

HEMODYNAMIC DISTURBANCES IN VERTEBRO-BASILAR VASCULAR INSUFFICIENCY: EEG, REG AND DOPPLEROGRAPHIC CORRELATIONS

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The quantitative evaluation of the results of non-invasive vascular methods for diagnostics of cerebrovascular diseases, of the degree of cerebral lesions and of conditions of collateral circulation offers timely clinico-laboratory information in addition to the leading neurological syndrome (1, 3, 8, 9).

The practical results of simultaneous EEG and REG analysis prove their diagnostic value for the localization and for the status of microcirculation in ischemic cerebrovascular disorders of the vertebrobasilar system (1, 2, 4, 8, 9, 14). Data obtained can be added by Doppler ultrasonic investigations of magistral cerebral vessels thus objective criteria of the topics and conditions of collateral circulation increase considerably (3, 5, 10, 11). The lack of parallel constellations of non-traumatic methods mentioned caused us to define the purpose of the present work: ascertaining of the interrelations between EEG, REG and sonographic quantitative indexes with the view of their practical applicability in the diagnosis of vertebrobasilar vascular insufficiency (VBVI).

Material and methods

We studied 30 patients with mean age of 55.7 years with proved chronic VBVI. Cerebral atherosclerosis combined with hypertension was main disease in 25 patients but 5 other patients were with arterial hypertension only. Occipital headache, vertigo, positive reflexes of oral automatism, and bilateral pyramidal signs were the cardinal clinical symptoms.

EEG and REG examinations were performed in a lying position simultaneously by using of 8-channel EEG—RET, B T-1, with electrode assembly of 10—20 per cent and standard functional loadings. Besides visual analysis of the bioelectrical changes a manual frequency analysis according to Sulg (13) was used. REG investigation was performed by means of two-channel rheographic appliance — K_2 —110kHz, and frontomastoid and occipitomastoid OM leads of electrodes. REG curve registration was carried out on EEG with paper speeds of 30 mm/sec. Besides visual qualitative evaluation a quantitative one of the following rheographic parameters was applied: amplitude (A), time of ascendent part ($\alpha/\%$), relative share of the anacrotic part of the curve to one cardiac cycle $\frac{\alpha}{\alpha+\beta}$ in %, dicrotic index DI (in %), hemispheric blood flow (HBF) in ml/min (according to Hadzhiev (1976), and coefficient of amplitude asymmetry K_0A_s (%).

Doppler sonography of vertebral arteries was performed by using of vascular Doppler «Kranzbüller» 762 (GFR) with retromastoid tube location and linear paper velocity of 25 cm/sec. The following linear velocities were calcula-

ted: maximal systolic velocity (MSV), systolic velocity increase (SVI), end diastolic velocity (EDV) in cm/sec as well as S/T index in % according to Pourcelot et Planiol (12) reflecting hemocerebral perfusion variations.

EEG, REG and Doppler indexes were then compared with quantitative values from 30 healthy individuals with mean age of 44.5 years and processed by the methods of variation and correlation analyses.

Results and discussion

The results of the investigations mentioned in chronic VBVI were presented in table 1 and 2.

■ Bioelectrical disorders were characterized with low-voltage, desynchronized activity of diffuse scattered teta, peak waves with average frequency 6.89 up to 7.01 Hz for every hemisphere and significance of the data from healthy persons ($p < 0.05$). These results coincided with the sharp reduction of REG curve amplitudes in OM leads arguing for deficit of the blood supply in the pool of the vertebrobasilar system where $K_0A_s = 63.2 \pm 1.253$ per cent ($p < 0.001$). There was, however, no correlation between the determined extent of brain blood flow reduction and EEG frequency index ($r = -0.235$). Nevertheless, electrogenesis disturbances were added by REG data concerning brain vascular resistance enhancement, with anacrotic phase duration $\alpha = 20$ (up to 25) per cent ± 4.48 and relative time share to whole cardiac cycle $\frac{\alpha}{\alpha + \beta} = 34.3$ (up to 36.3) ± 1.124 which was a statistically significant difference as compared with that of the controls ($p < 0.01$ — up to $p < 0.05$).

Besides DI was bilaterally increased in a considerable number of patients with chronic VBVI ($p < 0.05$) whereas hemispheric blood flow determined according to Hadzhiev (1969) showed a bilateral reduction — 233—253 ml/min. The difference concerning equal leads between patients and controls was statistically significant ($p < 0.001$). Correlations reported between EEG frequency and brain blood flow in ischemic lesions of the vertebrobasilar system were not always significant (2, 8, 11, 14). This fact could be explained by the degree of metabolic disturbances causing electrogenesis changes. Brain blood flow reduction and increased vascular resistance as established from the REG study reflected into EEG picture which could be related also with neurogenic reflectory autoregulatory starting moments. This mechanism was analyzed by a series of investigators (7—9, 14).

The summary of sonographic parameters argued for their sharp reduction in both vertebral arteries which was statistically significant when compared with the control values ($p < 0.05$ — 0.001). This fact was evidence of a diffuse atherosclerotic process inducing stenosis or thrombosis in chronic VBVI patients. In the cases reported data about thrombosis were proved to be with bilateral localization. This conclusion was confirmed also by the significantly low A-index values ($p < 0.001$) arguing for sharply reduced brain blood flow in the vertebrobasilar system. Our sonographic results were in concordance with those reported by other authors (3, 5, 12).

The established results of EEG, REG and sonographic investigations made the search for correlation and general conclusions purposeful. However, we could not find similar data in the literature available. Each one of the single methods reflected a definite aspect supporting the clinical diagnosis of chronic VBVI

Table 1
EEG frequency index and REG indexes in healthy individuals and patients with chronic VBVI

n	Age years	Clinical diagnosis	EEG frequency index		Amplitude		%As		α (%)		$\frac{\alpha}{\alpha+\beta}$ (%)		DI (%)	HBF (ml/min)	
			S	α	S	α	%	S	α	S	α	S		α	
30	55.7	chronic VBVI	6.89±0.11	7.01±0.09	0.052±0.011	0.057±0.013	63.2±1.25	20±4.48	24±2.65	36.3±1.13	34.6±1.24	68.2±2.40	25.3±4.54	233±10.13	233±14.11
30	44.5	healthy	8.2±1.1	8.7±0.21	0.108±0.01	0.105±0.01	13.24±1.96	9±1.12	10±1.12	11.2±0.06	11.1±0.6	32.5±1.4	35.6±1.11	348±12.6	370±11.1
p			<0.05	<0.05	<0.001	<0.001	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001

Table 2
Main sonographic indexes in healthy individuals and patients with chronic VBVI

n	Age years	Clinical diagnosis	MSV cm/sec		SVI cm/sec		EDV cm/sec		S/T index (%)	
			S	α	S	α	S	α	S	α
30	55.7	chronic VBVI	12.78±11.07	11.56±9.86	7.79±6.96	8.78±8.2	4.2±3.8	4.09±3.06	4.09±3.6	4.09±3.6
30	44.5	healthy	19.8±5.42	18.62±5.12	12.4±3.18	11.6±3.21	8.9±2.21	8.4±1.95	8.9±2.21	8.4±1.95
p			<0.001	<0.001	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001

(2, 8, 14). Our experience of proving the degree of interrelation between quantitative REG and Doppler sonographic parameters was demonstrated in table 3. We concluded that there was no correlation between the main sonographic and REG criteria excepting EDV and DI (brain blood flow determined by both methods). The negative correlation ($r=-0.5848$ and $r=-0.5334$) between EDV

Table 3

Correlation between main REG and dopplerographic indices

REG criterion	Sonographic criterion	Correlation coefficient
A (Ω)	MSV	0.0379
α (%)	MSV	0.0022
$\frac{\alpha}{\alpha+\beta}$ (%)	MSV	0.0013
DI (%)	MSV	0.1797
HBF ml/min	MSV	0.0956
A (Ω)	SVI	0.0996
α (%)	SVI	0.0553
$\frac{\alpha}{\alpha+\beta}$ (%)	SVI	0.0847
DI (%)	SVI	0.0741
HBF ml/min	SVI	0.0936
A (Ω)	EDV	0.1345
α (%)	EDV	0.0843
$\frac{\alpha}{\alpha+\beta}$ (%)	EDV	0.0943
DI (%)	EDV	-0.5848
HBF ml/min	EDV	0.6541
A (Ω)	S/T	0.1384
α (%)	S/T	0.0974
$\frac{\alpha}{\alpha+\beta}$ (%)	S/T	0.0032
DI (%)	S/T	-0.5334
HBF ml/min	S/T	0.6782

and DI as well as S/T index argues for brain vascular perfusion reduction in the vertebral arteries accompanied by enhanced cerebral vascular resistance. It is an interesting fact that there is a significant correlation between brain blood flow ascertained by using of REG method and variations of brain circulatory perturbation proved sonographically when the vertebrobasilar system is concerned ($r=0.6541$ and $r=0.6782$). This fact indicates the value of the methods of noninvasive objectivization of the degree of hemodynamic disorders in VBVI patients.

In conclusion we emphasize that complex changes of electrogenesis and brain hemodynamics established in our study enlarge for the first time in part the scope of objective criteria concerning the changes of cerebrovascular resistance, the degree of blood supply and the compensatory capacities in chronic VBVI patients. The lack of correlations between EEG, REG and sonographic indices ref-

lects exactly their interrelations and the possibilities for non-traumatic establishing of various links in chronic VBVI pathogenesis and thus contributes to the usage of more diagnostic, therapeutic and prognostic criteria. Facts prove their information value concerning the status of brain metabolism, neurogenic reflectory influences upon total cerebral circulation due to ischemic changes affecting brain stem vasomotor centres. Our investigations are a serious precondition for introduction of a complex analysis of these methods in the course of dynamic follow-up in chronic VBVI with a view to an adequate prognostic and therapeutic approach.

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НАРУШЕНИЯ ГЕМОДИНАМИКИ ПРИ ВЕРТЕБРОБАЗИЛЯРНОЙ СОСУДИСТОЙ НЕДОСТАТОЧНОСТИ — ЭЭГ, РЭГ И ДОПЛЕРОГРАФИЧЕСКИЕ КОРРЕЛЯЦИИ

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РЕЗЮМЕ

Комплексные обобщения электрогенеза и мозговой гемодинамики, доказанных методами ЭЭГ, РЭГ и сосудистой доплерографии, представляют собой источником объективных критериев патофизиологической оценки вертебро-базиллярной сосудистой недостаточности. Исследовано 30 больных с доказанной хронической вертебро-базиллярной сосудистой недостаточностью. Полученные результаты сопоставлены с данными 30 здоровых лиц. Наблюдения показывают, что каждый метод отражает отдельную сторону сложной патогенетической цепи, обуславливающей сосудистые расстройства при вертебро-базиллярной недостаточности, но при наличии генетического родства в количественных показателях. Отсутствует корреляционная связь между всеми основными ЭЭГ, РЭГ и сонографическими критериями. Доказанные параллельные взаимоотношения между дикротическим индексом и КДС, кровотоком мозга, определяемый по РЭГ и S/t сонографическим индексом ($r=0,6541$ и $r=0,6782$) свидетельствуют о снижении кровотока мозга, что связано с повышением сопротивления сосудов. Исследование открывает новые возможности неинвазивной объективизации гемодинамических нарушений при хронической вертебро-базиллярной сосудистой недостаточности, а динамическое прослеживание этих нарушений является предпосылкой верного терапевтического и прогностического анализа.