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Relevance of Baroreflex Sensitivity in Hypertensives after Ischemic Stroke

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Abstract: *Objective:* Impaired baroreflex sensitivity (BRS) is a non-invasive marker of autonomic dysfunction which has been observed in acute stroke and is associated with a higher risk of long-term poststroke mortality and disability. The aim of the present study was to evaluate the clinical significance of baroreflex sensitivity in hypertensives ≥ 6 months after ischemic stroke onset.

Design: A total of 26 hypertensive patients (66 ± 10 years of age, 11 female/15 male) with a history of the first-ever ischemic stroke, which was neuroradiologically confirmed, were studied. They were compared to 30 hypertensive patients without a history of any cardiovascular event of similar age and sex. The relationship between baroreflex sensitivity and blood pressure in hypertensives with stroke in comparison to a group of stroke-free control patients was evaluated.

Method: BRS expressed in ms/mmHg or in Hz/mmHg (BRSf) was determined by the sequence and spectral method: a 5-minute non-invasive beat-to-beat recording of blood pressure and RR interval by means of a Collin CBM-7000 monitor, controlled breathing at a frequency of 0.1 Hz. Carotid intima-media thickness (IMT) was determined using ultrasonography.

Results: A significantly negative correlation between BRS and systolic blood pressure was present ($p < 0.001$). BRS values obtained by the spectral method (BRS spect) and sequence method (BRS seq) in hypertensives with stroke were significantly lower even ≥ 6 months after stroke onset compared to stroke-free control patients (BRS spect $p = 0.0237$, BRSf spect $p = 0.0285$, BRS seq $p = 0.0532$, BRSf seq = 0.0273). Significantly reduced BRS in hypertensives with stroke was associated with greater carotid IMT and bilateral carotid atherosclerosis.

Conclusion: Examination of baroreflex sensitivity as a marker of autonomic dysfunction along with global cardiovascular risk stratification of post-stroke hypertensives, especially with measuring carotid intima media thickness, seems to be a method for identifying patients at high residual cardiovascular risk.

Key words: baroreflex sensitivity, autonomic nervous system, blood pressure, arterial hypertension, stroke

Kurzfassung: Klinischer Stellenwert der Baroreflexsensitivität (BRS) bei hypertensiven Schlaganfallpatienten. *Hintergrund und Ziele:* Die gestörte Baroreflexsensitivität (BRS) ist ein Marker der frühen autonomen Dysfunktion. Sie spielt in der Langzeitperspektive eine wichtige Rolle bei der Zielorganschädigung bei Patienten mit arterieller Hypertonie. Unser Ziel war, die klinische Bedeutung der spontanen Baroreflexsensitivität bei hypertensiven Schlaganfallpatienten zu studieren.

Methode: Insgesamt wurden 26 hypertensive Patienten (66 ± 10 Jahre; 11 Frauen, 15 Männer) studiert, die den ersten ischämischen, neuroradiologisch bestätigten Schlaganfall erlitten hatten. Diese wurden mit 30 hypertensiven Patienten ohne kardiovaskuläres Ereignis mit ähnlichem Alter und Geschlecht verglichen. Die BRS wurde durch die Sequenz- und spektrale Methoden gemessen.

Ergebnisse: Der BRS-Wert war bei allen Patienten mit essenzieller Hypertonie gestört. Es wurde festgestellt, dass der Wert der spontanen BRS bedeutend niedriger bei hypertensiven Schlaganfallpatienten war als bei den Patienten ohne Schlaganfall. Die größte Senkung in den BRS-Werten fand sich bei hypertensiven Schlaganfallpatienten mit Metabolischem Syndrom, deren Prognose schlechter war als bei den übrigen Patienten. Die Beziehung zwischen dem BRS-Wert and Alter wurde als indirekt eingeschätzt.

Schlussfolgerung: Die BRS ist eine klinisch applikable Methode zur Bewertung der Dysfunktion des autonomen Nervensystems. Es wurde festgestellt, dass die BRS bei Schlaganfallpatienten mit essenzieller Hypertonie stärker beeinträchtigt war als bei Patienten ohne Schlaganfall. Hypertensive Schlaganfallpatienten mit Anzeichen des Metabolischen Syndroms hatten BRS-Werte < 3 ms/mmHg. Die Untersuchung der Baroreflexsensitivität ist die Methode der Wahl zur Identifikation von Patienten mit hohem kardiovaskulärem Risiko. **J Hypertonie 2012; 16 (2): 7–11.**

Schlüsselwörter: Baroreflexsensitivität, autonomes Nervensystem, Blutdruck, arterielle Hypertonie, Schlaganfall

Background

The baroreflex is one of the most important physiological mechanisms controlling blood pressure (BP) homeostasis [1, 2]. It is considered a blood pressure buffer system for damping short-term variations of arterial pressure [1]. It has always been thought that baroreceptors are of minor importance in "chronic" hypertension because of a complete resetting to any new mean arterial pressure level [3]. However, the current role of arterial baroreceptors in hypertension is being reviewed [3, 4]. Impaired baroreflex function is associated with a shift in autonomic balance towards sympathetic dominance, which may play an important role in the long-term development of arterial hypertension and subsequent target organ damage [5, 6]. Blood pressure is one of the most powerful determinants of stroke, but not the only one. The function of arterial baroreflex seems to be another important process in the regulation of cardiovascular function [7, 8]. Approximately 15 million people are affected by stroke annually, of whom one third die and another third are permanently disabled [7]. Satisfactory blood pressure control has always been the aim of clinicians to reduce morbidity and mortality associated with stroke. Currently, much interest is being paid to the interaction between autonomic dysfunction and global cardiovascular risk. The baroreflex system exhibits a degree of tonic negative feedback by aortic-carotid and cardiopulmonary baroreceptors that normally acts to oppose increases in BP by inhibiting the sympathetic nervous system [1, 6]. The baroreceptors regulate BP by means of a vagal component that reduces the heart rate or, alternatively, by an adrenergic component increasing peripheral resistance [9]. BRS is quantified in ms of the RR interval duration to each mmHg of arterial pressure [6]. The normal value is about 15 ms/mmHg [6].

Impaired BRS is a non-invasive marker of autonomic dysfunction which has been observed in acute stroke and is associated with a higher risk of long-term post-stroke mortality

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and disability [8, 10]. Mechanisms and effects of blood pressure dysregulation in stroke are not fully elucidated. Impaired cardiac BRS may be due to impaired central processing of baroreceptor information following stroke or reduced baroreceptor activity due to increased large-artery stiffness [11]. However, it is not clear if the impaired acute stroke BRS persists.

The aim of the present study was to evaluate the clinical significance of baroreflex sensitivity in hypertensives ≥ 6 months after ischemic stroke onset.

Patients and Methods

A total of 26 hypertensive patients (11 female/15 male, 66 ± 10 years of age) with a history of the first-ever ischemic stroke (6–24 months after stroke onset), which was neuroradiologically confirmed (CT, NMR), were studied. These were compared to 30 hypertensive patients (13 female/17 male, age 65 ± 6 years) without a history of any cardiovascular event. Stroke patients had a higher Body Mass Index (32.0 ± 3.5 kg/m^2 vs 28.5 ± 3.2 kg/m^2), impaired glucose tolerance (34.6 % vs 13.3 %), and lower HDL cholesterol levels (0.80 ± 0.30 vs 1.54 ± 0.25 mmol/l) in comparison to stroke-free patients (Table 1). Patients with stroke suffered more frequently from arrhythmias (paroxysmal atrial fibrillation) in the history (23.0 % vs 3.3 %) in comparison to patients without stroke. The relationship between baroreflex sensitivity (BRS) and blood pressure in hypertensives with stroke in comparison with a group of stroke-free control patients was evaluated.

All subjects were examined according to a standardized protocol. Patients were on standard antihypertensive and hypolipidemic (statin) therapy. These included calcium channel blockers (n = 26), beta-blockers (n = 32), angiotensin-converting enzyme inhibitors/AT$_1$ blockers (n = 41), diuretics (n = 14), central antihypertensive agents (n = 7), statins (n = 38), and acetylsalicylic acid (n = 28) (Table 2). Exclusion criteria comprised the following: atrial fibrillation, recordings of > 5 ectopics per minute and other cardiac arrhythmias, present-day mean systolic BP > 160 mmHg or diastolic BP > 100 mmHg, acute myocardial infarction, history and evidence of left-ventricular dysfunction, unstable angina, renal function impairment (creatinine > 200 µmol/l), age < 18 years old, non-cooperative patient, end-stage diseases or another chronic disease that may influence autonomic nervous system, such as long-lasting diabetes mellitus. All subjects had a history of arterial hypertension and were in sinus rhythm. They were hemodynamically stable and independent in their daily living activities. All subjects gave their informed written consent and the local ethics committee approved the study.

Patients were asked to avoid alcohol, caffeine, and nicotine l day prior to the procedure. The examination was performed in a quiet room at a constant temperature with subdued light. Subjects lay in supine position on a couch with their heads propped up. BP was measured continuously by the non-invasive BP monitor (COLLIN CBM 7000, Japan) with the appropriately sized cuff applied to the wrists. The cuff was maintained at heart level. Control BP was measured in the brachial artery on the other arm using the ausculatory technique. Three surface electrocardiographic chest leads were attached for continuous ECG monitoring.

After 15 minutes of rest and after achieving satisfactory BP and ECG signal and the stabilization of BP at the same level, a phase of first recording followed. A special sensor (COLLIN CBM 7000, Japan) was placed around the wrist where the radial artery is maximally pulsatile for beat-to-beat, indirect, continuous 5-min blood pressure recordings and heart rate measurements. Subjects were asked to maintain a respiratory rate of 17–20 breaths per minute. They were allowed to adjust the tidal volume for their own comfort. Breathing was synchronized by a metronome at 0.33 Hz. Three consecutive 5-minute recordings of BP and inter-beat interval (IBI) were obtained. In each subject, the arithmetic average of 3 recordings was calculated. IBI and BP were recorded simultaneously to a computer with an analogue-digital converter. Data were analysed using a specially designed software.

BRS expressed in ms/mmHg or in Hz/mmHg (BRSf) was determined by the sequence (BRS seq) and spectral method using a protocol of controlled breathing (BRS spect) at a frequency of 0.1 Hz. A five-minute, non-invasive, beat-to-beat recording of blood pressure and RR interval changes were analyzed by means of a Collin CBM-7000 monitor. The BRSf index was calculated on the basis of the instantaneous value of IBI measured beat-by-beat. Index BRSf expressed in Hz/mmHg

Table 1. Comparison of patient clinical characteristics according to the presence or absence of stroke.

	Hypertension + stroke	Hypertension	p
n	26	30	–
Male/female	15/11	17/13	ns
Age (years)	66 ± 10	65 ± 6	ns
BMI (kg/m^2)	32.0 ± 3.5	28.5 ± 3.2	< 0.05
Impaired glucose tolerance	9 (34.6 %)	4 (13.3 %)	< 0.05
Total cholesterol (mmol/l)	4.43 ± 1.36	4.94 ± 1.20	ns
LDL cholesterol	3.40 ± 0.45	3.25 ± 0.24	ns
HDL cholesterol	0.80 ± 0.30	1.54 ± 0.25	< 0.05
Triglycerides	2.35 ± 1.60	2.15 ± 1.45	ns

Values are presented as mean ± SD, category variables in percentage, statistical analysis by ANOVA. ns: not significant

Table 2. Comparison of medical therapy in hypertensive patients with stroke and hypertensive patients.

	Hypertension + stroke		Hypertension	
n	26		30	
Drug	**Yes**	**No**	**Yes**	**No**
Calcium blockers	12	14	14	16
Beta-blockers	14	12	18	12
ACEI/AT$_1$blockers	19	7	22	8
Diuretics	8	18	6	24
Central antihypertensive agents	3	23	4	26
Statins	18	8	20	10
Acetylsalicylic acid/clopidogrel	22	4	14	16

is less dependent on pulse interval changes than BRS [12]. The BRS seq was assessed by analysing the slopes of spontaneously occurring sequences of ≥ 3 consecutive beats in which systolic BP and IBI of the following beat increased or decreased in the same direction in a linear fashion.

Duplex ultrasonographic examination of the carotid wall and intima media thickness (IMT) expressed as the mean of the maxima at 4 sites of both common carotid artery and carotid bulb were performed in all patients. Carotid atherosclerosis (CA) was graded using duplex ultrasonography. Carotid stenoses ≥ 50 % or the presence of severe atheroma were considered as CA.

Statistics

Data were analysed using the Scope Win 95 software. Statistical data were expressed as mean ± SD, category variables in percentage. Comparisons between data obtained in different groups were made by analysis of variance (ANOVA) and Mann-Whitney U test for BRS and CA. Antihypertensive medications and statins were not excluded, therefore they were considered to be another variable. A p value < 0.05 was considered significant. Statistical analysis was performed using Microsoft Office Excel and GNU Octave 2.1.73.

Results

A significantly negative correlation between spontaneous BRS and systolic BP was present (r = –0.52; p < 0.001). Blood pressure amplitudes in hypertensives with stroke were significantly higher than in hypertensives without stroke (Table 3). Essential hypertension was associated with decreased BRS/BRSf (Table 4) and the higher the grade of hypertension present the lower the BRS/BRSf values found (p = 0.0012/p = 0.0015). The most evident decline in BRS/BRSf was in grade 3 of arterial hypertension, especially in patients with target organ damage such as stroke. The value of spontaneous BRS was lower in stroke hypertensive patients than in stroke-free hypertensive controls: BRS obtained by the spectral method (BRS spect) was 4.0 ± 2.2 vs 6.4 ± 3.5 ms/mmHg (p = 0.0237) or BRS obtained by the sequence method (BRS seq) was 5.9 ± 3.0 vs 8.4 ± 6.4 ms/mmHg (p = 0.0532). We also revealed a significant BRSf decrease in hypertensives with stroke (BRSf spect p = 0.0285; BRSf seq p = 0.0273). The differences between baroreflex sensitivity parameters (BRS and BRSf) in hypertensives and hypertensives with stroke are presented in Table 3. The coincidence of arterial hypertension, metabolic syndrome (presence of essential hypertension, impaired glucose tolerance, abnormal lipoprotein metabolism, and central obesity), and stroke is associated with extremely high cardiovascular risk. All 5 patients with these criteria had BRS values < 3 ms/mmHg, higher grades of disability, and 2 of them died within one year. A clinically noticeable difference in gender was not shown in BRS values. An inverse relationship between age and BRS has been demonstrated (r = –0.34; p < 0.05).

BRS was significantly reduced in bi- and unilateral carotid atherosclerosis (CA; p < 0.05) in comparison with no CA (Ta-

Table 3. Differences between parameters in hypertensives and hypertensives with stroke.

Parameter	Hypertensives	Hypertensives with stroke	p
n	30	26	–
Systolic/diastolic blood pressure (mmHg)	127/81 ± 13/9	139/85 ± 10/7	0.0417/ 0.0911 (ns)
Pulse pressure (mmHg)	46 ± 4	54 ± 3	< 0.05
IMT CC (mm)	0.7625	1.0975	< 0.05
Inter-beat-interval (ms)	834 ± 126	816 ± 157	0.0451
BRS seq (ms/mmHg)	8.4 ± 6.4	5.9 ± 3.0	0.0532 (ns)
BRSf seq (Hz/mmHg)	0.0083 ± 0.0045	0.0055 ± 0.0030	0.0273
BRS spect (ms/mmHg)	6.4 ± 3.5	4.0 ± 2.2	0.0237
BRSf spect (Hz/mmHg)	0.0090 ± 0.0047	0.0064 ± 0.0022	0.0285

Values are presented as mean ± standard deviation. BRS seq: baroreflex sensitivity values obtained by sequence method (ms/mmHg); BRS spect: baroreflex sensitivity values obtained by spectral method (ms/mmHg); BRSf seq: baroreflex sensitivity obtained by sequence method (Hz/mmHg); BRSf spect: baroreflex sensitivity obtained by spectral method (Hz/mmHg); IMT CC: intima media thickness of common carotid (mm), statistical analysis by ANOVA; ns: not significant

Table 4. Baroreflex sensitivity values obtained by both sequence and spectral methods based on the grade of arterial hypertension.

Arterial hypertension category	n	%	SBP (mmHg)	DBP (mmHg)	BRS seq vs BRS spect (ms/mmHg)	BRSf seq vs BRSf spect (Hz/mmHg)
Grade 1	5	8.92 %	140–59	90–99	8.4 ± 3.0 vs 9.5 ± 4.0	0.0082 ± 0.0040 vs 0.0090 ± 0.0035
Grade 2	22	39.28 %	160–79	100–109	7.2 ± 6.9 vs 8.4 ± 6.4	0.0075 ± 0.0035 vs 0.0079 ± 0.0030
Grade 3	29	51.78 %	≥ 180	≥ 110	4.5 ± 2.5 vs 6.4 ± 5.4	0.0052 ± 0.0020 vs 0.0055 ± 0.0035

Values are presented as mean ± standard deviation (SD), category variables in percentage. BRS: baroreflex sensitivity (ms/mmHg); BRSf: baroreflex sensitivity (Hz/mmHg); BRS seq: BRS values obtained by sequence method; BRS spect: BRS values obtained by spectral method; SBP: systolic blood pressure; DBP: diastolic blood pressure; n: total of subjects.

Table 5. Association between baroreflex sensitivity, intima media thickness parameters, and carotid atherosclerosis in hypertensives and hypertensives with stroke.

	No CA	Unilateral CA	Bilateral CA
n	18	17	21
Hypertensives with stroke (n)	0	5	21
BRS (ms/mmHg)	6.9 ± 4.4	5.8 ± 4.4	4.1 ± 2.5
IMT CC (mm)	0.660 ± 0.340	0.995 ± 0.250	1.200 ± 0.155
IMT CB (mm)	0.780 ± 0.150	1.080 ± 0.350	1.355 ± 0.275

Values are presented as mean ± standard deviation. BRS: baroreflex sensitivity values (ms/mmHg); CA: carotid atherosclerosis; IMT CC: intima-media thickness of common carotid (mm); IMT CB: intima-media thickness of carotid bulb (mm); ns: not significant; n: total of subjects (percentage). Statistical analysis by ANOVA: IMT CC/CB in bilateral CA vs unilateral ($p < 0.05$), IMT CC/CB in bilateral CA vs no CA ($p < 0.01$), Mann-Whitney U test for BRS and CA: bilateral CA vs No CA ($p < 0.05$); bilateral CA vs unilateral CA ($p < 0.05$); n : total of subjects.

ble 5). Hypertensives with stroke had a significantly increased IMT of common carotid and carotid bulb and decreased BRS values simultaneously in comparison with stroke-free hypertensives (Table 5).

Discussion

It has been shown that BRS was impaired after acute stroke within the first 72 hours [8, 10]. Decreased BRS was found in patients with acute intracerebral hemorrhage and correlated with increased beat-to-beat BP variability [10]. There is also established evidence of abnormal BRS in animal models after stroke and other cerebrovascular diseases [8, 10]. In our study, we have demonstrated that the values of BRS and BRSf were significantly lower in hypertensive subjects even ≥ 6 months after ischemic stroke onset (chronic phase) in comparison to stroke-free hypertensive controls, using the 2 indices BRS and IBI-independent BRSf we could evaluate complex BRS and better reflect the development of the BRS [13], especially in patients with target organ damage. Several studies have confirmed that essential hypertension is connected with decreased BRS [14, 15]. In support of these studies we have confirmed a noticeable negative correlation between BRS and systolic BP. Essential hypertension was associated with decreased BRS, and the grade of hypertension was inversely correlated with BRS values. We observed that blood pressure amplitude in hypertensives with stroke was higher than in hypertensives without stroke. Significantly reduced BRS in hypertensives with stroke was associated with greater systolic blood pressure, pulse pressure, and carotid IMT. Increased IMT refers to higher arterial stiffness that contributes to increased pulse pressure. Reduced BRS in hypertensives with stroke may reflect age-dependent atherosclerotic carotid lesions amplified with central changes of baroreflex as a consequence of stroke even in the chronic phase. Patients with stroke suffered more from impaired glucose tolerance and arrhythmias in the history (atrial fibrillation), had a higher Body Mass Index (BMI), and lower HDL cholesterol levels in comparison to patients without stroke. Hypertensive stroke patients with metabolic syndrome had critical BRS values < 3 ms/mmHg.

BRS is an independent risk factor for morbidity and major adverse cardiovascular events in hypertensive patients [14]. Except for classic risk factors such as elevated blood pressure, abnormal serum lipids, or glucose, BRS seems to be an integral predictor for future cardiovascular events in patients with arterial hypertension [16]. Decreased BRS with additional risk factors (obesity, lack of exercise, smoking) in children and adolescents predisposes to the development of an early stage of essential hypertension [17]. Examination of BRS is convenient in clinical practice because of its non-invasive nature. Recent research has lead to new treatment possibilities. Chronic baroreceptor stimulation by means of implantable devices in patients with drug-resistant arterial hypertension showed an effect on the autonomic cardiovascular regulation with a reduction of systolic and diastolic BP as well as of the heart rate [18].

A diminished BRS and also heart rate variability are independent risk factors for sudden death [19]. According to the multicenter ATRAMI (Autonomic Tone and Reflexes After Myocardial Infarction) and Robinson studies, impaired BRS seems to provide a long-term prognostic value for cardiovascular morbidity and mortality [8, 19]. Impaired cardiac BRS after acute stroke may also be associated with central autonomic cardiovascular dysautoregulation [8, 10]. Cross-linked mechanisms of impaired cerebro-cardio-vascular autoregulation and altered autonomic balance may be responsible for impaired cerebral perfusion, metabolic, inflammatory reactions, blood-barrier disruption, and cardiovascular complications such as disturbed circadian blood pressure patterns and cardiac arrhythmias [20].

An inverse relationship between BRS and age was demonstrated. A combination of high BP and old age was associated with a significant reduction in BRS. Hypertension and ageing may have a synergistic effect on cardiac parasympathetic function, which ultimately cause prolongation in baroreflex response [21]. A total of 26 hypertensive subjects with stroke were compared to 30 hypertensive patients of similar age to eliminate age-dependent decrease of BRS. Age-dependent decrease of BRS corresponds to the age-related structural changes of the carotid wall [22]. Measurement of IMT of the carotid wall along with BRS seem to be additive methods for the identification of subclinical atherosclerosis in subjects with high normal BP and hypertensives; the combination of BRS with grading of CA seems to be better for the stratification of cardiovascular risk in hypertensives with target organ damage. Carotid IMT ultrasound measurements do not allow for a clear distinction between intima and media and between atherosclerosis and hypertrophy [23]. BRS could identify hypertensives with major cardiovascular events on statin therapy who have a very high cardiovascular risk but a different residual risk to fall victim to another cardiovascular event.

The pharmacological possibility to influence early autonomic dysfunction long before the change of vascular structures presents a great challenge. Antihypertensive and statin therapies, which were not excluded, could have influenced BRS values. Long-term BP control with modern antihypertensive drugs such as angiotensin-converting enzyme inhibitors (ACEI), angiotensin II receptor blockers, calcium channel

blockers, and beta-blockers improves baroreflex functions [24, 25]. Despite the fact that potential increases in BRS values may have resulted from these medications in hypertensive and stroke patients, they had BRS values still impaired in comparison with healthy subjects. It is evident that the influence of medication on BRS values and interpretation of results warrants more investigation in the future.

Conclusion and Relevance to Practice

The inappropriately active sympathetic nervous system in patients with arterial hypertension is an important etiopathogenetic factor that contributes also to disease progression and the resultant cardiovascular risk. In this study, BRS and BRSf values were more impaired in ischemic stroke patients (chronic phase) with essential hypertension than in stroke-free hypertensive patients. A significantly reduced BRS in hypertensives with stroke was associated with greater carotid IMT and bilateral carotid atherosclerosis. Examination of baroreflex sensitivity as a marker of autonomic dysfunction along with global cardiovascular risk stratification of individuals seems to be a method for identifying patients at high cardiovascular risk.

Zusammenfassung und Relevanz für die Praxis

Das inadäquate aktive sympathische Nervensystem bei Patienten mit arterieller Hypertonie ist ein wichtiger ätiopathogenetischer Faktor, der zur Progression der Krankheit in großem Ausmaß beiträgt und schließlich in einem erhöhten kardiovaskulären Risiko resultiert. In dieser Studie waren die BRS- und BRSf-Werte bei Schlaganfallpatienten (chronische Phase) mit essenzieller Hypertonie stärker beeinträchtigt als bei Patienten ohne Schlaganfall. Reduzierte BRS bei Schlaganfallpatienten war mit einer erweiterten Intima-media-Dicke sowie Atherosklerose beider Karotiden assoziiert. Die Untersuchung der Baroreflexsensitivität als Marker der autonomen Dysfunktion mit globaler Stratifizierung von Individuen mit kardiovaskulärem Risiko scheint eine Möglichkeit zur Identifizierung von Patienten mit hohem kardiovaskulärem Risiko zu sein.

Conflict of Interest

None.

References:

1. Schachter M. The sympathetic nervous system and hypertension. Martin Dunitz Ltd, London, 1997.
2. Izzo JL, Taylor AA. The sympathetic nervous system and baroreflexes in hypertension and hypotension. Curr Hypertens Rep 1999; 1: 254–63.
3. Persson PB. Baroreflexes in hypertension: a mystery revisited. Hypertension 2005; 46: 1095–6.
4. Lafranchi PA, Somers VK. Arterial baroreflex function and cardiovascular variability: interactions and implications. Am J Physiol 2002; 283: R815–R826.
5. Grassi G. Role of the sympathetic nervous system in human hypertension. J Hypertens 1998; 16: 1979–87.
6. La Rovere MT, Maestro R, Mortara A. Baroreflex sensitivity. Ital Heart J 2001; 2: 472–7.
7. Liu AJ, Ma XJ, Shen FM, et al. Arterial baroreflex a novel target for preventing stroke in rat hypertension. Stroke 2007; 38: 1916–23.
8. Robinson TG, Dawson SL, Eames PJ, et al. Cardiac baroreceptor sensitivity predicts long-term outcome after acute ischemic stroke. Stroke 2003; 34: 705–12.
9. Schrezenmaier C, Singer W, Mauenter S, et al. Adrenergic and vagal baroreflex sensitivity in autonomic failure. Arch Neurol 2007; 64: 381–6.
10. Sykora M, Diedler J, Rupp A, et al. Impaired baroreflex sensitivity predicts outcome of acute intracerebral hemorrhage. Crit Care Med 2008; 36: 3074–9.
11. Eveson DJ, Robinson TG, Shah NS, et al. Abnormalities in cardiac baroreceptor sensitivity in acute ischaemic stroke patients are related to aortic stiffness. Clin Sci 2005; 108: 441–7.
12. Al Kubati MAA, Fišer B, Siegelová J. Baroreflex sensitivity during psychological stress. Physiol Res 1997; 46: 31–7.
13. Závodná E, Fišer B, Semrád B. Age-dependent relationship between the carotid intima-media thickness, baroreflex sensitivity, and the inter-beat interval in normotensive and hypertensive subjects. Physiol Res 2005; 54: 593–600.
14. Ormezzano O, Cracowski JL, Quesada JL, et al. Evaluation of the prognostic values of baroreflex sensitivity in hypertensive patients: the EVABAR study. J Hypertens 2008; 26: 1373–8.
15. Head GA. Baroreflexes and cardiovascular regulation in hypertension. J Cardiovasc Pharmacol 1995; 26 (Suppl 2): S7–S16.
16. Lantelme P, Khettab F, Custaud MA, et al. Spontaneous baroreflex sensitivity: toward an ideal index of cardiovascular risk in hypertension? J Hypertens 2002; 20: 935–44.
17. Krontorádová K, Honzíková N, Fišer B, et al. Overweight and decreased baroreflex sensitivity as independent risk factors for hypertension in children, adolescents and young adults. Physiol Res 2008; 57: 385–91.
18. Wustmann K, Kucera JP, Scheffers I, et al. Effects of chronic baroreceptor stimulation on the autonomic cardiovascular regulation in patient with drug- resistant arterial hypertension. Hypertension 2009; 54: 530–6.
19. La Rovere MT, Bigger JT, Marcus FI, et al. Baroreflex sensitivity and heart variability in prediction of total cardiac mortality after myocardial infarction. Lancet 1998; 351: 478–84.
20. Sykora M, Diedler J, Rupp A, et al. Impaired baroreflex sensitivity in acute stroke is associated with insular involvement, but not with carotid atherosclerosis. Stroke 2009; 40: 737–42.
21. Peckerman A, Hurwitz BE, Nagel JH, et al. Effects of gender and age on the cardiac baroreceptor reflex in hypertension. Clin Exp Hypertens 2001; 23: 645–56.
22. Láborová R, Honzíková N, Madìrová E, et al. Age-dependent relationship between the carotid intima-media thickness, baroreflex sensitivity and the inter-beat interval in normotensive and hypertensive subjects. Physiol Res 2005; 54: 593–600.
23. Zanchetti A. The antiatherogenic effects of antihypertensive treatment: trials completed and ongoing. Curr Hypertens Rep 2001; 3: 350–9.
24. Munakata M, Aihara A, Nunokawa T, et al. The influence of one-year treatment by angiotensin converting enzyme inhibitor on baroreflex sensitivity and flow-mediated vasodilation of the brachial artery in essential hypertension-comparison with calcium channel blockers. Clin Exp Hypertens 2003; 25: 169–81.
25. Chen X, Hassan MO, Jones JV, et al. Baroreflex sensitivity and the blood pressure response to beta-blockade. J Hum Hypertens 1999; 13: 185–90.

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