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COMPARATIVE ASSESSMENT OF PROGNOSIS OF THE DIAGNOSTIC POSSIBILITIES OF THE STOP-STIMULUS AND TRAPEZOIDAL ROTATION PROGRAMS

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Translation of "Sravnitel'naya otsenka dlya prognoza diagnosticheskikh vozmozhnostey vrashchatel'nykh programm--stop-stimula i trapetseydal'noy," Vestnik Otorinolaringologii, No. 2, Mar-Apr 1980, pp 30-33

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16. Abstract
For prognosis of the diagnostic possibilities of the stop-stimulus and trapezoidal rotation programs, with respect to the nystagmus response, 24 healthy young persons with normal auditory and vestibular analysers were studied experimentally. The trapezoidal program more accurately reflects the function and tone balance of the vestibular system than the stop-stimulus program and causes the subject no unpleasant sensations during the study. Some optimum couples, acceleration and armchair rotation rate, necessary for effective deviation of the cupuloendolymphatic system, were determined. The maximum angular velocity of the slow nystagmus component was more informative than nystagmus duration. The trapezoidal program is recommended for otoneurological practice and the maximum angular velocity of the slow nystagmus component, as the basic index.

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ANNOTATION

An experimental study was conducted for prognosis of the diagnostic possibilities of two rotation programs (stop-stimulus and trapezoidal) with respect to the nystagmus response. Twenty-four healthy young persons with normal auditory and vestibular analyzers were studied. It is evident from the results obtained that the trapezoidal program reflects the function and tone balance of the vestibular system more accurately than the stop-stimulus program, and that it causes the test subjects no unpleasant sensations during the study. Some optimum couples also were determined (acceleration and armchair rotation rate), necessary for effective deviation of the cupuloendolymphatic system. Of the two indices considered, the maximum angular velocity of the slow nystagmus component is more informative than nystagmus duration. The trapezoidal program is recommended for otoneurological practice and the maximum angular velocity of the slow nystagmus component, as the basic index.

COMPARATIVE ASSESSMENT OF PROGNOSIS OF THE DIAGNOSTIC POSSIBILITIES OF THE STOP-STIMULUS AND TRAPEZOIDAL ROTATION PROGRAMS

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The Barany test [1] is one of the basic tests which, in connection /3
with the simplicity of the equipment used and procedure, is used in otoneurological practice. With improvement in the design and introduction of special electrical rotating armchairs with recording devices, the trapezoidal program has become popular. In using it, the rotational and postrotational nystagmus is recorded simultaneously, and the test subject does not have such a degree of pronounced unpleasant sensations as in stop-stimulus.

Various experimenters use stimuli of varied magnitude in the trapezoidal program. For example, A.Ye. Kurashvili and V.I. Babnyak [4] used a 20°/sec^2 angular acceleration and an 80°/sec maximum angular rotation rate in their studies.

According to the principle of Mulder [1908], the deviation of the cupula equals the product of the acceleration and the time of action. The question arises as to which are the most effective and informative limits, within which the principle of Mulder is utilized.

Material and Method

The study was conducted on healthy people (24 men from 17 to 28 years old), without sujective or objective data on diseases of the auditory or vestibular analyzers. Two rotation programs were performed, by means of a Tonnies type electrically rotating armchair: stop-stimulus from rotation at an angular velocity of 90°/sec to the right and left, and trapezoidal rotation with the following angular accelerations and velocities: 4°/sec^2, 90°/sec; 8°/sec^2, 90°/sec; 12°/sec^2, 120°/sec;

*Numbers in the margin indicate pagination in the foreign text.

$20°/sec^2$, 160°/sec; $30°/sec^2$, 180°/sec; $40°/sec^2$, 180°/sec. Rotation was performed in both directions (alternation of left and right rotation). Each program was performed on different days. Postrotational nystagmus was recorded for the stop response after rotation in both directions. In performance of the trapezoidal program, the rotational (during positive acceleration) and postrotational (during negative acceleration) nystagmus was recorded for each acceleration.

In both rotation programs, we noted 2 nystagmus indices, the dura- /31
tion of the response and the maximum angular velocity of the slow nystagmus component. Selection of the indices was determined by the fact that the duration of the response was determined to a greater extent by the functional state of the central nervous system than by processes in the peripheral vestibular system [3] and, on the other hand, the angular velocity of the slow nystagmus component completely reflects the activity of the receptors of the vestibular system [Henriksson, 1955].

Results and Discussion

The average duration of nystagmus in both programs is presented in Table 1. The results obtained and statistical processing according to Student-Fisher indicate the lack of significant difference in the duration of the nystagmus response, despite stimuli of different strengths. The regularities determined are consistent with the statement of Mittermaier [1965], according to whom, the duration of the response depends little on stimulus strength.

After calculating the percent asymmetry between the rotational and postrotational nystagmus separately for both rotations in the trapezoidal program, according to the formula of Visser [5], we determined that the postrotational nystagmus (with negative acceleration) is longer than the rotational (with positive acceleration) nystagmus, in accordance with the hypothesis of Barany [1] and the theory of V.I. Boyachek [2], on detonations in the vestibular centers.

Based on the results obtained, it can be stated that the duration of the response is a poorly informative index. The ratio of the duration of the rotational and postrotational nystagmus in the trapezoidal program is more informative. A perturbation of this relationship, with the development of asymmetry in favor of rotational nystagmus and a difference of 15% or more, can be a pathological manifestation in the vestibular system. However, this requires experimental confirmation.

TABLE 1. DURATION OF NYSTAGMUS (SEC) IN USE OF TRAPEZOIDAL AND STOP-STIMULUS ROTATION PROGRAMS

a	b				c Асимметрия, %	
	d	e	d	e (−) конечное	g вращение	
	f					
	h	i	i	h влево	h влево	i вправо
	j		k при вращении вправо			
4	[illegible]	54,08	48,42	50,0	7,35→D	1,61→S
8	[illegible]	48,82	42,82	47,36	14,63→D	5,03→S
12	[illegible]	48,75	38,92	45,33	13,37→D	7,61→S
20	35,50	45,92	33,75	46,33	12,8→D	15,71→S
30	32,0	44,75	35,0	42,42	16,61→D	9,58→S
40	32,08	44,42	33,17	42,50	16,13→D	12,33→S
l Стоп от 90		43,52	40,39		3,73→D	

Note: Here and in Table 2, →D is predominance of nystagmus duration to the right; →S is predominance of nystagmus duration to the left.

Key:
- a. Acceleration, degree/sec^2
- b. Acceleration
- c. Asymmetry, %
- d. Initial
- e. Final
- f. Direction of nystagmus
- g. Rotation
- h. To the left
- i. To the right
- j. During left rotation
- k. During right rotation
- l. Stop from 90

What can be said of the magnitude of the stimulus and its duration? Data are presented in Table 2, on the averaged maximum angular velocities of the slow component of the nystagmus response, after the stop-stimulus and during rotation in the trapezoidal program. The asymmetry between the rotational and postrotational nystagmus was calculated separately for left and right rotation, by the formula of Visser [5]. /32

TABLE 2. MAXIMUM ANGULAR VELOCITY OF SLOW NYSTAGMUS COMPONENT (DEGREE/SEC^2) DURING USE OF THE TRAPEZOIDAL AND STOP-STIMULUS ROTATION PROGRAMS

a Величина ускорения, град/с²	b Ускорение				c Асимметрия, %	
	d (+) начальное	e (−) конечное	d (+) начальное	e (−) конечное	g вращение	
	f направление нистагма					
	h влево	i вправо	i вправо	h влево	h влево	i вправо
	j при вращении влево		k при вращении вправо			
4	34,82	36,4	40,1	33,7	2,2→S	8,7→D
8	45,5	44,57	49,89	43,6	1→S	6,7→D
12	60,48	57,85	63,37	57,63	2,2→S	4,7→D
20	91,34	89,77	93,2	88,9	1→S	2,3→D
30	101,85	98,47	108,79	106,06	1,7→S	1,3→D
40	112,76	102,12	126,82	109,34	4,9→S	7,4→D
l Стоп от 90		64,28		65,22	0,73→S	

Key:
a. Acceleration, degree/sec^2
b. Acceleration
c. Asymmetry, %
d. Initial
e. Final
f. Direction of nystagmus
g. Rotation
h. To the left
i. To the right
j. During left rotation
k. During right rotation
l. Stop from 90

During rotation with a 30°/sec^2 acceleration and 180°/sec velocity, i.e., during a 6 sec stimulus time, almost symmetrical nystagmus responses are obtained in both directions. Consequently, during the so called physiological acceleration of 30°/sec^2, in the time required for effective deviation of the cupuloendolymphatic system, a tone balance is observed in healthy persons, which is expressed by the maximum velocity of the slow nystagmus component. However, the magnitude of this acceleration is substantial, and its use in clinical practice is not advisable.

In connection with what was stated above on the stimulus and its duration, an optimum couple must be selected (acceleration and rotation rate), which simultaneously is sufficient to reach the maximum angular velocity of the slow nystagmus component, i.e., effective deviation of the cupuloendolymphatic system.

For this purpose, we studied groups of healthy persons in the trapezoidal program, with a series of experimental accelerations. The following optimum pairs were obtained (acceleration and rotation rate):

$4°/sec^2$, 80°/sec; $6°/sec^2$, 100°/sec; $8°/sec^2$, 120°/sec; $12°/sec^2$, 150°/sec; $20°/sec^2$, 160°sec; $30°/sec^2$, 180°/sec. The results presented above concern only positive accelerations.

For clinical diagnosis, a pair (acceleration and velocity) must be selected, which is the most appropriate for a given case.

Conclusions

1. The trapezoidal program is more informative than the stop-stimulus, since it more accurately reflects the function and tone balance of both vestibular systems, and it does not cause the test subject unpleasant sensations.

2. The maximums angular velocity of the slow nystagmus component in the trapezoidal program gives considerable information on the function and excitability of the vestibular system, and it can be used as the basic index in otoneurological diagnosis. /33

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