Cardiointervalography as aMethod for Diagnosing Disturbances in Neurovegetative Regulation in Patients with Ischemic Cerebral Stroke

Section A-Research paper

CARDIOINTERVALOGRAPHY AS A METHOD FOR DIAGNOSING DISTURBANCES IN NEUROVEGETATIVE REGULATION IN PATIENTS WITH ISCHEMIC CEREBRAL STROKE

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Abstract

This article discusses the cardiointervalography as a method for diagnosing disturbances in neurovegetative regulation in patients with ischemic cerebral stroke. Heart rate variability (HRV) is one of the dynamic prognostic markers that characterize autonomic cardiovascular regulation, so its study in patients can bring significant significance to the diagnosis and prognosis of any pathology associated with CVS

Keywords: cardiointervalography, diagnosing disturbances, neurovegetative regulation, ischemic cerebral stroke.

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Cardiointervalography as aMethod for Diagnosing Disturbances in Neurovegetative Regulation in Patients with Ischemic Cerebral Stroke

Section A-Research paper

Relevance

Cerebral stroke or acute cerebrovascular accident (ACC) is the final stage of a complex chain of interdependent and interrelated progressively developing morphological changes in many systems - arterial, cardiac, as well as disruption of the central and cerebral hemodynamics [4, 5].

Many authors consider brain damage to be one of the main causes of frequent post-stroke mortality. The lethal outcome in the acute period of stroke is often due to extensive disorders of cerebral hemodynamics, usually with involvement in the process of stem structures - vital centers of respiration and cardiac activity [7]. Somewhat later, the most common causes of mortality are pulmonary embolism (PE), extensive inflammatory complications, severe disorders of the cardiovascular system (CVS) [7].

As is known, all functioning systems of the body are controlled by the autonomic nervous system (ANS), in particular, adaptive-trophic regulation of all organs and systems. The role of the ANS is that it is the main regulator in maintaining the constancy of homeostasis. Deviations that occur in the regulatory circuits of the autonomous NS predetermine various changes in the body - hemodynamic, metabolic, energy [5].

Therefore, these functional disorders can be used as prognostic markers for the course of pathology. Heart rate variability (HRV) is one of the dynamic prognostic markers that characterize autonomic cardiovascular regulation, so its study in patients can bring significant significance to the diagnosis and prognosis of any pathology associated with CVS [10,11]. Also, based on it, it is realistic to predict the risk of sudden cardiac death [11].

Many research papers that contain topics devoted to the study of the dynamics of HRV in patients with a history of ischemic stroke (IS) were carried out against the background of clear selection criteria. They obtained data that show that in the acute and acute period of IS there is a decrease in HRV values [1, 3, 6] and this is combined with the occurrence of arrhythmias, as well as an increase in the risk of sudden cardiac death [8, 9].
The relationship between the influence of ANS and HRV on the nature of the acute period of stroke and the development of complications in it has been proven [7, 9], which suggests the use of HRV as a prognostic marker for the formation of complications of cerebral strokes from the CVS, especially the level of risk of sudden cardiac death. However, among the available literature, we did not find evidence of scientific studies on the dynamic monitoring of HRV during the acute and early rehabilitation periods of stroke, and we also did not study the correlation of electrophysiological parameters and cardiac performance indicators with the types and localization of brain damage in cerebral strokes.

Thus, the above facts determine the relevance of this study of the influence of HRV dynamics during early verticalization in the acute period of hemispheric IS. Cardiointervalography (CIG) is a technique for studying the ANS in terms of determining the adaptive capabilities of the human body and the susceptibility to the formation and development of certain chronic pathologies [2].

The study of HRV is a method for assessing the self-regulation of the physiological functions of the body and the balance of the sympathetic and parasympathetic mechanisms of the ANS. The method is non-specific in relation to nosological forms and highly sensitive to internal and external influences. The essence of the method is to determine the distance of ECG RR-intervals, on the basis of which the CIG dynamic series is modeled, followed by computer statistical analysis and the determination of absolute and relative indicators. With the availability of obtaining initial data, it is possible to extract extensive and versatile data on the neurohumoral regulation of physiology and the possibilities of adaptation of the body [2, 8].

The use of this technique in many areas of medicine proves its versatility, free technical feasibility and non-invasiveness, the absence of contraindications, which allows it to be widely used [2]. However, CIG, despite all the possibilities of application, is far from widespread implementation in practical healthcare.

Purpose of the study. The study of heart rate variability to identify the reserve of the functional state of the body in patients with ischemic stroke against the background of concomitant cardiac pathology.

Research material. An assessment of the neurological and vegetative status of patients with hemispheric cerebral stroke was carried out. The studies were carried out on the basis of the neurological department of the Bukhara branch of the RSCEMC for the period 2019-2021.

Eur. Chem. Bull. 2023, 12 (S3), 3266 – 3272

3267

Table 1.Characteristics of the groups of examined patients

Group	Number of patients		Qualifying sign
	abc	%	
Main group (OG)	115	63,2%	Patients with IS and CAD, acute and rehabilitation periods
Comparison group (CS)	67	36,8%	Patients with IS without CAD, acute and rehabilitation periods

Note: IS, ischemic stroke; ischemic heart disease.

In total, we studied 182 patients (95 women and 87 men) aged 41 to 79 years in the acute and acute periods of ischemic stroke (IS) in the basin of the middle cerebral artery (MCA) with concomitant cardiac pathology. The main group (MG) consisted of 115 examined (63.2%) patients with hemispheric ischemic stroke IS (ISI) (acute and early rehabilitation periods) and coronary heart disease (CHD). The comparison group (CG) included 67 (36.8%) patients with PIS without CAD (Table 1). Table 2 and Figure 1 show the distribution of patients by age and gender. The main group (MG) included 63 women (54.8% of the entire group) and 52 men (45.2%). The average age of men is 65.3 ± 7.6 years, women - 71.3 ± 6.1 years. The comparison group (CG) included 24 (35.8%) women and 43 (64.2%) men, the average age of men and women was 67.1 ± 6.2 years and 69.0 ± 4.3 years, respectively. Table 2 shows that in the study groups, there were mainly elderly and senile patients (WHO, 2022). In the MG, the proportion of such patients was 65.2% (75 people), and in the CG - 61.2% (41 people). It can be concluded that patients in the MG were older than those in the SG. In the MG, the mean age of patients was 69.2 ± 5.1 years; in the CG, the mean age was 58.4 ± 6.5 years ($p<0.05$).

Table 2. Distribution of patients by age and gender

Groups	Gender		18 - 44 years - young	45 - 59 years - average	Age 60 - 74 years old - elderly	WHO, 2022 75 - 90 years - senile
MG, n=115	**M** n=52	abc	8	12	18	14
		%	7,0%	10,4%	15,7%	12,2%
	W n=63	abc	5	15	23	20
		%	1,7%	6,1%	6,1%	7,0%
CG, n=67	**M** n=24	abc	2	7	7	8
		%	3,0%	10,4%	10,4%	11,9%
	W n=43	abc	5	12	14	12
		%	7,5%	17,9%	20,9%	17,9%
нTotal	**M** n=76	abc	10	19	25	22
		%	5,5%	10,4%	13,7%	12,1%
	W n=106	abc	10	27	37	32
		%	5,5%	14,8%	20,3%	17,6%

Note: WHO - World Health Organization; m-men; w-women

Moreover, in the MG there were significantly more women of elderly and senile age (37.4% n=43) than men in this group (27.8%, n=32) ($p<0.05$). In the CG, women of elderly and senile age also prevailed - 38.8% (26 people) versus men -22.4% (15 people) ($p<0.05$).

Cardiointervalography as aMethod for Diagnosing Disturbances in Neurovegetative Regulation in Patients with Ischemic Cerebral Stroke
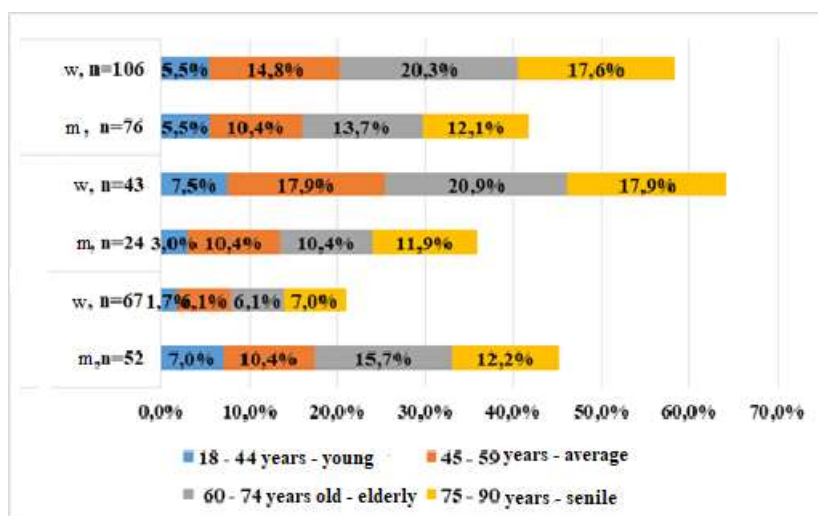
Section A-Research paper

Fig. 1. Distribution of patients by sex and sex

Thus, in the compared groups - MG and CG prevailed in a quantitative ratio, especially in the elderly and senile age, females.

2. Research methods

All patients underwent a standard clinical and neurological examination (analysis of patient complaints, anamnesis of life and anamnesis of the disease, an objective examination, including the study of neurological status) and a physical examination. You studied the initial vegetative tone (IVT) in our study according to the tables of A.M. Wayne (1981), they implied the introduction of certain clinical and laboratory parameters and indicators of electrocardiography (ECG) [8]. Heart rate variability (HRV) was assessed by CIG performed in the horizontal and vertical positions of the patient.

HRV was studied by rhythmocardiography (RKG) with recording for the purpose of subsequent analysis of the functional state of the whole organism and violations of regulatory systems [1, 3].

Processing of the results is carried out by the methods of variational statistics with the determination of the mean and its error values (M±m), differences in the mean values, the matching criterion ($\chi 2$), and the calculation of the probability (p). The results were accepted as significant at $p<0.05$.

3. Research results

In the studied patients, complaints of cardialgia, some weakness, cephalgia and syncope prevailed. IWT in the OH was found to be vagotonic in 42.6% (49) of the examined patients, sympathetic in 38.2% (44) of the patients, in other patients it was determined to be mixed. Symptoms were sympathetic signs: sleep disturbances (49.6%), skin pallor (41.7%), white or pale pink dermographism (51.3%), palpitations (55.6%), sympathoadrenal paroxysms (9.6%), increased arterial pressure (AP) (98.2%). The following were considered as parasympathetic signs: redness (30.4%) or cyanosis of the skin of the extremities (32.2%), hyperhidrosis of the palms and feet (35.7%), redness rising above the surface of the skin, dermographism (39.1%), poor tolerance stuffy and crowded places (53.9%), recurrent abdominal pain (57.4%). According to the analysis of the ECG in patients with MG, the syndrome of early ventricular repolarization (34.8%), incomplete blockade of the right bundle branch block - and 68 (59.1%) patients, intraventricular (49 (42.6%)) and intra-atrial (55 (47.8%)) conductivity. Scientists believe that the most likely cause of cardiac asynchronism is an imbalance of the myocardium and the impulse system of the heart [5]. Sinus arrhythmia was diagnosed in 62 (53.1%) representatives of the MG, tachycardia in 79 (68.7%), and 46 on the background of tachyarrhythmia), 45 (39.1%) patients suffered from bradycardia, and 6 with bradyarrhythmia. We found a large number of extrasystoles in 36 (31.3%) patients. In 79 (68.7%) of the patients studied by us, combinations of early ventricular repolarization with: incomplete blockade of the right bundle branch block of Hiss - 41 (35.7%) patients, sinus arrhythmia - 29 (25.2%), extrasystole - 2 patients. In our study, 105 (91.3%) patients with prolonged cardialgia underwent two-dimensional echocardiography (ECHO-KG) to exclude organic CVS diseases and minor heart defects. ECHO-CG diagnosed significant in 48 (41.7%) and moderate in 57 (49.6%) mitral valve

Eur. Chem. Bull. 2023, 12 (S3), 3266 – 3272

3269

Cardiointervalography as aMethod for Diagnosing Disturbances in Neurovegetative Regulation in Patients with Ischemic Cerebral Stroke

Section A-Research paper

(MV) regurgitation, its prolapse in 54 (47.0%) patients, the presence of an additional chord of the left ventricle in 12 (24.5%. The main cardiac arrhythmias (HRD) detected during 24-hour ECG monitoring in patients with coronary artery disease: supraventricular tachycardia (SVT) prevailed in the OH - 58.2% of cases, ventricular tachycardia (VT) - 41.7%, ventricular extrasystole (VEC) III and group IV - 39.1%, and paired and group supraventricular extrasystole (SVP) - 24.4%, there were frequent episodes of atrial fibrillation (AF) in 45.2% of paroxysmal VT and SVT. Arrhythmic syndrome was stated in 65.7% of the patients examined by us (table 3). In the HS, ventricular extrasystole (VEC) of II and I groups was more often recorded - 41.8%, paired and group NVEP - 28.4%, VT - 22.4%.

Table 3 Cardiac arrhythmias in patients depending on coronary artery disease

Type of arrhythmia	CG (n=115)		MG (n=67)		Total (n=182)	
	abc.	%	abc.	%	abc.	%
PVC I-II gradation	32	27,8%	28	41,8%	60	33,0%
PVC III-IV gradation	45	39,1%	11	16,4%	56	30,8%
Frequent single SVES	5	4,3%	10	14,9%	15	8,2%
Pair and group SVES	28	24,3%	19	28,4%	47	25,8%
AF paroxysms	52	45,2%	12	17,9%	64	35,2%
Supraventricular tachycardia	48	41,7%	12	17,9%	60	33,0%
ventricular tachycardia	67	58,3%	15	22,4%	82	45,1%

Note: PVC-ventricular extrasystoles; SVES - supraventricular extrasystoles; AF - atrial fibrillation;

An analysis was made of the frequency of PVCs, as the most common type of SVES in groups of patients with complaints of pain in the heart and shortness of breath in the MG and CG (Table 4).

Table 4. Communication of ventricular extrasystoles and complaints of patients, $(M+\sigma)$

Index	MG	CG	p
PVC per day	94,3 ±16	15,5 ±1,1	0,004
Average gradation of PVC	1,67 ±0,33	0,72 ±0,18	0,002
Paroxysms of PVCs	45%	17,91%	< 0,0001

As can be seen from Table 4, PVC was significantly more common in patients with MG compared with CG. When analyzing the age aspect in the MG and CG, statistically significant correlations were found in the frequency of PVC (r=0.53) and HRV (r=0.57) (p<0.05). It should be concluded that patients with cerebral strokes and coronary artery disease have a much weaker adaptive potential and a predictive probability of restoring the functionality and activity lost during stroke. By the end of the acute period of stroke, we stated a negative correlation between the frequency of PVC and HRV parameters in the MG: SDNN (r= -0.23, p<0.004), HF (r= -0.17, p=0.047) and LF (r= -0.29, p<0.05). The comparability of the obtained correlations with similar ones in the HS allows us to state the beginning of a period of

Eur. Chem. Bull. 2023, 12 (S3), 3266 – 3272

3270

*Cardiointervalography as aMethod for Diagnosing Disturbances in
Neurovegetative Regulation in Patients with Ischemic Cerebral Stroke*

Section A-Research paper

relative stability of VOD caused by stroke by the beginning of the early rehabilitation period. The

results of the analysis of correlations between the results of ECG and HRV are presented in Table 5.

Table 5. Correlations between ECG monitoring and HRV

Indicators	Correlation coefficient	p
Circadian Index and SDANN	0,679	<0,005
Circadian index and rMSSD	0,463	<0,005
Circadian index andpNN50n	0,484	<0,005
PVC frequency per hour during the day and nHF	-0,471	<0,005
PVC frequency per day and VLFdn	-0,468	<0,005
PVC frequency per hour at night and LFdn	0,382	<0,005

As can be seen from Table 5, a decrease in HRV significantly correlated with a decrease in the circadian index in patients with complaints of arrhythmia (p<0.05). The appearance of PVC of high gradations during the day is interconnected with the decline in parasympathetic activity at night. We have found a weak direct relationship between the frequency of PVCs at night and the LFdn indicator, a negative relationship between IWT and the frequency of PVCs, which allows us to conclude that sympathetic VOD prevails. A direct relationship was found between the systolic size of the LA and the number of PVCs during the night (r=0.382, p<0.005) without a correlation between the size and contractions of both ventricles and the strength of the PVCs. The effectiveness of the treatment in terms of the frequency of arrhythmias in coronary artery disease was evaluated according to the main NRS in 68 patients who took Mebicar for an average of 1.55±0.21 years and 47 patients without treatment. Significant differences were obtained in the frequency of PVCs per day (65.1 ± 12.0 extrasystoles against the background of Mebicar, 101.3 ± 23.7, p = 0.041 without administration), the average frequency of PVC episodes (against the background of Mebicar - 15.3 ± 0.54\7, without admission - 39.5 ± 0.28, p = 0.009), the average frequency of PVC episodes per day (against the background of "Mebicar" - 89.1 ± 21.8, without admission - 156.2±42.7, p=0.025). Therefore, taking Mebicar reduces the frequency of PVC episodes in coronary artery disease in patients in the acute period of PIS. A comparative analysis of CIG parameters in patients in the acute period of hemispheric stroke was carried out. In patients with stroke against the background of coronary artery disease (MG), sympathetic VOD often prevails

relative to HC patients (49.5% and 18.2%, respectively). An adequate sympathetic response was noted in 57.6% of the representatives of the MG and in 26.4% of the HC, hyperreaction - in 28.4% and 12.4%, respectively, therefore, the autonomic imbalance in stroke with CAD is stronger than in stroke without CAD. This conclusion is also supported by the results of CIG: in patients with MG, asympathicotonic VR in 15.4%, and hypersympathicotonic - in 37.2% of cases, while in HC - 11.5% and 29.1% of cases.

4. Conclusion

Thus, in patients with coronary artery disease in the acute period of IS (OH), SVT (58.2%), VT (41.7%), PVC groups III and IV (39.1%), paired and group SVE (24, 4%), frequent AF (45.2%). Arrhythmic syndrome was found in 65.7% of the patients examined by us. Groups II and I PVCs were more often registered in the HS - 41.8%, paired and group PVC - 28.4%, VT - 22.4%. The formation of VES in CHD in the acute period of IS largely determines the dysfunction of the ANS, manifested by a multitude and variety of clinical symptoms, autonomic disorders in CHD and stroke are more significant than stroke without CHD. Clinical and functional features of SVD in patients with coronary artery disease make it possible to diagnose disorders in a timely manner and carry out therapeutic and preventive measures. The gradation of SVD severity according to subjective and objective signs and the results of functional tests with a static load, VEM, CIG allows for a differentiated assessment of the patient's condition, even with an erased clinical picture, and, therefore, to prescribe adequate targeted treatment and

Eur. Chem. Bull. 2023, 12 (S3), 3266 – 3272

3271

Cardiointervalography as aMethod for Diagnosing Disturbances in Neurovegetative Regulation in Patients with Ischemic Cerebral Stroke

Section A-Research paper

monitor its effectiveness. Cardiac arrhythmias in IHD are identical to a decrease in HRV and a predominance of sympathetic influence along with a decrease in parasympathetic regulation. Taking the drug "Mebicar" has a positive effect on the frequency of ventricular arrhythmias.

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Eur. Chem. Bull. 2023, 12 (S3), 3266 – 3272

3272