VILNIUS UNIVERSITY

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IMPACT OF THE AUTONOMIC NERVOUS SYSTEM ON VASOMOTOR NASAL REACTIONS

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VILNIAUS UNIVERSITETAS

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AUTONOMINĖS NERVŲ SISTEMOS ĮTAKA VAZOMOTORINĖMS NOSIES REAKCIJOMS

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ABBREVIATIONS

CNS	central nervous system
DABP	diastolic arterial blood pressure
HRV Index	Heart rate variability index: ratio between the most common occurrence of the number of R-R intervals and the general number of analyzed R-R intervals
MCA2	The second minimal nose cross-section area
NS	nervous system
RI	reliance interval
pNN50	the share of R-R intervals in ECG recordings, duration of which differs from the contiguous R-R intervals by >50ms, in the total number of R-R intervals
RMSSD	Root mean square of successive R-R interval differences in ECG recordings
AR	Anterior rhinomanometry
Q1	Quartile of 25%
Q3	Quartile of 75%
SABP	Systolic arterial blood pressure
SDANN-	Standard Deviation of Sequential Five-Minute R-R Interval Means in ECG recordings
SDNN	Standard Deviation of R-R Intervals in ECG recordings
SDNN Index	Standard Deviation Index of R-R Intervals in ECG recordings
SD	Standard Deviation
HCR	Heart contraction rate
PER	Posterior endoscopic rhinomanometry
PRTN	Posterior rhinomanometry through the nose
MBP	The mean arterial blood pressure
M	mean
VU	The Vilnius University

1. INTRODUCTION

The nasal mucous membrane, due to its ability of moistening strongly the passing air in big quantities, is of great importance for the entire homeostasis of the body. While breathing though nose half of the respiratory track resistance to the air flow depends on the nasal cavity characteristics. Therefore, even small changes in the nasal cavity resistance to the air flow have a clear influence on the general resistance capacity of the respiratory track, and general indicators of the breathing function as well. The nasal septum and turbinates divide the nasal cavity into meatuses forming thus a high ratio of mucous membrane / nasal cavity cross-section. Subsequently, even a small congestion in blood-vessels of the mucous membrane will modify (reduce) the nasal cavity cross-section and increase the resistance to the air. Moreover, the structure of the nasal cavity blood-vessels allows them to react by vasomotor reactions to various internal and external irritants.

Scientific novelty

The first survey of nervous mechanisms in regulating the tone of nasal blood-vessels was described in 1913. Vasomotor rhinitis, as a specific status for investigation, was for the first time identified and described in 1921 by Jules Cloquet. In later surveys the conclusion was drawn that vasomotor rhinitis and the misbalance of autonomic nervous system is related, and that in most cases vasomotor rhinitis should be referred with the relative domination of the parasympathetic NS because of the sympathetic NS hypotone, and not with the absolute hypertone of the parasympathetic NS.

However, surveys were in most cases limited to the assessment of only the current status of the autonomic NS and the current status of the nose or the existence of vasomotor rhinitis. There are no data available in the literature on surveys demonstrating how characteristic parameters of the autonomic NS could lead to identifying the course of upcoming nasal vasomotor reactions. Therefore this scientific work aimed at investigating and identifying the relation between parameters describing the status of the autonomic NS and vasomotor nasal reactions is a scientific novelty.

Practical importance

Clinical practice reveals paradoxical vasomotor reactions of the nasal mucous membrane. Surveys were carried out identifying that paradoxical reactions develop in patients having vasomotor rhinitis following the in-spray of alfa-1 adrenomimetics, when the mucous membrane retains its ability of reacting to external irritants in a dynamic way or even becomes turgent. Such reaction may develop also after the peripheral sympathetic stimulation – physical load or exposure of feet to cold. Possibility of forecasting reactions of the nasal vasomotor tissues would lead to more accurate selection of treatment methods and tactics for rhinologic patients.

Hypothesis

The existing opinion indicates that vasomotor rhinitis may be caused by the misbalance of the autonomic NS, therefore hypothesis was raised that parameters characterising the status of the autonomic NS may be used as prognostic for identifying the nature of nasal vasomotor reactions.

The aim and objectives of the study

The aim of the study was to investigate the existence of associations between the parameters of various physical and instrumental investigations reflecting the status of the autonomic NS and nasal vasomotor reactions, and to examine the possibility of identifying the tendencies and the course of nasal vasomotor reactions by indicators of the autonomic NS parameters.

The following objectives were set:

1. examine the existence of associations between the parameters of various physical investigations reflecting the status of the autonomic NS and nasal vasomotor reactions.
2. identify the autonomic NS status assessment parameters capable of reflecting the course of nasal vasomotor reactions.
3. investigate the possibility of using heart contraction rate variability parameters reflecting the status of the autonomic NS for the prognostication of nasal vasomotor reactions.
4. define which heart contraction rate variability parameters reflecting the status of the autonomic NS are related with nasal vasomotor reactions.
5. assess whether the encumbered breathing through nose influences the status of the autonomic NS.

Statements for defence

1. There are the associations between the parameters of various physical investigations reflecting the status of the autonomic NS and nasal vasomotor reactions.
2. The parameters reflecting of various physical investigations and HRV can be used for the prognostication of nasal vasomotor reactions.
3. The encumbered breathing through nose influences the status of the autonomic NS.

2. METHODOLOGY OF THE SURVEY

Methodology of the survey in assessing the status of the autonomic NS during physical examination

The status of the autonomic NS may be defined by parameters of the cardiovascular system, the heart rate variability, and indicators of the cardiovascular system restoration after physical loads or exercises.

The cohorts of investigated patients. Data used in the survey was obtained in retrospect from medical documentation. Patients were consulted at the Centre of Ear, Nose and Throat diseases of the Vilnius University Hospital "Santariškių klinikos" (Ear, Nose, Throat and Eye Clinics of the VU Medical Faculty).

In total, 59 patients, who addressed the doctor otolaryngologist for consultation during the period from 01 03 2007 to 01 03 2008 before receiving health status certificate or for preventive examination, gave their consent for using their medical data in scientific research. Selection criteria of patients for using their respective data in the analysis: 18 years of age or senior, and the consent to use their data for scientific research; criteria for withdrawing the data of patients from further analysis: use of any pharmaceuticals within the last month before consultation, infectious diseases of the nose and paranasal sinuses, allergic anamnesis or objective allergic symptoms, diabetes, hypothyroidism, thyroidtoxicosis, bronchial asthma, pregnancy, lactation, former nasal operations, nasal polyps (ethmoiditis polyposa), oncological diseases, hyperplastic processes in the nose, nostrils, throat and larynx. In total, 44 consulted patients met the entry criteria and were free from any factors leading to withdrawal of their data from further analysis.

Each patient was checked by otoscopy, pharyngoscopy, laryngoscopy, anterior endoscopic rhinoscopy, posterior endoscopic rhinoscopy, anterior rhinomanometry before and after anemization of the nasal mucous membrane (in 3 min. after in-spray of 0,5 ml of sol. Adrenalini 1:10000 into the right and the left nostrils). Rhinomanometry was performed electronically using the computerised HOMOTH HNO Diagnostic Center rhinomanometer. For avoiding the influence of the different body position on the resistance of the nose, rhinomanometry for all investigated patients was performed by seating the patients in the same position. Early reaction of the nasal soft tissues (in 3 minutes time) to the anemization was assessed indirectly - by measuring the change of the nasal air flow (debit) with rhinomanometer at 150 Pa pressure regime.

All patients were examined at the same time of the day: between 4 to 7 pm, at the room temperature of 19^{o}C. Classical tests (the triad of tests) were used for assessing the status of the autonomic NS, where the status of the autonomic NS is assessed by changes in the cardiovascular system during the exercise of deep breathing, Valsalva manoeuvre and active reaction of orthostasis sampling.

For the assessment of the status of the autonomic NS of each patient samples of deep breathing, Valsalva manoeuvre and active reaction of orthostasis were taken of each patient in the same succession prior to the otorinolaringological examination.

Deep breathing sampling methodology was applied in the survey: the examined patient was deeply breathing in for maximum 5 sec and breathing out for 5 sec. Data was fixed after 8 such cycles of 10 sec.

Valsalva manoeuvre methodology was applied in the survey: the examined patient in the sitting position was maximally breathing in and, strangulating the nose, was blowing into a tube connected to the manometer, keeping for 15 sec a 40mm Hg air pressure in the respiratory tract.

Active reaction of orthostasis (upright tilt) testing methodology was used in the survey: the examined patient was lying quietly on his back for 5 min, and then was suddenly standing up.

Before each sampling, during the sampling and after the sampling the pulse was measured by non-invasive method – the arterial systolic and diastolic blood pressure in the right artery of the humerus, fixing the time needed for the arterial blood pressure and the pulse rate to return to the initial status.

The derivative parameter – the mean arterial blood pressure (MBP) – was used in the value analysis instead of the systolic arterial blood pressure (SABP) and the diastolic arterial blood pressure (DABP). Its meaning was calculated by applying the following formula

MBP= 2/3 DABP+1/3 SABP

General blood test and cytological nasal secretion examination of each patient was performed on the same day (at the Centre of laboratory diagnostics of the Vilnius University Hospital Santariskiu klinikos). If at least one indicator of this examination demonstrated deviation from the norm or presence of pathological findings, data of such patients were excluded from further analysis.

Methodology of the survey in assessing the autonomic NS by heart rate variability indicators

Selection criteria of patients for using their respective data in the analysis: 18 years of age or senior, and the consent to use their data for scientific research; criteria for withdrawing the data of patients from further analysis: use of any pharmaceuticals within the last month before consultation, infectious diseases of the nose and paranasal sinuses, allergic anamnesis or objective allergic symptoms, diabetes, hypothyroidism, thyreotoxicosis, bronchial asthma, pregnancy, lactation, former nasal operations, nasal polyps (ethmoiditis polyposa), oncological diseases, hyperplastic processes in the nose, nasopharynx, throat and larynx.

In total, 49 patients, who were hospitalized during the period from 01 01 2009 to 01 05 2009 for in-patient surgical otolaringological treatment with general anaesthesia, gave their consent for using their clinical data in the scientific research. Clinical or laboratory features of infectious or allergic processes were identified in 33 patients, who were using some pharmaceuticals less than one month before the survey, therefore their data were excluded.

Each patient was checked by otoscopy, pharyngoscopy, laryngoscopy, anterior endoscopic rhinoscopy, posterior endoscopic rhinoscopy, acoustic rhinometry before and after anemization of the nasal mucous membrane (in 3 min. after in-spray of 0,5 ml of sol. Adrenalini 1:10000 into the right and the left nostrils). Acoustic rhinometry was performed electronically using the computerised SR2000 module with RhinoScan software (Interacoustic A/S, Denmark).

For avoiding the influence of the different body position on the resistance of the nose, acoustic rhinometry for all investigated patients was performed by seating the patients in the same position. Early reaction of the nasal soft tissues (in 3 minutes time) to the anemization was assessed directly - by measuring the volume of the nose from the nasal vestibulum till 5,4 cm deep (the standard setting of the acoustic rinometer by manufacturer) before and after the anemization. A continuous 7 hour ECG was registered for all patients (registration was performed by LIFECARD CF, firmware v7, Del Mar Reynolds Medical Inc., USA).

All patients were examined at the same time of the first day of hospitalization: acoustic rinometry from 4 to 7 pm, at the room temperature of 19^{o}C. A continuous 7 hour ECG was registered for all patients (from 11 pm to 6 am). ECG data was analyzed by using the Impresario Software version 3 and module HRV Analyzer v.1.1.2.5 (Del Mar Reynolds Medical Inc., USA).

General blood test of each patient under examination was performed not earlier than 7 days before the hospitalization. If at least one indicator of this examination demonstrated deviation from the norm or presence of pathological findings, data of such patients were excluded from further analysis.

The author of the survey for a doctor's thesis Justinas Ivaška performed otorhinolaryngological examination of all patients himself, including the assessment samples of the autonomic NS at the Centre of Ear, Nose and Throat diseases, supervised the cardiological examination of all patients by Holter's monitors. Cardiological examination was carried out at the Centre of Cardiology and Angiology of the Vilnius University Hospital Santariskiu klinikos.

3. FINDINGS OF THE SURVEY

3.1 Findings of the survey in assessing the status of the autonomic NS by physical sampling, and the statistical analysis

3.1.1 Findings of the survey and the scheme of the statistical analysis

For avoiding the impact of stable asymmetric anatomic structures on the analysis of findings the total air volume passing through the right and the left nostrils was estimated. Patients were divided into two groups. The first group consisted of patients with the higher sum of exhalation debits by the right and the left nostrils before the anemization (herein further in the text "Group 1"), and the second group – of patients with the higher value of this dimension after the anemization ("Group 2"). Such distribution was applied as in measuring inhalation as exhalation. Analysis was carried out in two stages: in the first stage the said groups (Group 1 and Group 2) were compared vis-à-vis the autonomic NS parameters in the phase of inhaling, and in the second – in the phase of exhaling.

Statistical analysis

The data was processed using the statistical package SPSS *(version 16.0.1 for Windows).* The descriptive statistics is provided in the form of mediums and standard deviations, supplemented by medianas and Q1 (25%) and Q3 (75%) quartiles. As the

groups of examined patients were rather small, non-parametric Mann-Whitney test was applied for comparisons. In comparing the groups by gender the χ^2 test was applied. In addition, logistic regression was applied for sorting out which indicators of the autonomic NS lead to prognostication of different early reaction to the anemization of the nose (models with one independent variable were analyzed). The level of significance was fixed around 0,05. Duplex values are provided throughout the survey.
The population of examined patients consisted of 44 persons: 21 (47.7%) women and 23 (52.3%) men. The average age of the examined patients was 23,4 years, The Standard deviation – 3,4 years. Separate analysis was carried out investing the link of the volume of the inhaled air through the nose with the data of the autonomic NS analysis, and the link of the volume of the exhaled air through the nose with the data of the autonomic NS analysis.

3.1.2 Analysis of inhalation

Group 1 consisted of 14 (31.8%) patients, and Group 2 – of 30 patients (68.2%). The groups were similar by gender aspect (p = 0,837): Group 1 consisted of 7 men (50%) and 7 women (50%), Group 2 consisted of 16 men (53.3%) and 14 women (46.7%). The groups were also homogeneous by the age aspect (p = 0,353): the average age in Group 1 (SD) = 22,93 (3,67), mediana [25% quartile; 75% quartile] = 22,00 [21,00; 23,00]; correspondingly, in Group 2 the average age (SD) = 23,63 (3,18), mediana [25% quartile; 75% quartile] = 23,00 [21,00;25,00].

By analyzing the findings of MBP recordings in taking functional samples of the autonomic NS testing the following outcomes were obtained:
Comparison of the findings of Group 1 and Group 2 MBP recordings in taking functional samples of the autonomic NS testing is provided in Tables 1 – 2. It is obvious that the two groups statistically were significantly different during the orthostatic MBP sampling (88,1 ± 12,4 VS 98,59 ± 12,72, p=0,039; also see Fig. 1), while differences by other indicators were not simultaneously fixed.

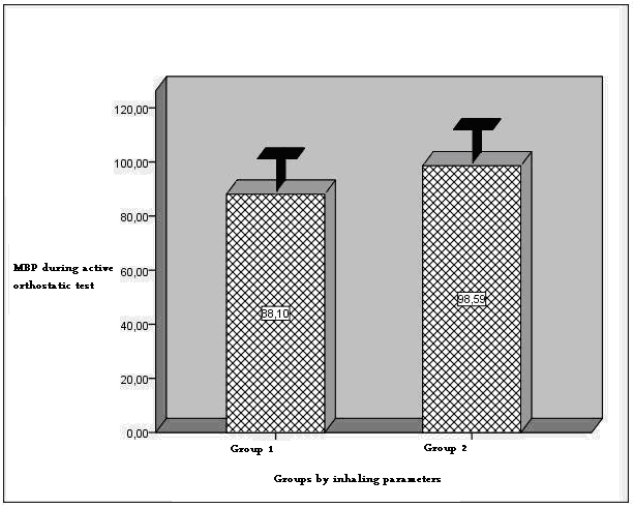

Figure 1. MBP during the active orthostatic sampling in analyzing the groups by inhalation parameters. The Picture shows the mediums and standard deviations.

Table 1. Comparison of Group 1 and Group 2 by the changes in the MBP during the performance of functional sampling in the NS examination (the medium and the standard deviation is presented: mean ± SN).

Parameter	Group 1	Group 2	**P value**
MBP during deep breathing test	86,43 ± 13,16	91,21 ± 13,13	0,082
MBP during active orthostasis reaction test	88,1 ± 12,4	98,59 ± 12,72	0,039
MBP during Valsalva manoeuvre	107,95 ± 16,38	116,79 ± 16,25	0,068

Table 2. Comparison of Group 1 and Group 2 by changes in the MBP during the performance of functional sampling in the NS examination [mediana and 25% – 75% quartiles: Me(Q1;Q3) are presented].

Parameter	Group 1	Group 2	**P value**
MBP during deep breathing test	85,5 [75,33;90,67]	90,33 [85;100]	0,082
MBP during active orthostasis reaction test	87,83 [81,67;97,67]	94,17 [90,67;100,67]	0,039
MBP at the Valsalva manoeuvre	108,17 [93,33;117,33]	117,67 [106,67;121,67]	0,068

Analyzing the groups by the time during which the MBP returned to the initial status in performing functional testing of the autonomic NS, statistically reliable differences were not fixed.

Analyzing the recordings of the pulse in the two groups during the performance of functional testing of the autonomic NS, the following results were obtained: the pulse rate before the active orthostatic test was slower in Group 1 (mean 60,79) than in Group 2 (mean 70,53); such difference is statistically reliable (p=0,008). The pulse rate after the Valsalva manoeuvre in Group 1 was slower (mean 65,21) than in Group 2 (mean 73,5); such difference is statistically reliable (p=0,025); other statistically reliable differences

were not fixed; the respective data is presented in the tables 3 – 4 (the comparison of the pulse rate and the recordings).

Table 3. Comparison of Group 1 and Group 2 by the pulse rate in performing functional NS sampling (medium and the Standard deviation are presented: mean ± SN).

Parameter	**Group 1**	**Group 2**	**P value**
Pulse rate before deep breathing test	65,79 ± 9,7	74,63 ± 14,84	0,124
Pulse rate before active orthostasis reaction test	60,79 ± 8,14	70,53 ± 12,29	0,008
Pulse rate before Valsalva manoeuvre	67,57 ± 10,37	75,13 ± 14,11	0,150
Pulse rate during deep breathing test	77,07 ± 14,57	82,93 ± 16,5	0,405
Pulse rate during Valsalva manoeuvre	85,21 ± 19,08	87,8 ± 15,81	0,351
Pulse rate during active orthostasis reaction test	77,29 ± 23,67	88,1 ± 14,56	0,101
Pulse rate after deep breathing test	68 ± 10,82	76,17 ± 14,2	0,127
Pulse rate after active orthostasis reaction test	78,29 ± 12,58	85,8 ± 15,24	0,147
Pulse rate after Valsalva manoeuvre	65,21 ± 7,34	73,5 ± 13,25	0,025

Table 4. Comparison of Group 1 and Group 2 by the pulse rate in performing functional NS sampling [mediana and 25% – 75% quartles: Me(Q1;Q3) are presented].

Parameter	**Group 1**	**Group 2**	**P value**
Pulse rate before deep breathing test	70,00 [62;72]	71,00 [64;80]	0,124
Pulse rate before active orthostasis reaction test	62,50 [55;68]	71,00 [61;78]	0,008
Pulse rate before Valsalva manoeuvre	70,00 [60;73]	73,50 [66;81]	0,150
Pulse rate during deep breathing test	75,50 [67;90]	78,50 [71;86]	0,405
Pulse rate during Valsalva manoeuvre	80,00 [75;85]	87,00 [76;98]	0,351
Pulse rate during active orthostasis reaction test	80,00 [71;91]	89,00 [79;100]	0,101
Pulse rate after deep breathing test	70,50 [61;75]	73,50 [68;83]	0,127
Pulse rate after active orthostasis reaction test	77,00 [71;90]	84,00 [75;91]	0,147
Pulse rate after Valsalva manoeuvre	66,00 [62;70]	73,00 [64;80]	0,025

It may be seen from the data presented in Tables 3 – 4, that the following parameters were significantly different statistically: the pulse rate after the Valsalva manoeuvre, and the pulse rate before the active orthostatic sampling (see also Fig. 2).

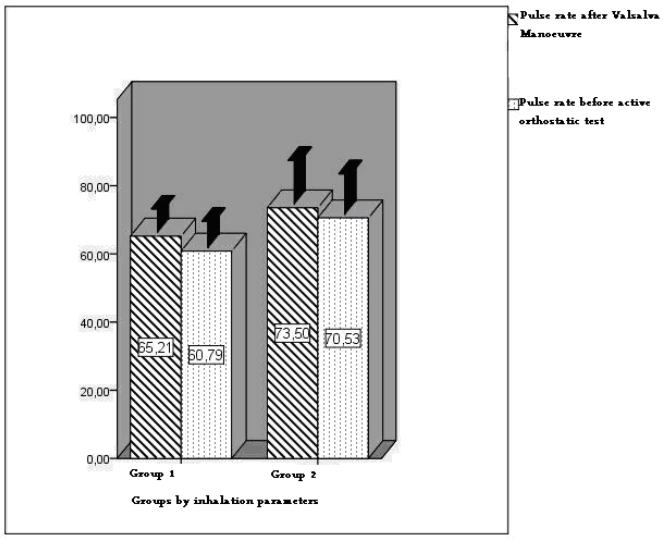

Figure 2. The pulse rate after the Valsalva manoeuvre, and the pulse rate before the active orthostatic test, dividing the groups by inhalation parameters. The Figure demonstrates mediums and standard deviations.

In developing models of logistic regression, where the dependant variable is the variable indicating the impact of the anemization (in Group 1 and Group 2), and the independent variable is one of parameters describing the autonomic NS, similar findings were obtained (see Table 5): the impact of anemization on the patient may be prognosticated by the MBP during the active orthostatic sampling, the pulse rate after the Valsalva manoeuvre or the pulse rate before the active orthostatic sampling. Increase in any of these parameters by 10 units enables to predicate that possibilities to get into the group of the positive balance by the inhalation speed (group 2) increases approx. by 2 times (see Table 5 on the values of the possibility rates).

5 Table. Models of logistic regression for analysis of reaction of inhalation *.

Argument	Regression coeff. (SD)	P value for regression coeff.	Ratio of possibilities (95 % PI)
MBP during deep breathing test	0,030 (0,027)	0,265	1,030 (0,977;1,086)
MBP during active orthostasis reaction test	0,080 (0,037)	0,029	1,083 (1,008;1,164)
MBP during Valsalva manoeuvre	0,040 (0,025)	0,106	1,041 (0,992;1,092)
Pulse rate after deep breathing test	0,056 (0,031)	0,072	1,058 (0,995;1,124)
Pulse rate after active orthostasis reaction test	0,039 (0,025)	0,122	1,040 (0,990;1,093)
Pulse rate after Valsalva manoeuvre	0,079 (0,039)	0,042	1,082 (1,003;1,167)
Pulse rate before deep breathing test	0,060 (0,032)	0,060	1,062 (0,997;1,131)
Pulse rate before active orthostasis reaction test	0,097 (0,040)	0,016	1,102 (1,018;1,192)
Pulse rate before Valsalva manoeuvre	0,052 (0,030)	0,089	1,053 (0,992;1,118)

* – getting into the Group 2 was considered an incident

3.1.3 Analysis of exhalation

The same scheme was applied for the exhalation analysis as for the analysis of inhalation. In this case Group 1 consisted of 10 patients (22.7%), and Group 2 – of 34 patients (77.3%). The groups were homogeneous by gender again (p=0,202): 7 men (70%) and 3 women (30%) in Group 1, and 16 men (47.1%) and 18 women (52.9%) in Group 2. The same applies for the age aspect (p=0,610): the average age in Group 1 [SD = 23,00 (3,43), mediana (25% quartile; 75% quartile) = 22,00 (21,00; 26,00)]; in Group 2 the average age correspondingly [SD = 23,53 (3,32), mediana (25% quartile; 75% quartile) = 23,00 (21,00;25,00)].

Analyzing the findings of Group 1 and Group 2 MBP recordings in performing the sampling of the autonomic NS investigation, statistically reliable differences were not obtained.

Analyzing the pulse rate of Group 1 and Group 2 in performing functional sampling of the autonomic NS investigation, the following outcomes were obtained:

The pulse rate after the orthostatic sampling in Group 1 was slower (mean 75,00) than in Group 2 (mean 85,88). This difference is statistically reliable (p=0,024).

There were no other statistically reliable differences observed.

The consolidated report of findings is presented in Tables 6 and 7.

Table 6. Comparison of Group 1 and Group 2 by the pulse rate in performing the sampling of the autonomic NS investigation (mean and the standard deviation: (mean and ± SN are presented).

Parameter	Group 1	Group 2	P value
Pulse rate after deep breathing test	68,70 ± 8,35	75,00 ± 14,64	0,216
Pulse rate after active orthostasis reaction test	75,00 ± 9,44	85,88 ± 15,19	0,024
Pulse rate after Valsalva manoeuvre	66,90 ± 7,59	72,03 ± 13,17	0,312

Table 7. Comparison of Group 1 and Group 2 by the pulse rate in performing the sampling of the functional autonomic NS investigation [mediana and 25% - 75% quartiles (Q1; Q3) are presented].

Parameter	Group 1	Group 2	P value
Pulse rate after deep breathing test	70,50 [61;76]	73,00 [68;83]	0,216
Pulse rate after active orthostasis reaction test	74,00 [67;83]	84,00 [75;94]	0,024
Pulse rate after Valsalva manoeuvre	69,00 [63;72]	71,00 [64;79]	0,312

* - mediana and 25% - 75% quartiles (Q1; Q3) are presented

Similar results were obtained by using the logistic regression (see Table 8), as in performing direct comparisons: the pulse rate after the active orthostatic sampling offers the prognostication the nasal mucous membrane reaction to the anemization (see also Fig. 3).

Table 8. Logistic regression models for the analysis of exhalation reaction.

Argument	Regression coeff. (SD)	P value for regression coeff.	Ratio of possibilities (95 % PI)
Pulse rate after deep breathing test	0,041 (0,032)	0,202	1,042 (0,978;1,109)
Pulse rate after active orthostasis reaction test	0,064 (0,032)	0,049	1,066 (1,000;1,135)
Pulse rate after Valsalva manoeuvre	0,042 (0,036)	0,244	1,043 (0,972; 1,120)

* –getting into the Group 2 was considered an incident

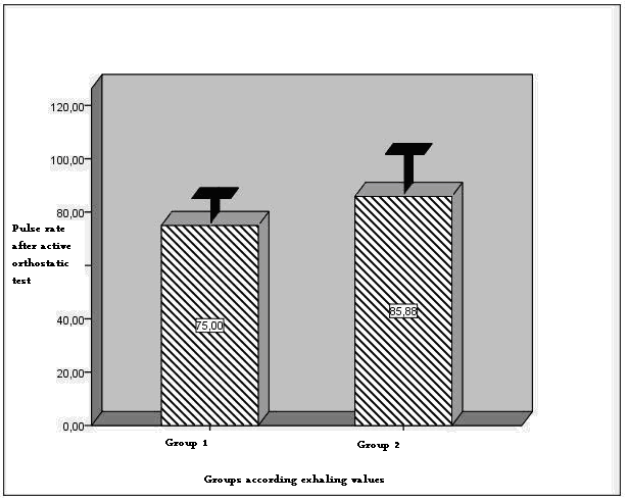

Fig 3. The pulse rate after the active orthostatic test in the groups according axhaling values. The Figure represents mediums and standard deviations.

3.2 Findings of the survey and statistical analysis in assessing the nasal vasomotor reactions by acoustic rhinometry, and assessing the autonomic NS status by heart contraction rate variability indicators

3.2.1 The first stage

Changes of the nasal vasomotor reactions were assessed by the variations in the total nasal volume (measured by acoustic rhinometry). The autonomic NS status was assessed by the indicators of heart contraction rate variability (HCR). Such investigation was performed in two stages, where the number of patients in the first stage was rather small (16 patients in total). Consequently, the division of patients into groups by the reaction of their nasal mucous membrane after the anemization (contracted or became turgent), and comparing the derived groups against the heart rhythm variability parameters was impossible, therefore other ways of analyses were needed.

It was decided in the first stage of the analysis to divide the examined patients into groups referring to the differences of the nasal volume before and after the anemization. The total nasal volume was calculated by adding up the numerical values of the volume

in the meatuses of left and the right nostrils. This helped to avoid the impact of the stable asymmetric nasal structures (nasal septum, nasal bone and cartilage carcass) on the outcomes. Thereafter the difference between the nasal volume before and after the anemization was calculated for each patient. Patients were divided into two groups according to the obtained differences: Group 1 consisted of patients with smaller or equal differences to the sample mediana, and Group 2 consisted of patients with bigger difference to the sample mediana. Such distribution reflects different reaction of nasal tissues to anemization: Group 1 consisted of patients, nasal tissues of which contracted less or became less turgent, and Group 2 consisted of patients, nasal tissues of which contracted more after the anemization. Subsequently, groups formed in such way were compared against the indicators of the heart rhythm rate variability. Referring to the results of the analysis in the first stage similar scheme was applied in the second stage, only here patients were divided into groups by using relative changes in the nasal volume, and not the absolute.

3.2.1.1 Statistical analysis

Data were processed by using the statistical package SPSS (version 16.0.1 for Windows). The descriptive statistics for quantitative variables is provided in the form of mediums ± standard deviations, supplemented by medianas (Me) and Q1 (25%) and Q2 (75%) quartiles. Rates are provided for qualitative variables.

3.2.1.2 Outcomes

In total 16 patients were examined: 7 women (43.8%) and 9 men (56.2%). The average age of the examined patients was 34,75 years, with the standard deviation of 8,99 years.

Following the analysis of the data obtained by uninterrupted ECG recordings during the night time and the data of acoustic rhinometry, parameters describing the heart contraction rate and the nasal volume before and after anemization were calculated.

The consolidated parameters of the entire group of examined patients are presented in Table 9.

Table 9. General parameters of the examined group of patients [mean and standard deviation (mean ± SN, mediana and 25% - 75% quartiles: Me (Q1;Q3)] are presented).

Parameter	**Mean ± SN**	**Me [Q1;Q3]**
Nasal volume before anemization (cm^3)	10,07 ± 2,02	10,00 [8,96;11,37]
Nasal volume after anemization (cm^3)	11,98 ± 2,54	12,85 [10,76;13,32]
SDNN (ms)	94,13 ± 27,21	84,15 [75,15;100,65]
SDNN Index (ms)	58,28 ± 17,02	51,65 [46,10;60,85]
RMSSD (ms)	45,76 ± 20,21	40,55 [33,20;52,10]
pNN50 (%)	15,38 ± 13,77	12,55 [8,20;16,70]
HRV triangular index	21,61 ± 8,82	18,40 [15,70;24,70]
SDANN (ms)	0,09 ± 0,03	0,08 [0,07;0,09]

The first stage of the analysis

Aiming at the investigation of the link between the reaction to the anemization and the indicators describing the autonomic NS a dual analysis was applied.

1) Correlation factor was calculated between the difference of the nasal volume (nasal volume before and after the anemization) and the heart rhythm rate parameters (see Table 10).
2) As the total number of patients was rather small, comparison of patients by dividing them into two groups in the usual way (into patients with contracting nasal mucous membrane, and patients with turgent nasal mucous membrane) was impossible, subsequently another method of analysis was chosen. Mediana of the nasal volume differences was calculated for the entire group of patients, and thus patients were divided into two equal groups with 8 patients in each: the first group consisted of patients with the nasal volume differences below mediana, the second group consisted of patients with the nasal volume differences exceeding mediana; i.e. the first group consisted of patients with lower contraction of the nasal mucous membrane, and the second – of patients with higher contraction parameters. The data of the two groups were compared with the heart contraction rate variability parameters (see Tables 11 and 12).

Table 10. Correlation coefficients between the heart rate variability parameters and the nasal volume differences in the entire group of patients.

Parameter	**SDNN**	**SDNN Index**	**RMS SD**	**pNN50**	**HRV indeksas**	**SDANN**
Correlation coeff.	0,243	0,211	0,376	0,406	0,433	0,026
P value	0,364	0,433	0,152	0,118	0,094	0,924

Table 11. Comparison of heart rate variability parametres between groups formed by nasal volume differences (mean and standard deviation are presented: mean ± SN).

Parameter	**Group 1**	**Group 2**	**P value**
SDNN (ms)	91,91 ± 29,63	96,34 ± 26,40	0,645
SDNN Index (ms)	56,46 ± 9,76	60,10 ± 22,76	0,382
RMSSD (ms)	40,93 ± 10,11	50,59 ± 26,82	0,645
pNN50 (%)	11,54 ± 5,87	19,21 ± 18,39	0,382
HRV indeksas	19,20 ± 9,14	24,03 ± 8,36	0,224
SDANN (ms)	0,09 ± 0,03	0,09 ± 0,03	0,959

Table 12. Comparison of heart contraction rate variability parametres between groups formed by nasal volume differences [mediana and 25% – 75% quartiles: Me (Q1;Q3) are presented).

Parameter	**Group 1**	**Group 2**	**P value**
SDNN (ms)	83,35 [75,15;93,55]	89,55 [77,05;107,55]	0,645
SDNN Index (ms)	54,45 [49,10;60,85]	47,40 [45,60;73,65]	0,382
RMSSD (ms)	38,70 [33,20;50,10]	42,40 [33,35;56,45]	0,645
pNN50 (%)	10,15 [8,20;15,20]	14,75 [7,50;22,55]	0,382
HRV indeksas	16,05 [13,85;22,40]	20,00 [17,85;31,10]	0,224
SDANN (ms)	0,08 [0,07;0,09]	0,08 [0,07;0,09]	0,959

Numerically the average values of parameters describing heart rate variability in the group with lower contraction of the nasal mucous membrane were lower (see Fig. 4.), though statistically significant differences were not fixed.

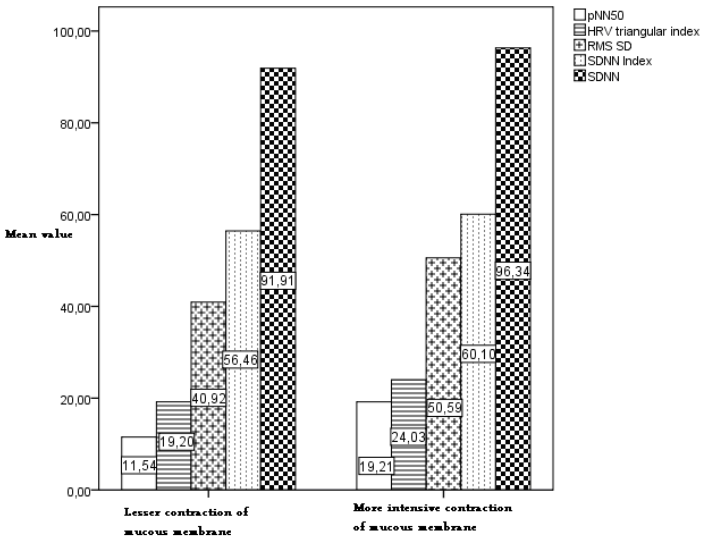

Fig. 4. Heart rate variability parameters in groups formed by nasal volume differences.

The second stage of the analysis

Referring to the results obtained in the first stage it was decided to divide patients into two groups by the relative change of the nasal volume. The dimension δ was calculated for each patient indicating the relative percentage change of the nasal volume according to the formula: δ = (the nasal volume after the anemization – the nasal volume before the anemization) / the nasal value before the anemization*100%. According to these relative dimensions patients were divided into two equal groups (Group 1 and Group 2): the first group consisted of patients with relative dimensions lower of equal to mediana, the second – with relative dimensions exceeding the relative change sample mediana, i.e. Group 1 consisted of patients with the less increasing nasal volume (because of the soft tissue anemization), and Group 2 – of patients with more increased nasal volume, but for the distribution relative and not absolute parameters were used. Comparison of the groups formed in this way against the parameters of the heart rate variability revealed that SDNN and HRV index was significantly different between the groups (see tables 13 and 14).

Table 13. Comparison of the heart rate variability parameters between the groups formed according to the nasal volume relations (mean and standard deviation are presented: mean ± SN).

Parameter	Group 1	Group 2	P value
SDNN (ms)	80,54 ± 9,54	107,71 ± 32,76	0,046
SDNN Index (ms)	53,00 ± 5,65	63,56 ± 22,92	0,878
RMSSD (ms)	39,61 ± 8,75	51,90 ± 26,69	0,442
pNN50 (%)	10,95 ± 4,80	19,80 ± 18,40	0,328
HRV indeksas	16,48 ± 4,37	26,75 ± 9,35	0,019
SDANN (ms)	0,09 ± 0,03	0,09 ± 0,03	1,000

Table 14. Comparison of the heart rate variability parameters between the groups formed according to the nasal volume ratios [mediana and 25% - 75% quartiles are presented: Me (Q1; Q3)].

Parameter	Group 1	Group 2	P value
SDNN (ms)	79,30 [72,55;88,65]	100,65 [83,05;130,15]	0,046
SDNN Index (ms)	51,65 [48,60;58,05]	53,00 [45,60;81,90]	0,878
RMSSD (ms)	38,70 [33,20;44,85]	45,65 [33,35;58,45]	0,442
pNN50 (%)	10,15 [8,20;15,20]	14,75 [7,50;24,90]	0,328
HRV indeksas	15,95 [13,85;19,75]	24,10 [18,40;36,55]	0,019
SDANN (ms)	0,08 [0,07;0,09]	0,08 [0,07;0,09]	1,000

* - mediums and standard deviation are presented: mean ± SN), [mediana and 25% - 75% quartiles are presented: Me (Q1; Q3)].

Correlation factors between the relative dimensions and the heart contraction rate variability parameters were not statistically significant (see Table 15).

Table 15. Correlation factors between the heart contraction rate variability parameters and the relative change in the nasal volumes.

Parameter	SDNN	SDNN Index	RMS SD	pNN50	HRV triangular index	SDANN
Correlation coeff.	0,252	0,194	0,333	0,355	0,426	0,153
P value	0,346	0,471	0,207	0,178	0,100	0,570

3.2.2 Findings of the survey assessing the nasal vasomotor reactions by acoustic rhinometry, and the autonomic NS status by the heart rate variability indicators. The second stage

3.2.2.1 The scheme for data analysis

A larger group of 40 patients was collected in the second stage of the survey. The total nasal volume before and after the anemization was calculated for each patient, and referring to the obtained differences in the volume 6 persons were identified as patients with the lower total nasal volume after the anemization than before (i.e. patients with turgid mucous membrane). Due to this reason, as in the first stage of the survey, it was decided to search for another way of dividing patients into groups according to non-standard nasal reaction to the anemization. Subsequently, another two methods were tested: dividing patients into normally – abnormally reacting to the anemization by the

volume in the MCA2 range, and by the narrowest cross-section area in the MCA2 range (for medical justification of this choice see chapter 'Discussions of the findings'). In the first case the division did not bring good results, as the number of patients who reacted abnormally has reduced to 4. Dividing patients in the other way, the number of patients with smaller area of the narrowest cross-section after the anemization than before was 9. Consequently, it was decided to choose this version and compare the groups formed in this way according to the heart rate variability parameters.

3.2.2.2 Outcomes

In the final stage 40 patients were examined in total: 17 women (42.5%) and 23 men (57.5%). The age of the examined patients fluctuated from 19 to 76 years. Other parameters of the examined patients are presented in Table 16.

Table 16. General parameters of the examined group of patients: (mediums and standard deviation are presented: mean ± SN), [mediana and 25% - 75% quartiles: Me (Q1; Q3)].

Parameter	**Mean ± SN**	**Me [Q1;Q3]**
Crross-section area before anemization at MCA2 (cm^2)	0,83 ± 0,26	0,79 [0,67;0,97]
Crross-section area after anemization at MCA2 (cm^2)	0,97 ± 0,29	0,96 [0,77;1,10]
SDNN	103,07 ± 28,15	95,45 [82,70;116,85]
RMS SD	49,53 ± 27,20	41,95 [31,25;59,60]
SDSD	35,06 ± 19,12	29,50 [22,55;43,75]
HRV indeksas	22,05 ± 7,51	21,40 [17,15;25,50]
TINN	674,03 ± 229,28	656,25 [531,25;812,50]
Mean RR	874,64 ± 141,64	881,10 [783,30;944,15]
Mean HR	71,59 ± 12,17	68,60 [64,30;78,50]
pNN50	18,47 ± 16,38	14,80 [5,75;27,65]
SDNN Index	60,76 ± 23,00	57,10 [46,10;76,15]

The division of patients into groups by the narrowest cross-section area MCA2 in the range covered patients with normal reaction to the anemization, i.e. with the contracting mucous membrane (Group 1), and patients with the opposite reaction, i.e. with the turgid mucous membrane (Group 2). The comparison of the obtained groups against the parameters of the heart contraction rate variability revealed the significant statistical difference of the groups in the following parameters: RMS SD, SDSD, pNN50, SDNN Index (see Tables 17 – 18 and Fig. 5 for details).

Table 17. The comparison of the heart contraction rate variabilitye parameters between the groups formed according to the ratios of the nasal volumes (mediums and standard deviation are presented: mean ± SN).

Parameter	**Group 1**	**Group 2**	**P value**
SDNN	99,63 ± 27,12	114,94 ± 30,01	0,167
RMS SD	46,32 ± 28,69	60,61 ± 18,47	0,026
SDSD	32,84 ± 20,37	42,69 ± 11,84	0,024
HRV triangular index	21,17 ± 6,78	25,10 ± 9,41	0,235
TINN l	651,72 ± 214,71	750,87 ± 273,56	0,248
Mean RR	870,20 ± 138,20	889,92 ± 160,77	0,588
Mean HR N	71,79 ± 11,92	70,89 ± 13,73	0,610
pNN50	16,04 ± 16,15	26,84 ± 15,13	0,034
SDNN Index N	57,96 ± 24,62	70,40 ± 13,10	0,034
SDANN Night 1	6,61 ± 3,32	7,11 ± 3,23	0,679
SDANN Night 2	71,80 ± 21,27	84,78 ± 31,91	0,321

Table 18. The comparison of the heart contraction rate variabilitye parameters between the groups formed according to the ratios of the nasal volumes [mediana and 25% - 75% quartiles are presented: Me (Q1; Q3)].

Parameter	**Group 1**	**Group 2**	**P value**
SDNN	94,40 [82,10;113,10]	114,30 [84,30;135,70]	0,167
RMS SD	37,80 [27,90;55,50]	54,10 [46,10;75,90]	0,026
SDSD	24,80 [20,70;36,90]	39,00 [32,70;54,20]	0,024
HRV triangular index	19,80 [16,80;24,60]	23,60 [21,00;32,50]	0,235
TINN	640,60 [515,60;734,40]	718,80 [625,00;937,50]	0,248
Mean RR	871,10 [770,60;954,30]	931,50 [797,90;943,30]	0,588
Mean HR	69,80 [63,60;78,90]	65,40 [64,40;78,10]	0,610
pNN50	10,20 [3,50;23,10]	26,00 [15,00;36,10]	0,034
SDNN Index	49,90 [45,40;64,30]	75,70 [59,50;78,80]	0,034

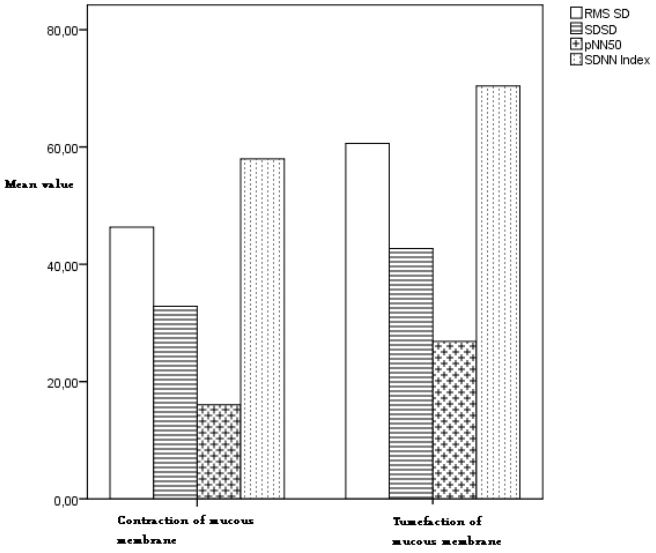

Fig 5. Parameters of the heart rate variability in groups formed according the differences of the nasal area in the narrowest cross-section of the MCA2 range.

Following the selection of the above parameters we developed a model of multiple logistic regression aimed at prognostication of reactions to the anemization in the MCA2 range of the narrowest cross-section area; i.e. the dependent variable in the developed model of logistic regression was the reaction to the anemization (contracting or turgid mucous membrane), and the independent variable – the said heart contraction rate parameters (RMS SD, SDSD, pNN50, SDNN Index). Irrespective of the fact that three (3) heart contraction rate parameters were significant only on 0,1 level, and one (1) was not significant at all, the developed model enables to achieve 77.8% sensitivity and 80.6% specificity (see Table 19 and Fig. 8).

Table 19. The model of logistic regression for the prognostication of reactions to the anemization in the MCA2 range of the narrowest cross-section area*.

Argument	**Regression coeff. (SD)**	**P value for regression coeff.**	**Ratio of possibilities (95 % PI)**
RMS SD	-0,763 (0,452)	0,092	0,466 (0,192;1,131)
SDSD	0,697 (0,418)	0,095	2,009 (0,885;4,558)
pNN50	0,499 (0,289)	0,084	1,646 (0,935;2,899)
SDNN Index	0,006 (0,055)	0,917	1,006 (0,904;1,119)

* - turgid mucous membrane was considered an incident

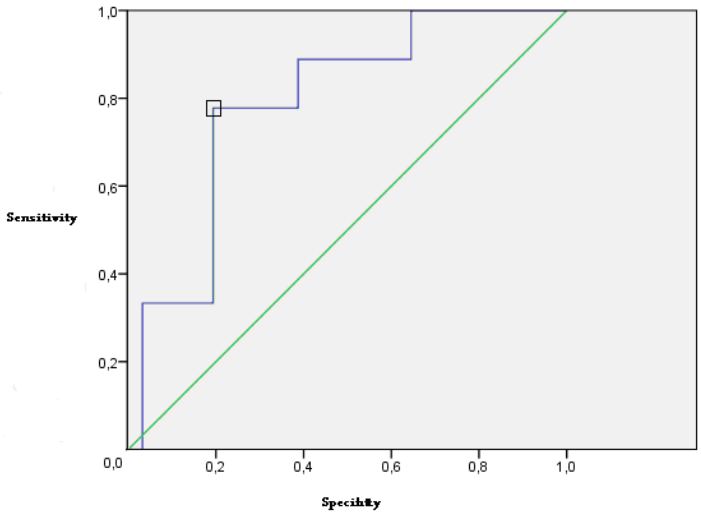

Fig. 6. ROC curve for the logistic regression model aimed at the prognostication of reactions to the anemization in the MCA2 range of the narrowest cross-section area. The area under the curve is 0,789; the point marked by a square corresponds to 77.8% sensitivity and 80.6% specificity.

No linear link between area differences in the narrowest cross-section MCA2 range before and after anemization with the heart contraction rate variability parameters was observed: all the calculated correlation factors were statistically insignificant (see Table 20).

Table 20. Correlation factors between the heart rate variability parameters and cross-section area differences in MCA2 range of the narrowest cross-section area.

Parameter	**Correlation coeff.**	**P value**
SDNN	-0,074	0,651
RMS SD	-0,026	0,874
SDSD	-0,025	0,876
HRV triangular index	0,046	0,776
TINN	0,054	0,741
Mean RR	0,103	0,528
Mean HR	-0,109	0,503
pNN50	-0,023	0,888
SDNN Index	-0,087	0,595

3.3 Comparison of the encumbered breathing through the nose and the control group parameters with the indicators of the heart contraction rate variability.

3.3.1 Scheme of data analysis

Part of the group in the final stage was heavily breathing through nose because of non-inflammatory nasal pathology (nasal deformation, nasal septum deviation, hypertrophy of nasal turbinates, or a combination of such pathologies). Accordingly, it was decided to compare patients with encumbered nasally breathing (Group 1) with patients having no complaints about the encumbered nasally breathing against parameters of the heart rate variability (Group 2), for assessing the impact of encumbered breathing through nose on the parameters of the heart rate variability defining the autonomic NS.

3.3.2 Outcomes

Group 1 consisted of 26 patients (65.0%), including 18 men (69.2%) and 8 women (30.8%), and Group 2 – of 14 patients, including 5 men (35.7%) and 9 women (64.3%). The average age of patients was 32,54 ± 10,28, in the control group - 34,57 ± 14,65. The average total volume of inhalation and exhalation through the left and the right nostrils in Group 1 was 1060,73 ml/s, and in Group 2 it was 1168,15 ml/s (at the nasal air flow pressure of 150Pa).

Table 21. Comparison of the heart rate variability parameters between Group 1 and Group 2 (medium and standard deviation are presented: mean ± SN).

Parameter	Group 1	Group 2	P value
SDNN	105,45 ± 29,04	98,66 ± 26,90	0,671
RMS SD	51,30 ± 29,34	46,26 ± 23,37	0,777
SDSD	35,96 ± 21,01	33,39 ± 15,58	0,989
HRV indeksas	23,22 ± 7,54	19,88 ± 7,20	0,169
TINN	710,04 ± 225,46	607,15 ± 229,23	0,173
Mean RR	888,55 ± 143,46	848,81 ± 139,65	0,444
Mean HR	70,47 ± 12,11	73,66 ± 12,44	0,452
pNN50	19,89 ± 17,10	15,83 ± 15,21	0,571
SDNN Index	63,83 ± 24,21	55,05 ± 20,14	0,342

Table 22. Comparison of the heart rate variability parameters between Group 1 and Group 2 [mediana and 25% - 75% quartiles are presented: Me (Q1; Q3)].

Parameter	VR group	Control group	P value
SDNN	100,35 [82,40;123,00]	94,40 [84,00;112,90]	0,671
RMS SD	40,55 [30,40;65,30]	44,30 [32,10;50,10]	0,777
SDSD	29,00 [21,70;45,00]	29,90 [24,20;37,60]	0,989
HRV triangular Index	22,20 [17,50;26,60]	18,05 [14,40;24,40]	0,169
TINN	671,90 [562,50;921,90]	570,30 [421,90;734,40]	0,173
Mean RR	888,90 [813,50;945,00]	854,15 [762,80;932,50]	0,444
Mean HR	68,25 [64,20;75,30]	71,20 [64,90;79,70]	0,452
pNN50	14,05 [6,70;33,90]	15,10 [4,80;21,10]	0,571
SDNN Index	58,05 [46,30;77,80]	56,05 [44,00;61,10]	0,342

There were no statistically significant differences between groups in respect of heart rate variability parameters. (see tables 21-22).

4. CONCLUSIONS

1. The obtained findings proved the existing link between the changes of parameters in assessing the autonomic NS by physical samples and nasal vasomotor reactions.
2. It was defined that links between the autonomic NS status and the nasal vasomotor reactions are reflected by the following parameters: MBP during the active orthostatic sampling, pulse rate after the Valsalva manoeuvre, pulse rate before and after the active orthostatic sampling.
3. the obtained findings confirmed that heart contraction rate variability parameters reflecting the autonomic NS status may be used in prognosticating nasal vasomotor reactions.
4. it was defined that heart contraction rate indicators *SDNN and HVR index* may be used as indicators assisting to prognosticate vasomotor reactions of the nasal soft tissues. Indicators of the heart contraction rate variability RMSSD, SDSD, pNN50, SDNN Index are statistically reliable in reflecting the link of the autonomic NS with the nasal vasomotor reactions, however such indicators may not be used for accurate prognostication of nasal vasomotor reactions.
5. it was defined that encumbered nasally breathing (when the total volume of inhaled and exhaled air passing through the nose is ≥1060 ml/s at 150 Pa air flow pressure) does not cause changes of the autonomic NS status.

5. PRACTICAL RECOMMENDATIONS

1. Recommended for the examination of rhinological patients and the autonomic NS status, as the data of the survey will assist in selecting diagnostic and treatment tactics more accurately.

2. It is advisable to use not only the absolute, but also the relative dimensions of changes in the nasal volume for analyzing nasal vasomotor reactions.

- Additional pharmaceutical and surgery measures are recommended to ensure proper course and volume of nasal vasomotor reactions, given the following results were obtained during the functional sampling of the autonomic NS examination:
- MBP during the active orthostatic sampling ≥98 mm Hg
- Pulse rate after the Valsalva manoeuvre ≥73 k/min.
- Pulse rate before the active orthostatic sampling ≥70 k/min.

(Any of the given parameters enables to propose that the likelihood for paradoxical nasal vasomotor reaction is by two times higher than for patients with lower examination parameters than the indicated in the above recommendation).

3. Additional pharmaceutical and surgery measures are recommended to ensure proper course and volume of nasal vasomotor reactions, provided the following findings were obtained after analyzing Holter ECG data: SDNN ≤80,54ms , HRV index ≤16,48 .

6. PUBLICATIONS BY THE AUTHOR IN RELATION TO THE TOPIC OF THE THESIS

1. Ivaška J, Lesinskas E, Petrulionis M, Pušinskaitė S, Grigonis T. Prognostication of vasomotor reactions referring to the assessment of the autonomic nervous system. Medicinos teorija ir praktika. (Medical theory and practice) 2009 – T15. (Nr.2), 133-139 p.

2. Ivaška J, Lesinskas E, Karužas A, Pušinskaitė S. Prognostication of vasomotor reactions referring to the examination of the heart rate variability. Sveikatos mokslai. (Health sciences) 2009 (5) 2646 – 2650 p.

ABOUT THE AUTHOR OF THE THESIS

Justinas Ivaška was born on 2 June 1975 in Vilnius. In 1982-1992 he studied at the Vilnius 22nd secondary school (graduated the school under the equivalency examination after 11 years), entered the Medical Faculty at the Vilnius University and graduated in 1998 qualifying for the profession of a medical doctor. He performed his primary residence practice at the M. Marcinkevičiaus hospital in 1998-1999, passed the national exam scoring 9 points. In 1999-2002 he studied in the residential otorhinolaryngological studies at the Vilnius University, passing the final exam with excellent marks (scoring 10). Since 1999 he has also studied at the Vilnius University faculty of Economics and in 2004 acquired baccalaureate in business management and administration. In 2005-2009 he was a PhD student at the Vilnius University.

He started working in the sphere of Health care in 1993 at the Vilnius st. Jokūbas hospital as an extra surgery medic. Since 2002 he is working at the Vilnius University Hospital Santariskiu klinikos as a doctor otorhinolaryngologist. As from 2007 he is the assistant doctor at the Ear, Nose, Throat and Eye Clinics of the Medical Faculty at the Vilnius University. For upgrading skills he studied in the refresher courses organised by the Universitatsklinikum Tubingen (Germany) and Universitatsklinikum Mainz (Germany). Delivered presentations at the Congress of Otorhinolaryngologists from the Baltic States and the 19th World Congress of Otorhinolaryngologists (Sao Paulo, Brazil).

REZIUMĖ

Darbo tikslas

Darbo tikslas – ištirti, ar egzistuoja ryšiai tarp autonominės NS būklę atspindinčių įvairių fizinių ir instrumentinių tyrimų rodiklių bei nosies vazomotorinių reakcijų bei ištirti, ar pagal autonominės NS parametrų rodiklius galima spręsti apie nosies vazomotorinių reakcijų kitimo tendencijas ir kryptis.

Darbo uždaviniai

1. Ištirti, ar egzistuoja ryšiai tarp autonominės nervų sistemos būklės įvertinimo fizinių tyrimų metodais rodiklių ir nosies vazomotorinių reakcijų.
2. Nustatyti, kurie autonominės nervų sistemos būklės įvertinimo parametrai gali atspindėti vazomotorinių nosies reakcijų kryptis.
3. Ištirti, ar autonominės nervų sistemos būklę atspindintys širdies susitraukimų dažnio variabilumo parametrai gali būti panaudoti nosies vazomotorinių reakcijų prognozavimui.
4. Nustatyti, kurie autonominės nervų sistemos būklę atspindintys širdies susitraukimų dažnio variabilumo parametrai yra susiję su vazomotorinėmis nosies reakcijomis.
5. Įvertinti, ar apsunkintas kvėpavimas per nosį apsprendžia autonominės NS būklę.

Rezultatai

Tyrimų rezultatai ir statistinė analizė, autonominės NS būklę vertinant fizinių mėginių metu: Tirtųjų populiaciją sudarė 44 pacientai: 21 (47,7 %) moteris ir 23 (52,3 %) vyrai. Tiriamųjų amžiaus vidurkis 23,4 m., standartinis nuokrypis – 3,4m. Atskirai analizuotas įkvepiamo per nosį kiekio oro ryšys su autonominės nervų sistemos tyrimų duomenimis ir iškvepiamo oro kiekio ryšys su autonominės nervų sistemos tyrimų duomenimis.

Įkvėpimo analizė: I grupėje buvo 14 (31,8 %) pacientų, II grupėje – 30(68,2 %). Grupės nesiskyrė lyties atžvilgiu (p = 0,837): I grupėje buvo 7 (50 %) vyrai ir 7 (50 %) moterys, II grupėje buvo 16 (53,3 %) vyrų ir 14 (46,7 %) moterų. Taip pat grupės buvo homogeniškos ir amžiaus atžvilgiu (p = 0,353): I grupėje amžiaus vidurkis (stand. nuokr.) = 22,93 (3,67), mediana [25% kvart.; 75% kvart.] = 22,00 [21,00;23,00]; II grupėje atitinkamai vidurkis (stand. nuokr.) = 23,63 (3,18), mediana [25% kvart.; 75% kvart.] = 23,00 [21,00;25,00]. Grupės statistiškai reikšmingai skyrėsi VAS ortostatinio mėginio metu (88,1 ± 12,4 VS 98,59 ± 12,72, p=0,039). Analizuojant I ir II grupių pulsą atliekant funkcinius autonominės NS tyrimo mėginius , gauname tokius rezultatus: pulso dažnis prieš aktyvios ortostazės mėginį mėginį I grupėje buvo retesnis (Vid. 60,79) negu II grupėje (Vid.70,53), šis skirtumas buvo statistiškai patikimas (p=0,008). Konstruojant logistinės regresijos modelius, kuriuose priklausomu kintamuoju imtas anemizacijos poveikį (I grupė arba II grupė) indikuojantis kintamasis, o nepriklausomu kintamuoju – vienas iš autonominę nervų sistemą charakterizuojančių parametrų, gauti analogiški rezultatai.

Iškvėpimo analizė: Iškvėpimo analizei taikyta tokia pati schema kaip ir įkvėpimo analizei. Šiuo atveju I grupėje buvo 10 (22,7 %) pacientų, o II grupėje– 34(77,3 %)

pacientai. Pulso dažnis po ortostatinio mėginio I grupėje buvo retesnis (Vid. 75,00) negu II grupėje (Vid.85,88), šis skirtumas buvo statistiškai patikimas (p=0,024). Kitų statistiškai patikimų skirtumų nebuvo. Logistinės regresijos pagalba gauti tokie patys rezultatai (žr. 14 lentelę), kaip ir atliekant tiesioginius palyginimus.

Tyrimų rezultatai ir statistinė analizė, nosies vazomotorines reakcijas vertinant akustine rinometrija, o autonominės NS būklę vertinant pagal širdies susitraukimų dažnio variabilumo rodiklius: ištirta 40 pacientų: 17 (42,5 %) moterų ir 23 (57,5 %) vyrai. Tiriamųjų amžiaus svyravo nuo 19 iki 76 metų (vid. ± SN = 33,25 ± 11,84 metai). Nosies vazomotorinių reakcijų kitimas buvo vertintas pagal bendro nosies tūrio pokyčius (buvo matuojama akustine rinometrija). Autonominės NS būklė buvo vertinta pagal širdies susitraukimų dažnio (ŠSD) variabilumo rodiklius. Pirmajame etape pacientai buvo suskirstyti į grupes naudojantis absoliutiniais nosies tūrio pokyčiais. I-ąją grupę sudarė pacientai, kurių nosies tūrio skirtumas neviršijo medianos, II-ąją – tie, kurių viršijo, t.y. I-oji grupė buvo sudaryta iš tų pacientų, kurių nosies gleivinė traukėsi mažiau, o II-oji – iš tų, kurių nosies gleivinė traukėsi daugiau. Vėliau pacientai skirstyti į grupes naudojantis santykiniais nosies tūrio pokyčiais. Kiekvienam pacientui apskaičiuotas dydis δ, rodantis santykinį procentinį nosies tūrio pokytį pagal formulę: δ =(nosies tūris po anemizacijos - nosies tūris prieš anemizaciją)/ nosies tūris prieš anemizaciją*100%. Naudojant šiuos santykinius dydžius pacientai suskirstyti į dvi (I-ąją ir II-ąją) lygias grupes: I-ąją grupę sudarė pacientai, kurių santykiniai pokyčiai buvo mažesni arba lygūs imties medianai, II-ąją – tie, kurių santykiniai pokyčiai buvo didesni už santykinių pokyčių imties medianą, t.y. I-ąją grupę sudarė pacientai, kurių nosies tūris (dėl minkštųjų audinių anemizacijos) didėjo mažiau, o II-ąją – tie, kurių nosies tūris didėjo daugiau, tik skirstymui naudoti santykiniai, o ne absoliutūs dydžiai. Palyginus tokiu būdu gautas grupes širdies dažnio variabilumo parametrų atžvilgiu gauta, kad SDNN ir HRV indeksas statistiškai reikšmingai skyrėsi tarp grupių. Antrame etape pacientai skirstyti į grupes pagal siauriausio skespjūvio plotą nosies MCA2 atkarpoje. Grupės statistiškai reikšmingai skyrėsi šiais parametrais: RMS SD, SDSD, pNN50, SDNN Index. Sukonstruotame logistinės regresijos modelyje priklausomu kintamuoju imta reakcija į anemizaciją, o nepriklausomais – minėtieji širdies susitraukimų dažnio parametrai. Nepaisant to, kad gautame modelyje trys širdies susitraukimų dažnio parametrai buvo reikšmingi tik 0,1 lygmenyje, o vienas apskritai nebuvo reikšmingas, gautas modelis leidžia pasiekti 77,8 % jautrumą ir 80,6 % specifiškumą.

Palyginus apsunkinto kvėpavimo per nosį irkontrolinę grupes širdies ritmo dažnio variabilumo rodiklių atžvilgiu, skirtumų neužfiksuota.

IŠVADOS

1. Gauti rezultatai patvirtina, kad egzistuoja ryšiai tarp kad autonominės NS būklės vertinimo fiziniais mėginiais parametrų ir nosies vazomotorinių reakcijų kitimo.
2. Nustatyta, kad ryšius tarp autonominės NS būklės ir nosies vazomotorinių reakcijų atspindi šie parametrai: VAS aktyvios ortostazės mėginio metu, pulso dažnis po Valsalvos mėginio, pulso dažnis prieš ir po aktyvios ortostazės mėginio.
3. Gauti rezultatai patvirtina, kad autonominės NS būklę atspindintys širdies susitraukimų dažnio variabilumo parametrai gali būti naudojami nosies vazomotorinių reakcijų prognozavimui.

4. Nustatyta, kad širdies susitraukimų dažnio rodikliai *SDNN* ir *HRV* indeksas gali būti naudojami kaip rodikliai, padedantys numatyti nosies minkštųjų audinių vazomotorines reakcijas. Širdies susitraukimų dažnio variabilumo rodikliai RMSSD, SDSD, pNN50, SDNN Index statistiškai patikimai atspindi autonominės NS ryšį su nosies vazomotorinėmis reakcijomis, tačiau šie rodikliai negali būti naudojami tiksliam nosies vazomotorinių reakcijų prognozavimui.
5. Nustatyta, kad apsunkintas kvėpavimas per nosį (kai pratekančio per nosį įkvepiamamo ir iškvepiamamo oro suminis kiekis ≥1060 ml/s prie 150 mPa oro srovės slėgio) nesukelia autonominės NS būklės pakitimų.