls. Central hearing disorders are observed in children who have revealed disorders of central (neural) part of the auditory system. It is estimated that in every fourth child with dyslexia there are coexisting hearing disorders. Then, central auditory training may significantly improve their performance at school as well as their reading skills [3].

Material and methods

Tests were conducted in a group of 14 children at the age of 6 (seven girls and seven boys). Before testing, a meeting for children was organised where they were told how the tests at the so-called "sound room" will look like. Each child was tested for about 40 minutes. Before the tests the children were familiarized with the instruction to the tests, then examples were presented to make sure that they understood the commands, and only after that were the proper tests applied. We used the scale of the risk of dyslexia and tests for diagnosis of central hearing disorders, namely: FPT and DPT tests, the test of dichotic listening of words, the test of speech understanding in noise and the test of pitch differentiation. The dyslexia risk scale (SRD) is a very simple diagnostic technique which allows for an early detection of symptoms indicating a possibility of occurrence of developmental dyslexia or specific difficulties

in reading and writing. It draws parents' and teachers' attention to the child's behaviour that signals the presence of disharmony in the development. The scale of dyslexia risk has the form of a questionnaire which contains 21 statements concerning different symptoms of the risk of dyslexia. The statements are assigned to specific spheres of development: small and large motor skills, visual functions, functions of the language – speech perception and expression. The FPT test – the test of frequency sequence consists in the presentation of three tones which differ from one another by their frequency. The high tone has the frequency of 1122 Hz whereas the low-frequency one – 880 Hz. During the test, the examined person listens to a random sequence of 30 tones. The task of the respondent is to repeat verbally the sequence he/she has heard. The DPT test – the test of length sequence, consists in the presentation of three tones of 1000 Hz frequency, one of which differs from the others by duration. The tone can be long (D-500 ms) or short (K-250 ms). During the test, the examined person listens to 30 tone sequences chosen at random, formed out of 6 possible sequences. The task of the respondent is to repeat verbally the already-heard sequence [3]. The test of dichotic listening of words is a diagnostic tool designed to determine the dominant hemisphere in the perception of speech sounds. The isolation of dominant hemisphere makes it possible to specify the lateralization profile. It also allows for an assessment of the progress of coordination (integration) of perceptual and motor activities involved in the processes of linguistic communication (listening, speaking, reading and writing). The test consists in simultaneous presentation of different sounds separately for the left and right ear. The results has made it possible to determine the advantage of either the right or left ear in the perception of speech sounds [4]. The test of speech understanding in noise evaluates the intelligibility of 20 2-phone words presented in the presence of white noise. In this study, we used a pictorial test. In the case of abnormal results the program suggests repetition of the test. Only if the repeated test is also incorrect, may the supervisor consider the testing as invalid [5]. These types of tests are carried out to determine how a person understands the speech presented in the presence of a special speech-masking noise. Masking noise somewhat "mimics" the characteristics of typical acoustic environment- in most cases we receive speech signal which is more or less affected by other signals (traffic noise, other speakers, etc.). Therefore, in the considered measurements, the speech was presented against the background of noise in order to properly assess the functioning of hearing in terms of speech intelligibility, which is very important for communication. The test of pitch differentiation consists in the presentation of two tones which differ from each other by frequency. We first present the 8000 Hz tone, and finally the 125 Hz one. The task is to determine whether the sound heard by the child is higher or lower than the previous one.

Results

Among the fourteen children examined, the symptoms of dyslexia risk were revealed in five persons. One girl had a moderate risk of dyslexia and the second one manifested a high risk of dyslexia. Two boys in this study showed a borderline risk of dyslexia and a high risk was diagnosed in the case of one boy. All children exhibiting the risk of

dyslexia manifested difficulties with the differentiation of sounds (the length and pitch). In the case of two children with a high risk of dyslexia, significant problems with hearing words in noise occurred (45% of correct answers by a girl, and 55% by a boy). An additional test of sound differentiation performed by means of the Sconfirmed audiometer proved the difficulty of differentiation of sounds. Four children had also speech impairment. Out of the five children, one showed an undetermined lateralization, whereas three other right-hand lateralization and one child left-ear advantage. According to the caretakers, children also had trouble with understanding long commands, problems concerning phonation, attention, building long utterances as well as perception and expression of sounds. Central hearing disorders emerged also among those who, according to the Scale of the Risk of Dyslexia examination, revealed no signs of dyslexia risk. Three children were unable to notice the difference between the height and length of sounds. In the case of three children, left-ear lateralization was revealed, among other five – right-ear lateralization, and one person showed undetermined lateralization. Four children exhibited speech impairment.

Discussion

Early diagnosis of dyslexia and improvement of functions affecting the prospective reading and writing skills gives a child a chance of success at school, the joy of exploring the world, and also strong motivation to continue learning [6]. Close cooperation of psychologists, educators, speech therapists and audiologists is vital for achieving the best results in therapy. Central hearing disorders lead to abnormal auditory attention and worsening of listening in noise and disturbance of auditory-visual integration. Treatment of central hearing disorders should include, first of all, auditory training, practice of analysis and synthesis, time resolution exercises and improving the differentiation of the height and length of sounds. Teachers should give these children short and simple commands emphasising the most important elements of their speech. Verbal commands should be complemented with brief instructions in writing (e.g. by writing keywords on the blackboard). In the case of auditory attention disorders and difficulty of hearing in noise, therapeutic action focuses on improving signal to noise ratio, auditory exercises improving short-term memory and exercises involving speech understanding in noise.

Conclusions

The measures taken in the case of children with impaired hearing should include a conversation with a parent or a teacher to inform them about the characteristics of these disorders and how to deal with children with such dysfunctions. The research which was carried out has confirmed that the number of children with central auditory disorders and the risk of symptoms of dyslexia is increasing. These children, despite generally good intelligence, require regular assistance during the education process. It is necessary to modify methods of teaching at schools and at home, apply training aids based on computer programs or use traditional exercise methods available. If possible, it is recommended to use hearing aids with FM systems in order to improve signal to noise ratio in school environment.

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