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Dizziness in the Office Employees with Hypertension, Posturography Reveals Vestibular Trigger.

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Abstract

Background: It is widespread opinion that cardiovascular disorders can cause dizziness or vertigo. The evidence basis for this statement is poor. That is why the problem of this presentation is establishing of the relationships between vestibular and vascular dysfunction.

Material and methods: 123 patients (office employees) have been studied, with average age of 52,34 ± 14,82 y.o., out of them 42 males and 81–females. In 51 persons blood pressure (BP) has been increased. Patients with normal BP have been considered to be control group (n=72). BP measurement at the moment of examination has been performed, as well as posturography with the help of posturographic platform "Micromedical Technologies, Inc." (USA), sensory organization test (SOT) has been done.

Results: The significant decrease of vestibular function has been found in the hypertensive patients: 88,92 ± 24,91% and 68,29 ± 33,01%, Cd=23,20% (Cd absolute figure is almost the same value as for blood pressure). Difference significance according to F-test p=0,17, and T-test p=0,01. Sway square increase in the hypertensive patient group has been the greatest – from 0,08 ± 0,05 to 0,34 ± 1,00 m2, Cd=325,00%, with difference significance according to F-test p=1,89E-24, and T-test p=0,18, thus manifesting the presence of qualitative, related to hypertension difference between the groups and underlining importance of sway square studies with eyes closed in the patients with arterial hypertension.

Conclusion: Vestibular dysfunction might be among the triggers of hypertension.

Keywords: Vestibular, Hypertension, Posturography, Sway square

Introduction

Technical progress changes our life: among managers, researchers, statisticians, clerks, - most used are now computer technologies. Long stay at the screen causes dizziness, as most common complaint. Dizziness is met in more then 20% of Global population. It appears to be the third reason of patient admittance to the doctor in USA [1]. According to Cochran reports a nationally representative sample of 4869 adults living in Germany being screened for dizziness, and 1003 individuals with dizziness underwent validated neurootologic interviews to differentiate vertigo from dizziness according to explicit diagnostic criteria. Dizziness/vertigo has a prevalence of 22.9% in the last 12 months and an incidence (first episode of dizziness/vertigo) of 3.1%. For vertigo, the prevalence is 4.9% and the incidence is 1.4%. 1.8% of unselected adults consulted a physician in the last 12 months for dizziness/vertigo (0.9% for vertigo) [2]. Other authors describe the situation as being even more pessimistic: 36% of females and 29% of males are complaining of dizziness. After 88-90 y.o. the figures increase to 51-45%, respectively [3]. In some countries they report dizziness prevalence up to 39%, though these data have lack of evidence [4]. At the same time it is estimated that there are more than 50 mln hypertensives in USA and it occurs

more in blacks (38%) than in whites (29%). Among the reasons of dizziness and vertigo they indicate circulatory reasons: transient vertebrobasilar ischemic attacks [5], but no evidence basis is provided. From the other side, at a big material it has been found no correlation between vertebrobasilar occlusions and dizziness [6]. Therefore the problem of this presentation has been the establishment of the relationship between hypertension and dizziness.

Materials

123 patients (office employees) have been studied, with average age of 52,34 ± 14,82 y.o., out of them 42 males and 81 – females, with average height of 168,25 ± 8,46 cm, weight - 76,24 ± 16,09 kg. All the patients have complained of dizziness (R42). Stress has been the reason of the disease in 35, 77% patients, without reason - 17, 89%; other patients have different reasons with frequency less than 10%. In the whole group at the moment of study blood pressure has been: systolic (SBP) – 132, 22 ± 22, 11 mm Hg, diastolic (DBP) – 84, 44 ± 12,26 mm Hg. In 51 persons (43, 09%, group of study) BP has been increased: in 36 (29, 27%) patients SBP is 140 mm Hg and more, in 43 (34, 96%) patients DBP has been 90 mm Hg and more. Both SBP and DBP increase being recorded in 27 (21, 95%) patients, in 9 (7, 32%) patients only SBP, and in 16 (13, 01%) – only DBP. Patients with normal BP have been considered to be control group (72 persons, 56, 91%). Average age of group of study is 56, 10 ± 14, 33 y.o., while control - 50, 05 ± 14, 56 y.o. (difference significance according to F-test p=0,917, and T-test p=0,024). There are 72, 37% females and 27, 63% males in the group of study and in the control group 59, 62% females, and 40, 38% – males. Average height of the group with normal BP is 168,00 ± 7,74 cm and with increased - 168,68 ± 9,50 cm (difference significance according to F-test p=0,12, and T-test p=0,68), average weight for group with high BP – 73,10 ± 13,91 kg, control – 80,96 ± 17, 78 kg (difference significance according to F-test p=0,06, and T-test p=0,01). Weight changes in the control group (-) 0, 80 ± 6, 26 kg, and with high BP – (+)1,62 ± 6,81 kg (difference significance according to F-test p=0,48, and T-test p=0,049). BP in control group is 118,38 ± 12, 14/76, 19 ± 8,53 mm Hg and with high BP 148,98 ± 19, 76/94, 44 ± 7, 83 mm Hg (difference significance for SBP according to F-test p=0,00039, and T-test p=2,56 E-15 and for DBP difference significance according to F-test p=0,53, and T-test p=1,05E-21, coefficients of change being 25,85% and 23,95% correspondingly).

Methods

Blood pressure measurement at the moment of examination has been performed with UA-787 (A&D Medical, Japan). Posturography has been performed with the help of posturography platform “Micromedical Technologies, Inc.” (USA), sensory organization test (SOT) has been done as it is described in the literature [1]. Statistics is performed with excel standard software pack.

Results

Percentage from ideal performance of Romberg test at the stable platform with eyes open for normotensive persons has been 97,92 ± 1,02%, and for hypertensive – 97,67 ± 1,12%, coefficient of difference C_d=0,26%, (difference significance according to F-test p=0,63, and T-test p=0,40), thus indicating the absence of the difference in this parameter. Sway squares in the normotensive group appeared to be 0, 06 ± 0, 02 m^2, hypertensive – 0,07 ± 0,05 m^2, C_d=16,67%, difference significance according to F-test p=0,001, and T-test p=0,46, indicates the presence of qualitative difference in the groups and importance of sway square studies in the future in the hypertensive patients. Sway peak velocities in the normotensive patients have been in the frame of 0,04 ± 0,05, and in patients with hypertension – 0,06 ± 0,07 m/s, C_d=50,00%, (difference significance according to F-test p=0,56, and T-test p=0,31, which indicates rather big level of initial data dispersion resulting in the fact that the data appeared to be insignificant.

Closing the eyes has caused miserable as to absolute figure values of the Romberg test performance percentage changes from 96,96±1,20% in the normotensive patients to 95,23 ± 4,15% in the patients with hypertension C_d=1,78%, (difference significance according to F-test p=5,68E-08, and T-test p=0,037, indicating the presence of both qualitative and quantitative difference between groups of study. This result also demonstrated great independence of the parameters of variative and comparative statistics. Sway square increase in the hypertensive patient group has been the greatest – from 0,08 ± 0,05 to 0,34 ± 1,00 m^2, C_d=325,00%, with difference significance according to F-test p=1,89E-24, and T-test p=0,18, thus manifesting

the presence of qualitative, related to hypertension difference between the groups and underlining importance of sway square with eyes closed in the patients with arterial hypertension. Significantly greater C_d of sway square, compared to the one for blood pressure differences support the idea that just vestibular disorder is the leading process resulting in the quality change – appearance of hypertension. Therefore, this result indicates that vestibular dysfunction causes arterial hypertension. Sway peak velocities also have significantly increased with eyes closure from 0,08±0,04 to 0,12±0,11 m/s, C_d=50,0%, difference significance according to F-test p=4,47E-06, and T-test p=0,12, indicating again the presence of qualitative and absence of quantitative difference between groups.

Vision perturbation in the form of the rotating picture has allowed to reveal miserable according to absolute values impairment of Romberg test performance in the hypertensive patients: 96,50 ± 1,18% and 95,30 ± 3,37%, correspondingly and Cd=1,00%, difference significance according to F-test p=2,38E-06, and T-test p=0,078. One may pay attention at the qualitative difference, related to hypertension and important role of optokinetic reactions examination in the patients with arterial hypertension. Sway squares have increased in this study from 0,10 ± 0,05 to 0,19 ± 0,42 m^2, C_d=90%, difference significance according to F-test p=2,10E-15, and T-test p=0,23, which indicates the presence of qualitative difference between the groups and importance of sway square in the hypertonic patients in the future. Sway peak velocity has increased by 10%: 0,10 ± 0,04 and 0,11 ± 0,08 m/s correspondingly, $К_в$=10,00%, with difference significance according to F-test p=0,00046, and T-test p=0,37, indicating that the difference is dependent from the quality of pathology – hypertension and importance of optokinetic tests studies in hypertensive patients. Correlation analysis has shown that it is just complaints of optokinesis are correlating with hypertension [7].

Later on, the same tests have been repeated at the condition, when the platform is hanged on the springs. With eyes open Romberg test performance is worth in the hypertonic patients: 95, 71 ± 1, 78% and 94, 45 ± 1,73%, C_d=1,32%, difference significance according to F-test p=0,00052, and T-test p=0,11, indicating the presence of qualitative hypertension dependent difference between groups. Sway square in the hypertensive patients has appeared to be much greater: 0, 18 ± 0, 17 and 0,38 ± 0,66 m^2, C_d=111,11%, difference significance according to F-test p=8,18E-09, and T-test p=0,11, indicating qualitative difference between groups. Sway peak velocity obtained has manifested as being much greater in hypertensive patients: 0, 11 ± 0,05 and 0,14 ± 0,09 m/s, C_d=27,27%, (difference significance according to F-test p=0,0039, and T-test p=0,09). These data disclose significant difference between the groups studied.

Eyes closure has not revealed the decrease of Romberg test performance in the hypertensive patients: 90, 13±7,31% and 85,61 ± 10,23%, C_d=5,01%, difference significance according to F-test p=0,10, and T-test p=0,06, indicating the lack of difference between the groups. Sway squares study has disclosed its significant increase in the patient group with hypertension: 1, 32 ± 1, 89 and 2,96±3,63 m^2, C_d=124,24%, difference significance according to F-test p=4,03E-05, and T-test p=0,08, indicating qualitative difference between groups. Sway peak velocity has appeared to be less in the hypertensive patients 1,24 ± 0,17 and 0,36 ± 0,26 m/s, $К_в$=70,97%, difference significance according to F-test p=0,035, and T-test p=0,043, both qualitative and quantitative significant differences.

Vision perturbation has not allowed disclosing the decrease of Romberg test performance in the hypertensive patients: 93, 00 ± 5, 58% and 90, 61 ± 2, 36%, C_d=2, 57%, (absence of difference significance according to F-test p=0, 21, and T-test p=0, 09). Sway squares study has manifested its little increase in the group of hypertensive patients: 0, 73 ± 1, 63 and 0, 81 ± 0, 66 m^2, C_d=10, 96%, difference significance according to F-test p=1, 02E-05, and T-test p=0, 82, indicating qualitative difference between groups. Sway peak velocity has appeared to be bigger in hypertensive patients: 0, 17 ± 0,14 and 0,22 ± 0,11 m/s, C_d=29,41%, (absence of difference significance according to F-test p=0,11, and T-test p=0,12).

Data analysis provided the information about the condition of the main sensory systems related to balance function. No significant differences in somatosensory function and visual dependence have been obtained. From the other side, significant difference between the groups has been revealed in the visual function decrease in the hypertensive patients: 99, 79 ± 1, 02% and 95, 55± 9, 44%, C_d=4,25%, (difference is significant according to F-test p=2,98E-17, and T-test p=0,019, though both

groups have appeared to be in the normative frame). The most important finding has been the decrease of vestibular function in the hypertensive patients: 88, 92 ± 24, 91% and 68,29 ± 33,01%, C_d=23,20% (C_d absolute figure is almost of the same value as for blood pressure). Difference significance according to F-test p=0, 17, and T-test p=0, 01. The decrease of vestibular function in hypertensive patients has been the only parameter, which moved from the normative limit for hypertensives.

Reviewing the results presented it is possible to note the next facts. Both groups have complained of dizziness. Vestibular function in both groups, without hypertension and with it, is impaired. Parameters characterizing the condition of vestibulo-spinal pathways are especially worth in hypertensive patients. The most exaggerated have appeared to be the sway squares, especially at the stable platform with eyes closed. This test may be proposed as a screening one for routine clinical studies.

Preliminary analysis of sway square parameters has shown that in general they use only the absolute value of the square and not its particular parameters. We know from the literature that the form of sway square (multigon, round, elliptic) and the angle of sway may be important [8]. It has been also shown that different mathematical methods for data interpretation may be used. Monte-Carlo method is proposed for estimation of normal/pathologic condition, method of triangles is suitable for express-diagnostics, for detailed study – extremes and Pick-methods are the ones of choice [9].

Sway peak velocity has smaller difference coefficients in the corresponding tests, except Romberg test, performed at the unstable platform with visual perturbation. This may be useful for future research.

Variative and comparative statistics parameters, especially coefficients of difference, qualitative F-test and quantitative T-test data appeared to be independent. Therefore, for hypertension studies it is necessary to use all the parameters, the highest sensitivity has demonstrated F-test.

Discussion

Vestibulo-spinal reactions studied are provided by lateral (not crossed) and medial (ipsi and contralateral, partly crossed) descending vestibulo-spinal pathways. They are initiated by the neurons of the lateral, medial and descending vestibular nuclei of rhomboid fosse. These neurons have significant amount of visual, acoustic and somatosensory olygosynaptic inputs, which demonstrate the integrative function of vestibular system and its key role in the formation of space perception and interaction with it [10]. In the interaction of living beings with environment, immediate constant blood redistribution between the head and extremities plays vitally important role [11]. It is especially significant in the bipedal creatures. Among the results obtained great values of coefficients of difference are impressive, the figure of which exceeds the blood pressure changes more than 10 times C_d=25, 85% for systolic blood pressure and C_d=325,00% for sway square at the stable platform with eyes closed. This is only possible in the condition of initial impairment of vestibular nuclei. From the other side, it is just the F-test sensitivity in the comparison of the groups described indicates that new quality – hypertension – is provoked by vestibular dysfunction. In the long lasting monitoring it has been shown that vestibular disturbances in patients with radiation disease have started 5-7 years earlier then hypertension [10]. Additional proof for this idea is the fact that vascular and rheological medications have no effect in the case of dizziness [12]. This indicates the necessity of vestibular function correction in patients with hypertension.

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