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A STUDY OF THE EFFECT OF BRONCHODILATATION ON SPEECH FLUENCY IN STUTTERING

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A b s t r a c t

Stuttering is a serious health and social problem that can distinctively affect not only the mental development of an individual but also their life possibilities, including social fulfilment and general life prospects. The aetiology of stuttering is, however, unknown and therefore it is not possible to treat it causally. In a pilot study carried out in six centres in the Czech Republic in accordance with a unified protocol for a period of 6 months, 42 patients were included. They were divided into two groups: A (school children and juveniles with a plan of 30 subjects) and B (adults aged 18–25, resistant to other treatment with a plan of 10 subjects). For six months, the patients received a bronchodilatation substance, formoterol, exerting its influence via $ß_2$ receptors. It was administered once daily in the morning in a dose of 12 μg. During 6 months, the evaluation of effectiveness on the basis of primary and secondary parameters was realised in each patient. The prime parameter, "extent of stuttering", was evaluated according to the ordinary scale (McGill Pain Questionnaire). The extent of stuttering was evaluated by an examining physician during the visits in centres and by the patients themselves (in case of the youngest with the assistance of a parent) on daily basis, recorded in the patient's diary. Initial EEG and EMG examinations were realised, biochemical tests performed at the beginning and at the end of the testing period. Spirometric values measured with the help of impulsed oscillometry, heart frequency variability, and tape records of speech fluency were recorded four times throughout the testing period. A non-parametric pair test (Wilcoxon signed rank test) was used for the comparison of average marks in the whole set of patients.

K e y w o r d s

Stuttering, Bronchodilatation, Patient's diary

INTRODUCTION

Stuttering is "explicitly" a disease *(1)*. It is a serious health and social problem that can distinctively affect not only the mental development of an individual but

also their life possibilities, including social fulfilment and general life prospects. A paraphrased description of stuttering is from the introduction to "Speech Fluency Disorders" by *Milan Lašťovka,* a former head of the Prague Phoniatrics Department of the First Medical Faculty of Charles University in Prague. In another part of his publication he writes that in 1934 Seeman formulated a presumption that the symptoms of stuttering do not emerge directly from striopallidal pathological and anatomical changes but are brought about by subsequent striopallidal dynamic deviations after strong affects. Seeman "starts from the fact that somatic symptoms which accompany strong emotional experiences manifest insufficient absorbing of subcortical mechanisms by the activity of cerebral cortices. Some somatic changes that we can observe in affects are the results of increased irritation of sympathetic divisions that are attended by increased secretion of adrenalin. He also thought that these states were not permanent and they could not sustain by themselves but were caused again and again by repeated conflict situations. For fear of stuttering the activity of the striopallida is broken, which results in a rise of hypertonia and hyperkinesis in the musculature of the vocal organ. In the end only a light stagger in speech or only an image of disability to pronounce a certain sound is enough to arise such intense excitement that it provokes another attack of stuttering." In the end, Lašťovka states that: "From all opinions and theories about the origin of stuttering we can conclude that all these theories agree in fact that stuttering is a central disorder in motorics conducting in which emotions play a dominant role. The aetiology of stuttering is, however, unknown *(2)* and that is why it is impossible to treat it causally in spite of research including numerous literary sources *(3*, *4)*.

Seeman *(5)* prompts that "most physicians should not behave completely unconcernedly towards the treatment of stuttering and that the treatment of this disease should be only in the hands of specialists without any medical education". His wish has until now not spread either to medical sphere or to pedagogic sphere yet. At present there are reasons for disappointment: – towards the end of the first half of the 19th century the German preacher Blume, to whom Vesely refers at the end of the 19th century *(6),* and Seeman in 1953, the situation has unfortunately not changed for people who suffer from stuttering significantly, anyhow.

Despite the fact that Seeman admitted that it was possible to find frequent deviations of respiratory motions in stutterers pneumographically, he assumed that their breathing at rest was completely unbroken *(5)*, *(1)*. Let us make notes to further new pieces of knowledge emerged from functional pulmonary investigation in children and young people with stutter *(7)*. Functional pulmonary examinations were made in 60 children and young people and their static pulmonary volumes, their mutual relations and ventilation values could be compared with the results of the examinations of a group of healthy children and juveniles *(8)*. The following results were found: – a volume reduction of all pulmonary capacities, a reduction of the relation of inspiratory capacity towards the expiratory reserve volume and, on the contrary, an increase of the relation of residual volume towards the total pulmonary

capacity and an increase of the relation of functional residual capacity towards the total pulmonary capacity. One-minute ventilation values were found considerably spread and totally reduced; perturbations were found at increased flow resistance and proportionately decreased specific conductivity. Probably the most suspicious functional parameter of the lungs is decreased specific conductivity 1.08 ± 0.48 l/s/kPa/l ($P < 0.0001$) compared to healthy population, where its value is 1.97 ± 0.45 l/s/kPa/l. Obviously the same cause, i.e. decreased specific conductivity, results (in children and juveniles with stutter) in a shift of the respiratory position at rest into the inspiratory position of the chest compared to respiratory volume in healthy population.

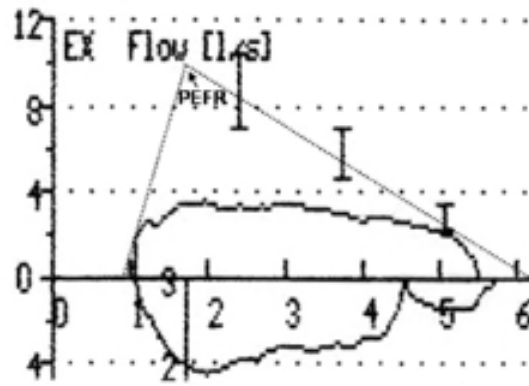

Fig. 1
A record of the flow volume of a stutterer

For the evaluation of obstruction of the respiratory organs the declining part of the flow volume (or rate volume) curve is the most important. In *Fig. 1*, the top expiratory rate PEFR is missing. The declining part of the expiratory arm in stuttering does not even reach the tolerance supposed by the computer programme. The described pulmonary pathology is probably the suspicious cause of stuttering *(9)*, *(10)*. It was, by the way, known already in previous civilisation stages and it has been known for about four millennia *(11)*. *Richard Kitchen* and *Van Riper (12)* collected the names for stuttering all over the world: – in 21 nations and nationalities in Europe, – in 15 state formations in the East, out of them 11 in the languages of India, in 10 nationalities in Africa, – in four areas on the American continent, among others in 11 Indian tribes, and in 3 areas in the Pacific islands. From the etymological point of view, there are more than 70 nouns that have been created by various onomatopoeic imitations of iterative speech manifestations of speech disturbed by stuttering. Thus, stuttering is a communication disorder abounding independently of the locality, population type, etc.

The occurrence of stuttering in children at the age of about 6 years, i.e. in the stage of schooling preparedness, is described in the illustrative *Fig. 2.*

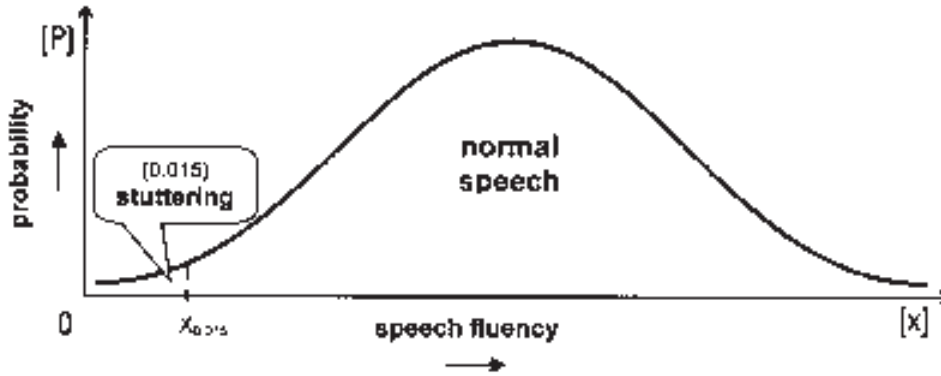

Fig. 2
In the period of school maturity about 1–2 % of children suffer from stuttering. There is a parameter of speech fluency thought on axis x, $x_{0.015}$ is orientational indication of the position of 1.5 percentile. On axis y "P" is the probability of stuttering occurrence

From the fact that in a part of stutterers stuttering spontaneously improves in adulthood, a false impression arises that stuttering does not deserve such great attention. Even if stuttering can improve spontaneously, it is necessary to note that it does not happen without any consequences.

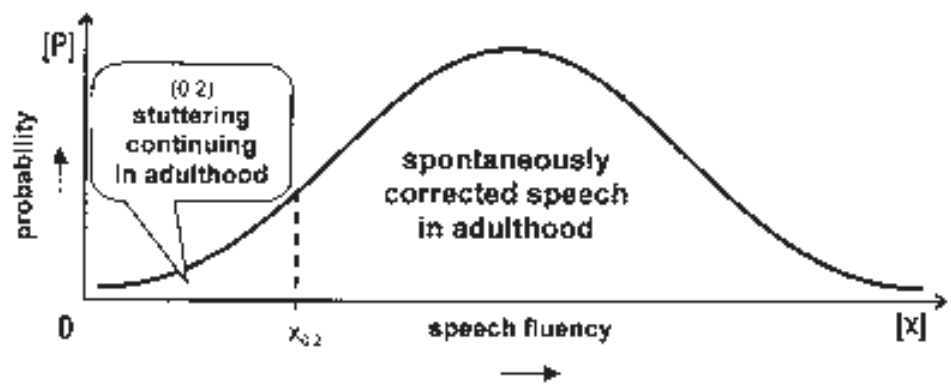

Fig. 3
Incidence of spontaneously unimproved stuttering. The parameter of speech fluency manifestation is on axis x, $x_{0.2}$ is approximate indication of the position of 1.5 % percentile. „P"on axis y is the probability of occurrence of the observed speech disorder-stuttering.

Spontaneous improvement happens during the concurrence together with frustration. In cases of severely stuttering individuals, frustration can displace them from their life positions; even a case is known when a thirteen-year-old boy who stuttered decided to end his life voluntarily *(13)*. The quantification of stuttering which does not improve spontaneously is shown in *Fig. 3 (14).*

MATERIAL AND METHODS

The seminar of the Department of Paediatrics with the main topic called "Stuttering in children and juveniles" *(15)* can be taken as an institutional beginning of the genesis of the study of bronchodilatation influence on speech fluency in stuttering. On its basis a block of lectures about the disorders of children speech was prepared on the XXIst Days of Clinical and Practical Paediatrics where, among others, reports were also presented on the first experience with the stuttering therapy *(16)*, *(17)*. On the basis of the presented findings and after a consultation with the Ethics Committee of the Medical Faculty of Palacký University and the Faculty Hospital in Olomouc on 12th May 2003, an agreement was given with the realisation of a clinical study according to the version that was presented by our documentation, whereas the Ethics Committee at the same time recommended: – to submit an application for the realisation of the clinical study to the SUKL (State Institute for Pharmaceutical Control), – to realise the presented study as an open pilot study with a given bronchodilatation preparation, formoterol, – in the next phase to realise a further study with a placebo group, and,if necessary, another one in combination with a psychopharmacological agent *(18)*.

The preparations of basic data *(18)* for the study including its following monitoring with regard to the Helsinki Declaration of the World Medical Association, especially to the revised version of 2000. 09. 01. Providing recommendations for physicians that deal with medical research on human beings, were undertaken by the Brno branch office of the Vienna company ZAK-Pharma.

In October 2003, in the framework of preparations, a meeting of examiners took place. Examiners – lady doctors with phoniatrics qualifications presented in Table 1 took part in it. Of the original team of examiners, two participants withdrew from the study beforehand, because they did not have any direct contacts with local speech therapy centres, where at present they have been meeting stutterers practically without any help paradoxically most frequently. From the example of these accidentally chosen candidates for centres it results that only in 75 % of the phoniatrics clinics there were more or less appropriate conditions for treatment of patients with stutter.

In a pilot study that was carried out in 6 centres in the Czech Republic (nos. 2–7) in accordance with a unified protocol for a period of six months 40 patients were included (+ 2 for potential substitutes) with the diagnosis of stuttering (F98.5). The patients created 2 groups: A (school children and juveniles with a plan of 30 subjects) and B (adults 18–25 resistant to other treatment with a plan of 10 subjects), see *Tab. 1*.

The bronchodilatation substance of formoterol was given to the patients. This substance works through $ß_2$ receptors for a period of 6 months. The medicine was administered once a day in the morning (by 10 a.m.) in a dose of 12 μg (one inhalation capsule). During the 6 months the evaluation of effectiveness on the basis of primary and secondary parameters was realised in every patient. The prime parameter "Extent of stuttering" was evaluated according to the ordinary scale K: 1 = excellent, 2 = tolerable "so – so", 3 = bad, 4 = terrible, 5 = unacceptable – McGill Pain Questionnaire *(19)*. The extent of stammering was evaluated by the examining physician during visits in centres and currently by the patient himself (in cases of the youngest with the assistance of a parent) and every day it was written down in the patient's diary. As an introduction EEG and EMG examinations were realised; at the beginning and at the end biochemical examinations were made and four times on the whole measurements of spirometric values by impulsed oscillometry and heart frequency variability measurements and records of speech fluency.

Table 1

Sets of patients – group A (school children and juveniles with a plan of 30 subjects) and group B (adults 18–25 resistant to other treatment with a plan of 10 subjects)

Group	**A**		**B**	
Gender	**men**	**women**	**men**	**women**
Number	**28**	**8**	**5**	**2**
$\bar{x}$ **[age]**	**11.35**	**13.63**	**21.60**	**19.50**
s [age]	**2.68**	**3.24**	**2.68**	**2.20**

RESULTS

According to the records in the Patient's Diary (i.e., evaluation of speech fluency by marks from 1 to 5, which was done by the patient himself/herself) there were 3 average marks calculated in every patient: – an average mark that evaluated the speech fluency in the period without formoterol use, – an average mark that evaluated the speech fluency in the first period of formoterol use, i.e. from the 1st to the 3rd month, – an average mark that evaluated the speech fluency in the second period of formoterol use, i.e. from the 4th to the 6th month.

A non-parametric pair test (Wilcoxon signed rank test) was used for the comparison of average marks in the whole group of patients (n=42) at a significance level of 0.05.

Table 2

The table contains detailed results of the study BZ-0003-BR

	Average mark without formoterol	Average mark with formoterol (1^{st} – 3^{rd} month)	Average mark with formoterol (4^{th} – 6^{th} months)
N	**42**	**42**	**42**
Minimum	**2.00**	**1.46**	**1.08**
Maximum	**5.00**	**3.66**	**3.82**
Median	**2.92**	**2.38**	**2.28**
Mean	**2.94**	**2.49**	**2.32**
Standard deviation	**0.63**	**0.47**	**0.58**

The test showed a statistically significant difference between the average marks in the period without the use of formoterol and in the first period of use, i.e. from the first to the third month. The speech fluency evaluation was assessed as lower in the first period of formoterol use, i.e. by a better mark than in the period without any application of formoterol. A statistically significant difference was found between the average marks in the period without any application of formoterol and in

the second period of application, i.e. from the fourth to the sixth month. The speech fluency evaluation in the second period is assessed as lower, i.e. by a better mark than in the period without application of formoterol. The first period differs statistically significantly from the second. The speech fluency is evaluated by a better mark in the second period of formoterol application. Detailed results are shown in *Tab. 2* and diagrams in *Fig. 4*.

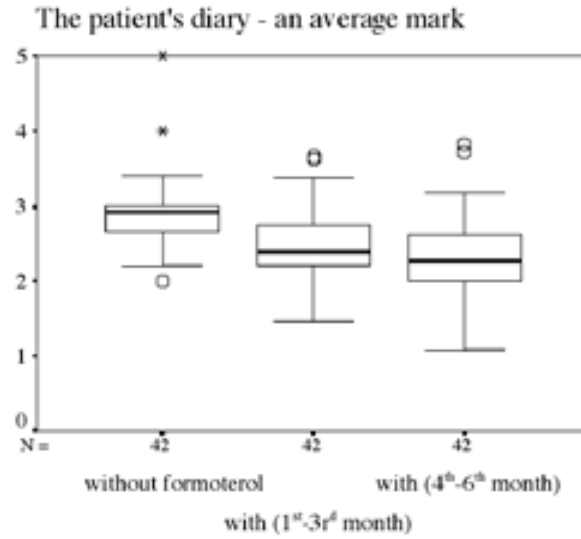

Fig. 4
The position of a median of average marks is drawn by a strong horizontal line for each period. The bottom and the top of the box identify the positions of the 1st and the 3rd quarts. The height of the box corresponds with the so-called interquartile span, as the characteristics of data variability. With each box there are marked positions of minimal and maximal non-distant values, distant values (so called outliers) are displayed as circles

DISCUSSION

At present, there are the first statistically processed records from the study BZ-0003-BR, i.e. records of speech fluency evaluation by the parents of the youngest patients and the rest of patients from the Patient's Diary. Statistical evaluation of the remaining data that were gained by the study still continues. Due to a great extent of the basic data acquired, further results will be published later. Only preliminary case records of the effectiveness of formoterol *(20, 21),* which are still being monitored in the case of subject P.B. from references *(16, 17)*, have been published so far.

CONCLUSION

The statistically significant decrease (improvement) of the average marks of speech fluency self-evaluation was proved by the Wilcoxon signed rank test. The self-evaluation was performed by patients with stutter according to the ordinary scale K (see chapter MATERIAL and METHODS as mentioned above) in the period without application of formoterol, in the first period of application, i.e. from the 1st to the 3rd month, and in the second period of application, i.e. from the 4th to the 6th month of the pilot study BZ-10003-BR Verification of bronchodilatation influence on speech fluency in juveniles and adults with stutter – part of the research project "MŠM 152100018".

A c k n o w l e d g e m e n t

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STUDIE VLIVU BRONCHODILATACE NA PLYNULOST ŘEČI U BALBUTIKŮ

S o u h r n

Koktavost je onemocnění. Je to závažný zdravotní a sociální problém, který může výrazně poznamenávat jak duševní vývoj jedince, tak i jeho možnosti, včetně společenského uplatnění a jeho celkových životních vyhlídek vůbec. Etiologie koktavosti je neznámá a stále ji proto nelze kauzálně léčit. V pilotní studii, která probíhala v České republice v šesti centrech podle jednotného protokolu po dobu šesti měsíců, bylo zařazeno 40 pacientů s diagnózou koktavost (F98.5). Pacienti vytvořili dvě skupiny: A – děti školního věku a mladiství a B – dospělí ve věku 18–25 let rezistentní na jinou léčbu. Pacientům byla po dobu 6 měsíců podávána bronchodilatační látka formoterol působící prostřednictvím $ß_2$receptorů. Přípravek byl aplikován jednou denně ráno (do 10 hodin) v dávce 12 μg. V průběhu 6 měsíců bylo u každého pacienta prováděno hodnocení účinnosti na základě primárních a sekundárních parametrů. Primární parametr Míra koktavosti byla hodnocena podle ordinární Škály K (McGill Pain Questionnaire). Míra koktavosti byla hodnocena zkoušejícím lékařem při návštěvách v centrech a pacientem (u nejmladších za asistence rodiče) každodenně a zapisována do Deníku pacienta. Úvodem bylo provedeno EEG a EMG vyšetření, na počátku a na konci biochemická vyšetření a celkem čtyřikrát měření spirometrických hodnot impulsní oscilometrií, hodnocení variability srdeční frekvence a mgf. záznamy plynulosti řeči. Wilcoxon signed rank test byl použit pro srovnání průměrných hodnot v celém souboru pacientů.

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