Severity of dysarthric speech in children with infantile cerebral palsy in correlation with the brain CT and MRI

Otapowicz D, Sobaniec W, Kułak W, Sendrowski K*

Department of Pediatric Neurology and Rehabilitation, Medical University of Białystok, Poland

Abstract

Purpose: Dysarthria is a sequel of reduced motor functions and refers to the sound aspect of the language. In children suffering from cerebral palsy, CT (computer tomography) and MRI **(**magnetic resonance imaging**)** examinations provide data on the relationship between the range of structural changes detected by neuroimaging investigations and the severity of motor dysfunction. The aim of study was to assess the severity of dysarthria in children with cerebral palsy in correlation with the pattern of morphological changes revealed on CT and MRI.

Material and methods: The study involved 48 children with the pyramidal form of infantile cerebral palsy aged 3-15 years, treated in the Department of Pediatric Neurology and Rehabilitation in Białystok. All the patients underwent CT examination, 29 of them also had MRI. Severity of speech dysfunction was established based on "Dysarthria profile" by Robertson. The degree of damage severity in the respective brain structures was determined according to the scale Kraegeloh-Mann. Statistical analysis was performed using % calculations, the arithmetic mean, standard deviation, the chi-square test of independence or t-Student test to compare the means of two samples.

Results: Significant differences were shown in dysarthria severity depending on lesions seen on CT and their intensity revealed by MRI, which were found to correlate positively with the severity of articulation disorders.

Conclusions: The results indicate that CT and MRI are useful for predicting prognosis of severity of speech disturbances in children and for early programming of the therapeutic process.

Key words: cerebral palsy, dysarthria, neuroimaging investigations.

Introduction

All pathologies that manifest themselves in dysfunctions of the muscular groups involved in the production of speech (respiratory, phonatory, articulatory), responsible for phonation, mainly cerebral palsy, are usually accompanied by dysarthria. Dysarthria is a sequel of reduced motor functions and refers to the sound aspect of the language [1]. In children suffering from cerebral palsy, CT and MRI examinations provide data on the relationship between the range of structural changes detected by neuroimaging investigations [2,3]. The few studies on the speech of children suffering from cerebral palsy performed in correlation with MRI findings refer to the linguistic functions and do not confirm such a relationship [3].

The aim of the study was to assess the severity of dysarthria in children with pyramidal form of cerebral palsy in correlation with the pattern of morphological changes revealed on CT and MRI.

Material and methods

The study involved 48 children with the pyramidal form of infantile cerebral palsy aged 3-15 years, treated in the Department of Pediatric Neurology and Rehabilitation in Białystok. All the patients underwent CT examination, 29 of them also had MRI. Severity of speech dysfunction was established based on "Dysarthria profile" by Robertson [4]. Dysarthria severity

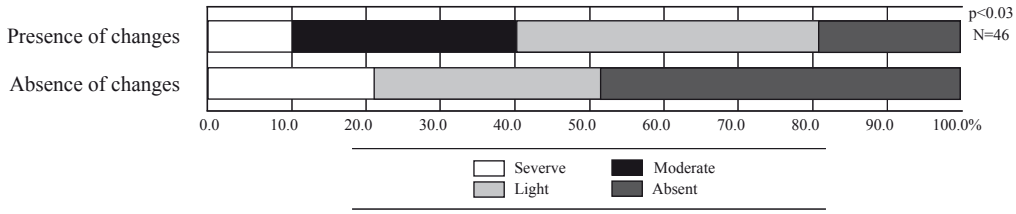
* CORRESPONDING AUTHOR:
Department of Pediatric Neurology and Rehabilitation
Medical University of Białystok
15-274 Bialystok, ul. Waszyngtona 17, Poland
Tel/fax: +48 85 7450812
e-mail: otapd@o2.pl (Dorota Otapowicz)

Received 07.03.2007 Accepted 12.04.2007

Table 1. **Differences in dysarthria severity in relation to the occurrence of changes on CT (computer tomography)**

Severity of dysarthria	Changes on CT	
	absent	present
Standard deviation	0.64	0.77
Mean value	3.272	2.779
Statistical analysis (t-Student test)	p<0021	

Figure 1. **Severity of articulatory disorders in relation to the presence and absence of changes on CT**



was expressed by the total score obtained from evaluation of the respective speech levels: articulation, articulatory motor activity, reflex actions, respiration, phonation and prosody. The degree of damage severity in the respective brain structures was determined according to the following scale Kraegeloh--Mann [5]: 1 – slight changes, 2 – moderate changes, 3 – marked changes. Statistical analysis was performed using % calculations, the arithmetic mean, standard deviation, the chi-square test of independence or t-Student test to compare the means of two samples. H1 hypothesis (correlation between features or differences between means) was considered true at $p<0.05$.

Results

In the study group of 48 children with cerebral palsy only 20% had no speech dysfunction, 37% presented with light dysarthria, 30% had moderate and 13% severe dysarthria. CT examination revealed changes in 28 (61%) children. In MRI, changes were slight in 17 (61%), moderate in 9 (32%) and severe in 2 (7%) children. No relationship was severity of dysarthric speech and changes seen on CT – $p>0.074$ was observed. Differences in dysarthria severity in relation to the occurrence of changes on CT presented (*Tab. 1*) ($p<0.021$). However, statistically significant differences were noted in the severity of articulatory disorders depending on morphological changes in the brain seen on CT ($p<0.03$). Data are presented in (*Fig. 1*). In relation to the other speech functions examined, correlations were insignificant. *Tab. 2* lists differences in moderate dysarthria with respect to the severity of morphological changes revealed on MRI. Differences in dysarthria severity on the range of changes revealed by MRI, revealed by t-Student test were considered significant at $p<0.004$. A statistically significant correlation was found between the severity of articulatory disorders and neuroimaging changes detected on MRI ($p<0.024$). Results are presented in (*Fig. 2*).

Discussion

In the study group of 48 children with the pyramidal form of cerebral palsy, 37% demonstrated only slight dysarthria and 20% had no speech dysfunction. In most of them, no damage was revealed on CT or only slight changes were detected on MRI.

Statistical analysis showed significant differences in the severity of dysarthrias, first of all in articulation disorders, in children with cerebral palsy, depending on the presence of changes on CT and their intensification degree on MRI. Bania Naeser ML et al. [6] indicate that damage to these regions, including nuclei and capsule and extending over the anterior/superior white matter and its posterior parts may, though not always, cause serious disturbances in verbal expression, such as subcortical dysarthria, transcortical motor aphasia and even total aphasia. In a patient with severe acquired dysarthria, functional MRI revealed cortical reorganization of articulation but not of the linguistic functions [7].

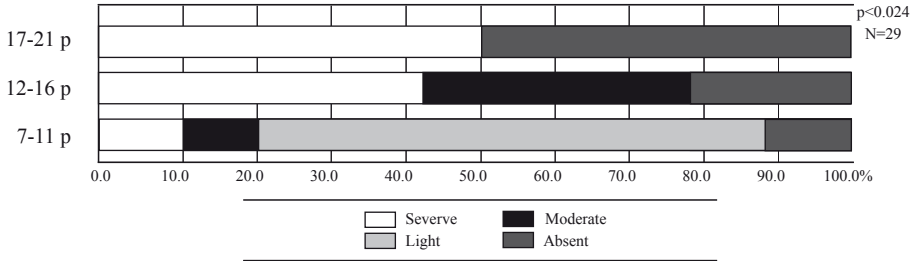
Worthy of note are some atypical cases, in which despite lack of damage on CT and only slight lesions on MRI, dysarthric disorders were severe, or those in which no speech abnormalities were observed although damage seen on MRI was substantial. Coleman L et al. [8] described two cases of children with marked changes on MRI – in one of them speech development was normal while in the other serious disorders were observed. The authors suggest that even when damage is serious, speech may remain intact. However, as shown by statistical analysis, dysarthric disorders in children with moderate changes on MRI are significantly more severe as compared to those observed in slight disorders.

Early symptoms of future speech disorders in children with cerebral palsy include difficulty with sucking, swallowing, mastication, retarded and poor cooing [9,10]. Analysis of CT and MRI findings with reference to these symptoms will facilitate early and proper decisions concerning programming of speech therapy in children with cerebral palsy already in infancy.

Table 2. **Dysarthria severity in relation to MRI (magnetic resonance imaging) findings**

Severity of dysarthria	MRI (changes)		
	slight	moderate	1 marked
Standard deviation	0.54	0.76	1.43
Mean value	3.281	2.614	2.925
Statistical analysis (t-Student test)	p<0.014		
	p>0.452		
	p>0.654		

Figure 2. **Severity of articulatory disorders in relation to the range of damage revealed by MRI**



Conclusions

Severity of dysarthric disorders, especially of articulatory defects, correlates with structural changes revealed on CT and with their intensity detected on MRI. CT and MRI findings can be useful for the prognosis of the severity of speech dysfunction in children with cerebral palsy, allowing early programming of the therapeutic process.

References

1. Jastrzębowska G. Zaburzenia dyzartryczne u dzieci. In: Logopedia. Pytania i odpowiedzi. Gałkowski T, Jastrzębowska G, editors. Opole: Wyd. Un. Opolskiego; 1999, p. 406-28.

2. Kułak W, Sobaniec W, Kubas B. Obraz MR w spastycznym mózgowym porażeniu dziecięcym w korelacji z rozwojem ruchowym i stopniem upośledzenia umysłowego. Pol J Radiol, 2004; 69: 41-7.

3. Feldman HM, Scher MS, Kemp SS. Neurodevelopmental outcome of children with evidence of periventricular leukomalacia on late MRI. Pediatr Neurol, 1990; 6: 296-302.

4. Tarkowski Z. Dyzartria. Teoria i praktyka. Lublin: Wyd. Fundacji „Orator"; 1999.

5. Kułak W. Neurofizjologiczna i obrazowa ocena uszkodzenia i plastyczności mózgu dzieci z mózgowym porażeniem dziecięcym. Praca habilitacyjna, Białostocka Biblioteka Padaczki, Tom VII, Białystok 2005.

6. Kądzielawa D. Zaburzenia językowe po uszkodzeniach struktur podkorowych mózgu. In: Związek mózg–zachowanie w ujęciu neuropsychologii klinicznej. Lublin: Wyd. UNCS; 1998, p. 141-58.

7. Renard JL, Baudelle E, Nioche C. Crossed anarthria and a dissociated lateralisation of language. Rev Neurol, (Paris), 2005; 161: 829-31.

8. Coleman LT, McCubbin JP, Smith LJ. Syntelencephaly presenting with spastic diplegia. Neuropediatrics, 2000; 31: 206-10.

9. Otapowicz D, Sobaniec W, Kułak W, Okurowska-Zawada B. Time of cooing appearance and further development of speech in children with cerebral palsy. Rocz Akad Med Bialymst, 2005; 50 (Supl. 1): 78-81.

10. Stecko E. Zaburzenia mowy u dzieci.Wczesne rozpoznanie i postępowanie logopedyczne. Warszawa: Wyd. Un. Warszawskiego; 2002.