

An analysis of causes and results of VNG examinations in patients with vertigo and balance disorders in private ENT practice

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ABSTRACT:

Introduction: This study attempted to analyse the most common causes leading to vertigo, vertigo and balance disorders based on gender and age.

Material and methods: Analysis of medical records and evaluation of VNG tests were performed on 608 patients of the private ENT practice "VERTIGO" in Opole between 2011 and 2017, including 404 women and 204 men. Patients ranged in age from 18 to 85 years, with an average age of 49.88 years. The following parameters were taken into account in the analysis: the result of subjective examination and basic ENT and otoneurological examination, videonystagmography, hearing assessment (tonal and impedance audiometry) and imaging tests (head MRI/CT and cervical spine x-ray), assessment of Doppler ultrasound of vertebral artery flow.

Results: In examinations, vertigo and vertigo were found more common in female (66.45%) than male (33.55%) patients, the most numerous group comprised 30 patients (76%) over 60 years of age with the predominance of systemic vertigo (61.02%). Hypertension was the most common chronic disease in the entire population of patients with vertigo, vertigo and balance disorder and its frequency increased with age, which translates into an increase in the frequency of non-systemic and mixed vertigo reported by patients. The frequency of lipid metabolism disorders increases statistically significantly with age, while thyroid dysfunction as well as migraines and frequent headaches are significantly more common in women reporting vertigo, vertigo and balance disorder than in men. In With age, the incidence of flow disorders in the vertebral arteries in Doppler ultrasound increases. The percentage of individual diagnoses in the examined patients was as follows: vestibular disorder (35.86%), benign paroxysmal positional vertigo (18.9%), mixed vertigo (16.12%), cervical vertigo (5.42%), Ménière disease and its suspicion (5.1%), vertigo and vertigo of central origin (3.78%), vascular vertigo (2.8%), vestibular neuritis (2.3%), post-traumatic vertigo (1.32%) and cerebellopontine angle tumours (0.16%). Visual-oculomotor tests in videonystagmography (VNG) showed an increase in the percentage of pathology with age between 51 and 60 years.

Conclusions: The structure of diagnoses made in private practice differs from public health care. This results from the fact that patients with acute symptoms first report to or are transported to the hospital emergency department. The second reason is the cost of diagnostics in the private sector which is not affordable to every patient.

KEYWORDS:

causes, ENT practice, evaluation of VNG, vertigo

INTRODUCTION

Vertigo and balance disorders are a common condition in the general patient population. In GP surgeries, the number of patients with vertigo of various aetiologies is 5–8% [1–3], while in ENT surgeries the percentage of these patients is higher and ranges from 10% to 15% [1–3]. Every thirtieth patient reporting to the hospital emergency department recognises vertigo as the main condition [4–5].

Patients this type of condition are very demanding, and differential diagnosis of vertigo with balance disorders is one of the most interdisciplinary fields among medical specialties. Vertigo may be neurological, laryngological, ophthalmic, musculo-articular, cardiovascular, metabolic and psychogenic.

In the Epidemiologic Catchment Area Programme conducted by Kroeke and Price [6] among 13,538 adults (>18 years of age) vertigo and balance disorders were reported by 23.2% of respondents. Based on a review of foreign literature on open-label population studies of vertigo, the following surveys can be presented: Nakashima et al. [7] surveys sent by post covered a group of 7685 people, of whom 6% reported vertigo and balance disorders; Neuhauser et al. [8], who in a telephone survey in 2005 examined 4869 people, of which 7.8% of respondents reported vertigo and balance disorders; Hannaford et al. [9] from 2005 – in a survey sent by mail they demonstrated that 21% of the surveyed 15,788 people reported vertigo and balance disorders. From Polish survey research, the study of Wojtczak et al. [10] can be cited, in which of 4799 inhabitants of Bytów, 780 people or 16.4% reported the presence of vertigo and

balance disorders. The group with the condition was dominated by 594 women (76.2%). Furthermore, women reported the presence of vertigo and balance disorders more than twice as often as men, with this difference being statistically significant.

According to Prusiński, women report vertigo and balance disorders up to three times more often [2]. The incidence of vertigo with balance disorders increases with age and in the population over 65 are already 3 times more common than in young people [2]. The highest incidence falls on the age range between 41 and 50 years of age, i.e. during the period of full professional and social activity [11–14].

Vertigo and balance disorders are a multidimensional problem. In addition to reducing the quality of life, they can limit the ability to work or even exclude a patient from his profession. According to Benecke et al. [15] in a multicentre analysis of patients reporting vertigo and balance disorders, as much as 69.8% were forced to limit their work, 63.3% showed a higher than average number of days of sick leave, 4.6% had to change their work, and 5.7% could not take up any professional work. The aim of the study is retrospective assessment of the causes and results of VNG tests in patients with vertigo and balance disorders.

MATERIAL AND METHODS

Examination of medical documentation and analysis of the results of VNG tests was performed on 608 patients of the private specialist ENTIGO VERTIGO practice in Opole, including 404 women and 204 men aged 18–85 (average age 49.88 years) between 2011 and 2017. The analysis included the following parameters: the result of subjective examination and basic ENT and otoneurological examination, videonystagmography, hearing assessment (tonal and impedance audiometry) and imaging tests (MRI/CT of the head and cervical spine x-ray), assessment of head vascularity in UDP examination, neurological and ophthalmological consultation. After analysing the documentation for the purposes of this study, patients were assigned to 11 groups of diagnoses: vertigo, benign paroxysmal positional vertigo (BPPV), Ménière disease and suspicion of Ménière disease, cervical vertigo, vascular vertigo, mixed vertigo, vestibular neuronitis, vertigo of central origin, cerebellopontine angle tumour, post-traumatic vertigo, lack of diagnosis and uncertain diagnosis.

The obtained results were subjected to statistical analysis, using the following significance tests: χ^2 independence, log-linear analysis, logistic regression and binary logistic regression, Shapiro-Wilks test for normality, Levene test for homogeneity of variance, one-way and multivariate analysis of variance (ANOVA) without replication.

The results of the significance tests in question were considered statistically significant when the significance level was $p < 0.05$.

RESEARCH RESULTS

Studies of medical documentation and analysis of VNG results were performed in 608 patients, including 404 (66.45%) women

and 204 (33.55%) men in the years between 2011 and 2017. Thus, it was proved that women were statistically more often ill. The average age of the respondents totalled 49.88 years for CI 48.66–51.10, including for women 50.59 years (CI 49.13–52.05) and for men 48.47 years (CI 46.24–50.70). The age of the respondents ranged between 18 and 85 years.

The respondents were analysed by gender and age group. The group up to 30 years of age overall comprised 11.68% of respondents, the 31–40 age group comprised 21.21% of respondents (men predominated in both these groups), the 41–50 age range included 18.26%, 51–60 years of age 18.09% and the age group above 60 years of age comprised 30.76% (women dominated in these three groups – Fig. 1.).

Overall, systemic vertigo was found in 61.02% of the subjects, non-systemic vertigo in 22.37% of the subjects, while both types of vertigo occurred in 16.61% of patients. There was no statistically significant difference in relation to gender ($p = 0.400$).

Among the respondents, 65.46% reported a total chronic disease, while 34.54% of patients did not. Statistical significance ($p < 0.001$) was demonstrated in the analysis of the overall chronic disease in relation to the age group. And so, for <30 years of age it was 59.15%, for 31–40 years of age 44.96%, for 41–50 years of age 50.45%, for 51–60 years of age 63.54% and for >60 years of age 91.98% was obtained, which is the highest percentage among age groups (Fig. 2.).

Individual groups of chronic diseases reported by patients were assessed. Thus, hypertension was present in 27.47% of respondents in total (K: 23.02% and M: 36.27%) and in statistical analysis ($p < 0.001$) showed statistical significance. Overall 3.45% of subjects reported glycaemic disorders, dyslipidaemia 6.91%, thyroid disorders occurred in 6.91% of all subjects (K: 9.16%, M: 2.45%) and was statistically significant in analysis with regard to gender ($p < 0.01$). A history of locomotion sickness was reported by 2.47% of all patients and sleep disorders were reported in 2.80% (Fig. 3.).

The presence of individual chronic diseases was analysed in relation to age groups. 5.63% reported hypertension: in the group <30 years of age, 7.75%; in the age range 31–40 years, 13.51%, among 41–50 years old, 29.09% and as much as 56.68% in the group of patients >60 years old. Furthermore, according to the analysis in relation to age groups, statistical significance was obtained for the occurrence of hypertension ($p < 0.001$). For glucose disorders in age ranges <30 years of age – 4.23%; 31–40 years old – 3.10%; 41–50 years old – 1.80%; 51–60 years old – 3.64%; >60 r.ż. – 4.28%, no statistical significance was obtained. For dyslipidaemia in age groups <30 years of age – 1.41%; 31–40 years old – 0.78%; 41–50 years old – 1.80% 51–60 years of age – 10.91%; >60 years of age – 13.90%. The results turned out to be statistically significant ($p < 0.001$). For thyroid disorders for <30 years of age – 7.04%; 31–40 years old – 4.65%; 41–50 years old – 3.60%; 51–60 years of age – 8.18%; >60 years of age 9.63%, showed statistical significance ($p < 0.01$). Sleep disorders and locomotion sickness were not statistically significant (Fig. 4.).

Migraines and frequent headaches occurred in 8.39% of the total number of subjects, i.e. 10.40% women and 4.41% men, and thus

a statistically significant difference was obtained ($p < 0.01$). Women were statistically more likely to report migraines and headaches. Other neurological disorders (Fig. 5.) occurred in total in 5.59%, 3.62% and 0.99% of the respondents and showed no statistical significance in relation to gender ($p > 0.05$).

In the analysis of mental and neurological disorders in relation to age groups, statistical significance was obtained in relation to the occurrence of migraines and frequent headaches ($p < 0.001$) and so in age ranges (<30 years of age; 31–40 years of age; 41–50 years of age; 51–60 years old; >60 years old) this condition was reported by: 12.68%, 13.95%, 7.21%, 9.09%, and 3.21% of respondents, respectively. Headaches of various origins more often affected people aged up to 30 years and in the range of 31–40 years of age compared to older patients. Depressive, neurotic and anxiety disorders did not show statistical significance in relation to age groups, but there is a trend of a more frequent occurrence in younger people mainly in the age range up to 30 years of age and 31–40 years of age.

Full imaging diagnostics i.e. head imaging (MRI/CT), Doppler ultrasound of the carotid and vertebral arteries, imaging examination of the cervical spine (MRI/RTG) were performed in total in 45.23% (K: 45.54%; M: 44.61%). The remaining subjects, i.e. 54.77% in total (K: 54.46%; M: 55.39%) lacked information about at least one of the imaging tests listed above. No statistical significance of the results was found ($p = 0.850$).

Among patients, imaging diagnostics of the head was performed in 78.09% of the total number of subjects (K: 82.67%; M: 72.42%), including computed tomography of the head (CT) in 14.99% of the total subjects (K: 11.47%, M: 19.70%), magnetic resonance imaging of the head (MRI) in 14.19% of the total subjects (K: 11.47%, M: 19.70%), and in 6.92% of the total subjects (K: 5.85%; M: 7.88%) both tests were performed (MRI and CT- $p = 0.217$). Computed tomography of the head (CT) was the most frequently ordered diagnostic test of the head, but the results are not statistically significant ($p = 0.217$).

Among the performed imaging examinations of the head, a normal image was found in 56.74% of the total subjects (K: 55.20%; M: 59.80%), and in 16.62% of the total subjects (K: 17.82%; M: 14.22%) some forms of pathology were described in head imaging.

In Doppler ultrasound of the carotid and vertebral arteries, a normal picture was found in 44.08% of the total subjects (K: 45.05%; M: 42.16%), and 25% of the total subjects (K: 23.27%; M: 28.43%) showed some forms of pathology in the UDP study. In the case of 30.92% of respondents in total (K: 31.68%; M: 29.41%) no data on the UDP test result was obtained or they were referred for examination and did not report for follow-up with the test result. Gender does not significantly affect the occurrence of vascular pathologies, there is no visible trend and no statistical significance was obtained in this analysis ($p = 0.994$).

In the analysis of the pathological results of Doppler ultrasound of the carotid and vertebral arteries by age group (<30 years old; 31–40 years old; 41–50 years old; 51–60 years old; >60 years old), impaired flow in one or both vertebral arteries was noted, respec-

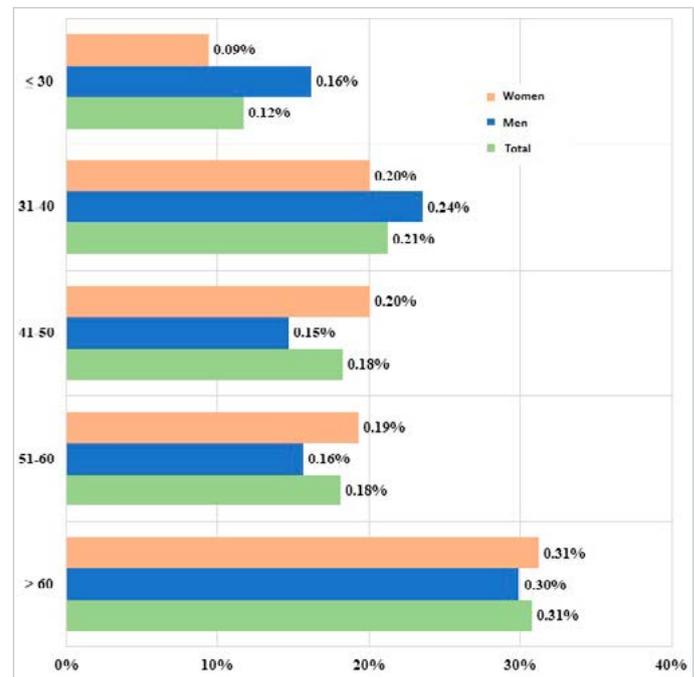


Fig. 1. List of subjects according to age range and gender ($p < 0.080$).

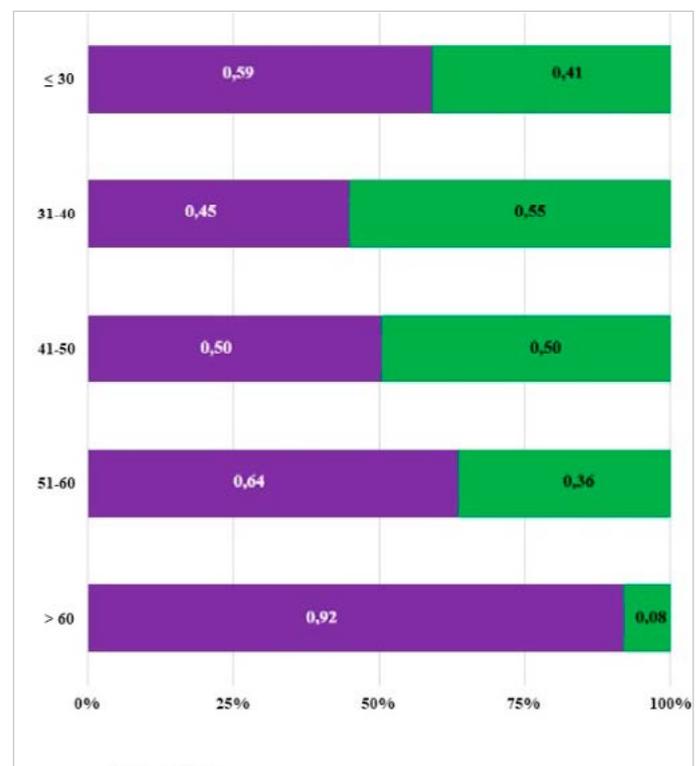


Fig. 2. List of subjects depending on the occurrence of chronic diseases and age range ($p < 0.001$).

tively: 9.86%, 14.73%, 13.51%, 22.73%, 24.60%. Stenosis of one or both vertebral arteries occurred in, respectively: 12.68%, 14.73%, 19.82%, 15.45%. Impaired flow in one or both vertebral arteries was described in 1.41%, 0.78%, 1.8%, 2.73% and 2.67%, respectively. The occurrence of flow disturbances in one or both vertebral arteries tends to increase with age, but no statistical significance was obtained in the analysis of these results ($p = 0.542$).

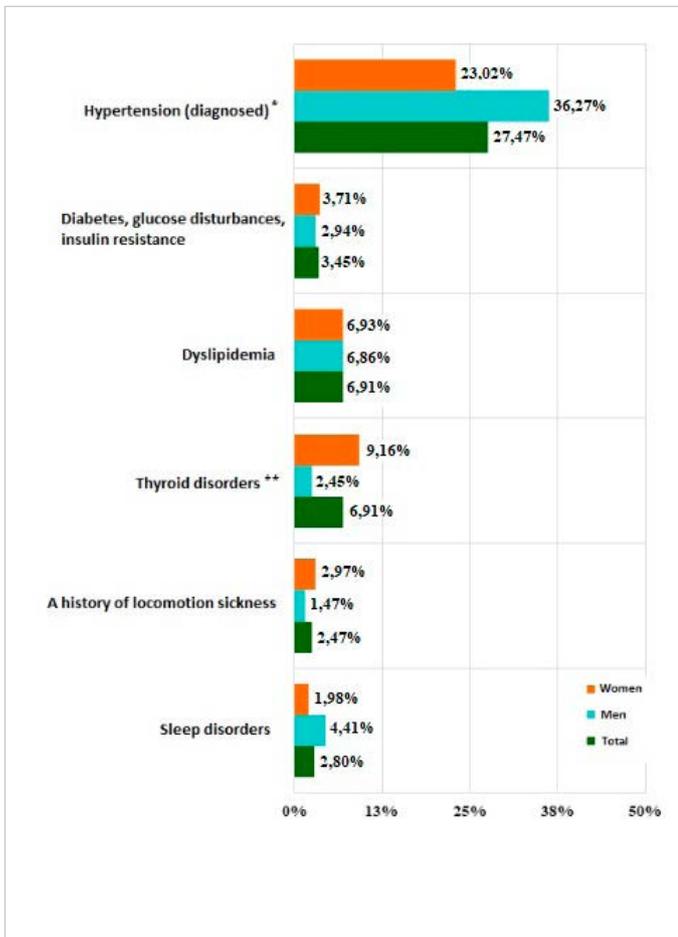


Fig. 3. List of subjects depending on the occurrence of chronic diseases and sex ($p < 0.001$).

Dix-Hallpike test result was subject to statistical evaluation by gender. Overall, a positive test was obtained in 19.87% of respondents (K: 19.15%; M: 21.29%). There was no difference in the occurrence of a positive Dix-Hallpike test by gender ($p = 0.677$).

The results of tone audiometry were analysed among all subjects in relation to gender and total pathology was found in 41.45% (K: 38.37%; M: 47.55%), which indicates that men display a statistically more frequent hearing impairment in the audiometric study ($p = 0.009$), with sensory and hearing loss occurring in 23.68% of all respondents (K: 19.31%; M: 32.35%) which means that it is more common in men. This result is statistically significant in relation to the gender of the tested group ($p < 0.001$), while tinnitus was found in 28.13% of the total number of subjects (K: 27.72%; M: 28.92%).

The assessment of results of the VNG study was first started with analysis of first visual-oculomotor reflexes in 3 tests: saccadic tracking, sinusoidal tracking and optokinetic nystagmus for pathology. And so, in the saccadic tracking test, a total of 35.36% of pathological results were obtained, i.e. 34.9% for women and 36.27% for men. No statistical correlation of saccadic testing with gender was obtained ($p = 0.586$).

A total of 66.61% of pathological results were found in the smooth pursuit test, i.e. 67.33% for women and 65.2% for men. No statis-

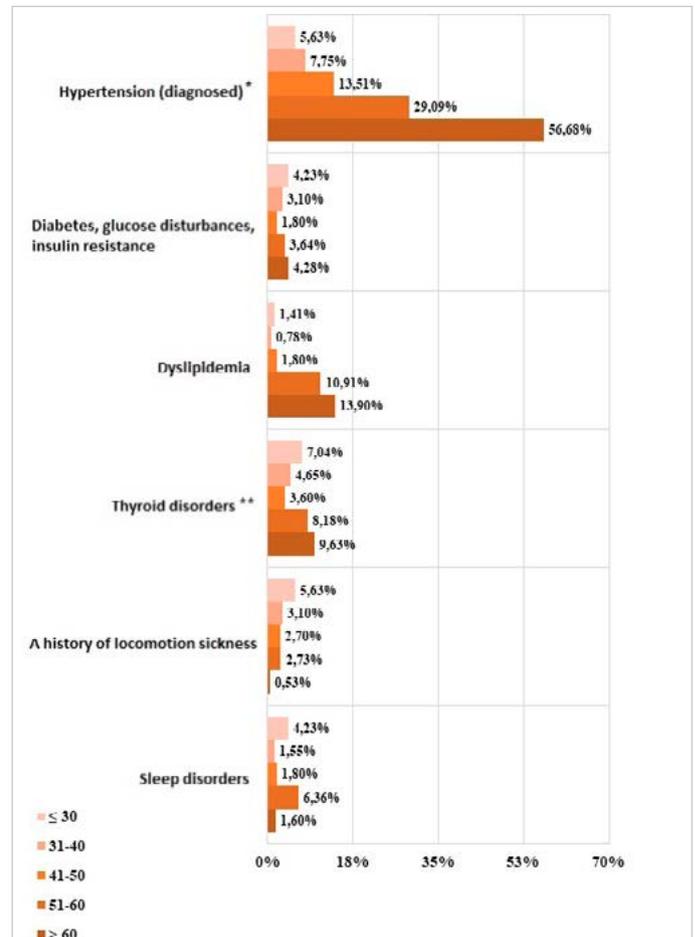


Fig. 4. List of subjects depending on the occurrence of chronic diseases and age range ($p < 0.001$).

tical correlation of the sinusoidal test with gender was obtained ($p = 0.906$). In the optokinetic nystagmus test, a total of 26.49% of pathological results were obtained, i.e. 26.49% for women and 23.53% for men. No statistical correlation was found between the optokinetic nystagmus test and gender ($p = 0.586$).

In the analysed group, spontaneous nystagmus was observed in the VNG study in 13.32% of the total (K: 13.37%; M: 13.24%), there was no statistically significant variability of the gender characteristic ($p = 0.882$). A statistically significant ($p = 0.002$) difference in the distribution of values of the measured angular velocities of spontaneous nystagmus in the group of men was found in the study group. The distribution of values measured for spontaneous nystagmus without specified nystagmus direction IQR 1.80–3.80 deg/s was found in men).

In the analysis of the results of the calorific test according to Fitzgerald-Hallpike in relation to gender, pathology was recorded in 72.29% of all respondents (K: 74.69%; M: 67.5%), while a normal result was recorded in 27.71% of the total (K: 25.31%; M: 32.5%). No statistical significance was found between the parameters tested ($p = 0.090$).

Symmetrical directional advantage was recorded in 36% of the total (K: 38.81%; M: 34.59%), deficit of the left labyrinth function was found in 32.17% of the respondents (K: 31.33%; M: 33.83%),

a right-sided labyrinthine disorder was observed in 28.83% of the total number of respondents (K: 30.82%; M: 24.87%), while areflexia of the labyrinth or suspicion of areflexia in 3% of the subjects (K: 3.26%; M: 2.49%).

In total, the most observed values of the labyrinth function deficit were not divided by deficit side, i.e. in 61% of all respondents (K: 62.15%; M: 58.7% – Fig. 6.).

After a complete analysis of the documentation of all 608 patients from the database, they were assigned to one of 11 groups of diagnoses: labyrinthine disorders – overall 35.86% (K: 37.13%; M: 33.33%), benign paroxysmal positional vertigo (BPPV) – overall 18.9% (K: 17.57%; M: 19.12%), mixed vertigo – 16.12% of all subjects (K: 16.09%; M: 16.18%), vertigo of cervical origin – 5.42% (F: 6.44%; M: 3.43%), Ménière disease and a suspicion of Ménière disease – 5.1% (F: 5.19%; M: 4.9%), vertigo of central origin – 3.78% (K: 3.46%; M: 4.42%), vertigo of vascular origin – 2.8% (K: 2.23%; M: 3.93%), vestibular neuritis – 2.3% (K: 2.23%; M: 2.45%), post-traumatic vertigo – 1.32% (K: 1.24%; M: 1.47%), suspected cerebellopontine angle tumour – 0.16% (including only women, which constituted 0.25%). In 9.05% of respondents (K: 8.17%; M: 10.78%) the diagnosis could not be determined, and the patient could be qualified to one of the other groups of diagnoses. There was no statistical significance by gender ($p = 0.518$).

DISCUSSION

The examined group was first analysed in terms of possible risk factors for vertigo and balance disorders, as well as comorbidities that are cited in the literature [16, 17].

Thus, hypertension turned out to be the most common chronic disease reported in the entire study group and occurred in 27.47% of all patients. Statistically, it was more common in men, which was confirmed by statistical analysis ($p < 0.001$). In primary care, 57% of patients who report vertigo have hypertension as one of the predominant chronic diseases [18].

Thyroid disorder was the second most frequently reported disease entity among the entire study group, i.e. 6.91%. In regard to gender, this condition was more frequently reported by women than men. It is known that thyroid disorder affects women up to 8 times more often than men. In the clinical picture, one of the symptoms is vertigo with balance disorders, and cochlear hearing loss is also observed [19, 20].

Lipid metabolism disturbances in the general study group accounted for 6.91% and no difference in the incidence rate between women and men was observed. We find information in the literature that lipid disorders, in particular total cholesterol and LDL cholesterol in blood serum, may be one of the causes of vertigo [21].

During the analysis of neurological disorders, a statistically significant correlation was observed between the incidence of migraines and headaches with gender. Research by Mudrina et al. [22] confirms the relationship between labyrinth stimulation during calor-

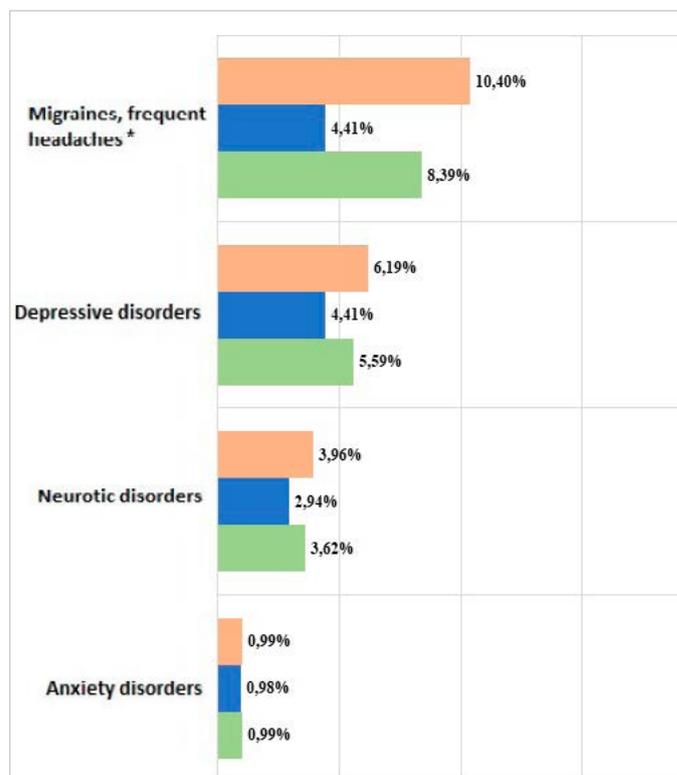


Fig. 5. List of subjects depending on mental and neurological disorders as well as gender ($p < 0.01$).

ic testing and the occurrence of a migraine attack, particularly in individuals who have a history of migraine headaches. Migraines have also been found to be more common in women.

In the case of depressive, neurotic and anxiety disorders, only a subtle downward trend was observed in relation to age, but this difference was not significant in the statistical analysis. Nevertheless, publications distinguish some correlation between the occurrence of mental disorders and disorders in the balance system [13, 14, 23].

Head tomography was the most commonly performed in head imaging (78%); in 15% it was magnetic resonance imaging of the head, and in almost 7% both tests were performed. Computed tomography of the head is ordered as the first examination in case of suspected pathology within the central nervous system.

The next analysed study was Doppler ultrasound of the carotid and vertebral arteries, where a normal picture was found in 44.08%, while in 25% the form of pathology was described, and in 30.92% of respondents no data on the result of the UDP test were obtained.

The result of Doppler ultrasound as an empirical study may differ from that of the diagnostician. As the diagnostician's experience increases, the test becomes more reliable. This may affect the results and correlations obtained in the analysis. In large public clinics, where tests are performed by one diagnostic imaging unit and often by the same person, we are able to obtain uniform results of ultrasound scan. Hence, we have the opportunity to obtain uniform results of ultrasound examination. In private institutions, to which patients report after examinations in various diagnostic labora-

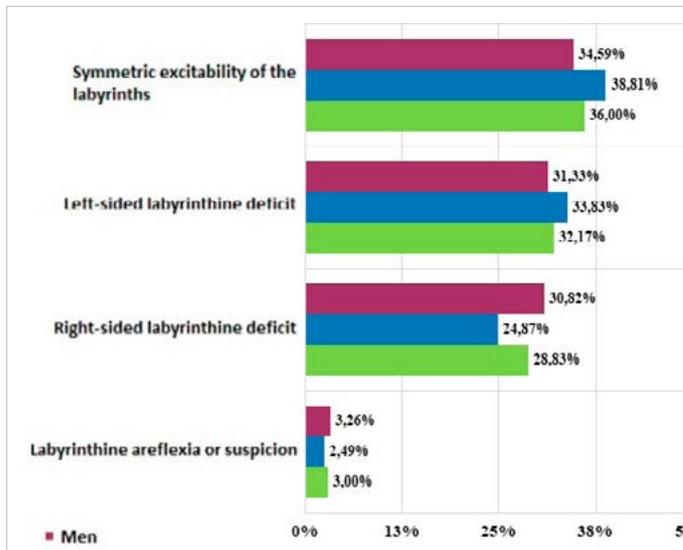


Fig. 6. List of subjects depending on the assessment of labyrinthine function in the VNG test and gender ($p = 0.768$).

tories, the variety of results increased, and conflicting results also occurred [24, 25]. The condition for including the documentation in the database and its analysis was the VNG test. Gender did not affect the occurrence of pathology in the assessment of saccadic tracking, while with age a significant increase in the number of pathological results was noted ($p = 0.005$). In sinusoidal tracking test, in addition to the morphology of the tracking curve, norms for maximum gain to the right 0.80 (+/-SD 0.16) and left 0.77 (+/-SD 0.20) were taken into account, i.e. the ratio of the angular velocity of the eye to the angular velocity of the tracked target [26, 27].

The norm in the assessment of optokinetic nystagmus, in addition to the morphology of the recording, was assumed as the value of gain in the range of 0.7 to 1. In this case, the gain is defined as the ratio of the velocity of the slow phase of nystagmus to the speed of the stimulus [26, 27]. Obtained results of visual-oculomotor reflexes and their significance in relation to the age group are confirmed by studies of other authors [28, 29]. The assignment of patients to 11 diagnoses was as follows: vertigo of labyrinthine origin – 35.86%, benign paroxysmal positional vertigo (BPPV) – 18.9%, mixed vertigo – 16.12%, followed by vertigo – 5.42%, Ménière disease and suspicion of Ménière disease – 5.1%, vertigo of central origin – 3.78%, vertigo of vascular origin – 2.8%, vestibular neuritis – 2.3%, post-traumatic vertigo – 1.32%, cerebellopontine angle tumour – 0.16%. Ménière disease was diagnosed or suspected most often in the group of patients between 41 and 50 years of age. Overall, it occurred in 5.1% of respondents. Epidemiological data on the occurrence of this disease indicate a lower percentage of diagnoses. Pierchała et al. report Ménière disease in 1.5% to 3.3% of subjects with vertigo [30]. Saeed reports that in the UK population, Ménière disease occurs in 1 in 1000 in men and women equally [31]. Vestibular neuronitis was most often diagnosed in the youngest subjects and their number decreased with age. In aetiology, inflammatory and viral theory is considered, and the course is very individual and depends on the individual's ability to compensate for the central nervous system [32].

CONCLUSIONS

1. In the years between 2011 and 2017, an analysis of medical documentation was carried out in 608 patients of the private specialist ENTIGO practice in Opole, which found vertigo to be more common in women (66.45%) than men (33.55%) and the largest group were 60 patients years of age (30.76%) with the predomination of systemic vertigo (61.02%);
2. Hypertension was the most common chronic disease in the entire population of patients with vertigo and its incidence increases with age, which translates into an increase in the frequency of non-systemic and mixed vertigo reported by patients, and likewise the frequency of lipid metabolism disorders increases statistically with age, while thyroid disorder, as well as migraines and frequent headaches are significantly more common in women reporting vertigo and balance disorders than in men;
3. With age, the incidence of flow disorders in the vertebral arteries increases in Doppler ultrasound and is more commonly found to be bilateral;
4. The percentage of individual diagnoses in the examined patients was as follows: vertigo (35.86%), benign paroxysmal positional vertigo (18.9%), mixed vertigo (16.12%), vertigo of cervical origin (5.42%), Ménière disease and a suspicion of Ménière disease (5.1%), vertigo of central origin (3.78%), vertigo of vascular origin (2.8%), vestibular neuritis (2.3%), post-traumatic vertigo (1.32%) and cerebellopontine angle tumour (0.16%);
5. The structure of diagnoses made in private practice differs from public health care, which results from the fact that a patient with acute symptoms first reports or is transported to the hospital emergency department, from where he is referred either for urgent hospital diagnostics or for outpatient diagnostics, and the second reason is the cost of diagnostics in the private sector, which is not affordable to every patient;
6. In the VNG study, visual-oculomotor tests (saccadic tracking test, sinusoidal tracking test and optokinetic test) show an increase in the percentage of pathology with age and spontaneous nystagmus is significantly more common between 51 and 60 years of age. Also, caloric tests showed a slight increase in the frequency of labyrinthine deficit with age;
7. Some patients with a positive Dix-Hallpike test result in VNG have a deficit of labyrinthine function, which is a consequence of otolith pathology or is a concomitance of both of these causes, which requires further research;
8. Although the presence of disorders in the carotid and vertebral arteries of the head in the UDP study predisposes to vertigo and balance disorders, no statistically significant correlation between these characteristics has been demonstrated, while the frequency of bilateral disorders in vertebral artery flow increases significantly with age.

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