SCRIPTA MEDICA (BRNO) – 81 (3): 181–184, *October 2008*

SEVEN-DAY AMBULATORY BLOOD PRESSURE MONITORING AND AMBULATORY ARTERIAL STIFFNESS INDEX

SIEGELOVÁ J.[1], FIŠER B.[1], HAVELKOVÁ A.[1], DOBŠÁK P.[1], POHANKA M.[1], DUŠEK J.[1], CORNÉLISSEN G.[2], HALBERG F.[2]

[1]Department of Physiotherapy and Rehabilitation, Department of Functional Diagnostics and Rehabilitation, Department of Physiology, Faculty of Medicine, Masaryk University, St. Anne's Faculty Hospital, Brno, Czech Republic
[2]Halberg Chronobiology Center, University of Minnesota, Minneapolis, MN, USA

Received after revision Juny 2008

A b s t r a c t

Stiffening of large arteries predicts adverse cardiovascular outcomes.
The estimation of the reliability of ambulatory arterial stiffness index (AASI) determination in individual patients was the aim of the study. Seven-day ambulatory pressure monitoring enabled us to obtain 6 values in 6 full consecutive days. The interindividual variation of AASI is large. It is concluded that the determination of AASI from 24-hour blood pressure monitoring should be supplemented by blood pressure self-monitoring lasting several days irrespective of the method of AASI calculation.

K e y w o r d s

Seven-day ambulatory blood pressure monitoring, Ambulatory arterial stiffness index

INTRODUCTION

Stiffening of large arteries predicts adverse cardiovascular outcomes (*1–3*). Measurements of arterial stiffness require ultrasound equipment to measure peripheral arteries in the subject in the supine or sitting position (*4*). The ambulatory arterial stiffness index (AASI) is defined as one minus the regression slope of diastolic on systolic pressure during 24-h ambulatory blood pressure monitoring and might be a measure of arterial stiffness (*5, 6*). The stiffer arterial tree the closer the regression slope and AASI are ranging from 0 to 1, respectively (*7, 8*).

In the present paper we attempted to estimate the reliability of AASI determination in individual patients. Studying the infradian rhythms in chronobiology of blood pressure we perform ambulatory blood pressure monitoring for 7 consecutive days (*9, 10, 11*). This enables us to obtain 6 values of AASI in 6 full consecutive days. The preliminary results from our laboratory were published (*12*).

METHODS

The set monitored consisted of fourteen patients after myocardial infarction in the past history more than 6 months before, of mean age 63 ± 6.5 and mean ejection fraction of the left ventricle 43 ± 12.3 %.

The patients underwent phase II of cardiovascular rehabilitation (controlled ambulatory rehabilitation program) lasting two to three months with the frequency of three times in a week at the Department of Functional Diagnostics and Rehabilitation of St. Anne's Faculty Hospital.

In the course of rehabilitation they went through 7-day ambulatory monitoring of blood pressure. During blood pressure recording they did not interrupt their pharmacotherapy.

The seven-day blood pressure monitoring was made by using the instrument TM – 2421 of the Japanese firm AD on the principle of oscillometric methods of blood pressure measurement. The regime of measurement of blood pressure was done for 7 days repeatedly every 30 minutes from 5 to 22 h during the daytime and once in an hour from 22 to 5 h at night (*9, 12*).

The blood pressure values measured for every patient from the monitored set were statistically processed in the form of arithmetic means for systolic and diastolic blood pressure values during each hour for every measured day. The average SBP and DBP and their standard deviations (SD) in the given days were determined by the calculation of arithmetic mean of these values.

These data were used for every consecutive day of seven-day monitoring to calculate the slope of diastolic on systolic pressure and to calculate the ambulatory arterial stiffness index (AASI) as one minus regression slope of diastolic on systolic blood pressure.

The study was approved by the local ethical committee and the patients signed the informed consent.

RESULTS

The results of AASI values together with 24-hour mean values of systolic (SBP) and diastolic (DBP) blood pressures of 14 patients are seen in *Table 1.*

Table 1

Variability of 24-hour blood pressure values and AASI in 14 patients calculated for 6 consecutive days

	AGE	SBP (mmHg)				DBP (mmHg)				AASI				R	
	(Y)	6 d	±SD	MIN	MAX	6 d	±SD	MIN	MAX	6 d	±SD	MIN	MAX	MIN	MAX
1	74	113	3	110	117	57	2	55	62	0.72	0.13	0.56	0.83	0.14	0.49
2	68	134	3	131	139	86	2	84	89	0.56	0.15	0.32	0.77	0.36	0.77
3	66	128	4	124	134	75	3	73	81	0.70	0.17	0.50	0.99	0.02	0.72
4	56	106	4	102	113	67	4	62	73	0.61	0.22	0.20	0.86	0.19	0.89
5	60	118	3	115	123	63	2	60	66	0.84	0.16	0.59	1.10	-0.20	0.68
6	58	124	7	115	134	66	3	60	70	0.68	0.12	0.51	0.87	0.22	0.71
7	58	126	7	114	137	72	4	64	78	0.61	0.10	0.50	0.79	0.40	0.73
8	60	107	4	103	113	65	4	60	69	0.69	0.12	0.50	0.90	0.13	0.90
9	72	128	4	123	132	63	1	62	65	0.74	0.12	0.54	0.89	0.38	0.69
10	61	113	5	108	119	71	2	68	73	0.69	0.11	0.48	0.83	0.45	0.72
11	54	117	2	112	120	76	1	73	77	0.39	0.09	0.20	0.49	0.59	0.82
12	66	133	6	126	144	87	4	82	91	0.23	0.17	0.02	0.58	0.61	0.94
13	53	141	6	129	147	90	5	80	93	0.22	0.16	0.00	0.44	0.68	0.9
14	70	119	3	115	123	67	5	60	75	0.51	0.2	0.28	0.76	0.34	0.64

SBP, mean systolic blood pressure; DBP, mean diastolic blood pressure; AASI, ambulatory arterial stiffness index; r, correlation coefficient between DBP and SBP; 6d, mean of 6-day values; SD, standard deviation; min, max, minimum and maximum 24-hour values.

The interindividual variation of AASI is large.

DISCUSSION

The simplest explanation for the variation in AASI is that it reflects spontaneous variability in arterial stiffness from one session to another. However, it should be considered that AASI is under the influence of other sources of variability, which are necessarily related to arterial functional properties (*13*).

Due to mathematical reasons AASI obtained from standard regression analysis depends on day-night blood pressure change (*14*), and hence variation in the latter may be expected to induce variation in the former. The reproducibility of day-night blood pressure changes and of the dipper-nondipper classification is far from being optimal. In a recent study (*15*), in which 150 hypertensive patients underwent 24-hour blood pressure monitoring twice, between-session agreement for the dipping-nondipping classification was found to vary from fair to moderate and the coefficient of repeatability of day-night blood pressure change was as high as 42–49 %. Such a large variation can be expected to influence variability of AASI as well.

The strong relation between AASI and day-night blood pressure changes is further confirmed by the paradoxical finding that daytime and night-time AASI are both much higher (0.48 ± 0.26 and 0.40 ± 0.21) than the corresponding 24-h values (0.31 ± 0.17), emphasizing its limited ability to specifically reflect arterial wall properties (*16*).

A further source of variation in AASI values is represented by the night/day ratio of blood pressure measurements number. In our study we calculated the AASI from the blood pressure values, given in one-per-hour regimen. In the literature it was demonstrated that the dependence of AASI on the number of daytime and nocturnal readings is a phenomenon related to the above relationship between day-night blood pressure reduction and AASI (*17*).

There is a need for more substantial data on AASI repeatability in larger cohorts of hypertensive patients and in the normal individuals; in any case, due attention should be paid to the influence of day-night blood pressure changes and to that of daytime and night-time between-reading time intervals on AASI and its variability (*18*).

The interindividual variation of AASI is large. It does not mean that the determination of AASI as a risk factor of the individual patient is useless, but that the determination of AASI from 24-hour blood pressure monitoring should be supplemented by blood pressure self-monitoring lasting several days irrespective of the method of AASI calculation.

A c k n o w l e d g e m e n t

Supported by MSM0021622402.

REFERENCES

1. *Benetos A, Safar M, Rudnichi A et al.* Pulse pressure: a predictor of long-term cardiovascular mortality in French male population. Hypertension 1997; 30: 1410–1415.
2. *Hayashi T, Nakayama Y, Tsumura K et al.* Reflection in the arterial system and the risk of coronary heart disease. Am J Hypertens 2002; 15: 405–409.
3. *Weber T, Auer J, O'Rourke MF, et al.* Arterial stiffness, wave reflections, and the risk of coronary artery disease. Circulation 2004; 20: 184–189.
4. *Van Bortel LM, Duprez D, Starmans-Kool MJ et al.* Clinical applications of arterial stiffness, task force III: recommendations for user procedures. Am J Hypertens 2002; 15: 445–452.
5. *Li Y, Wang LJ, Dolan E et al.* Ambulatory arterial stiffness index derived from 24-hour ambulatory blood pressure monitoring. Hypertension 2006; 47: 359–364.
6. *Dolan E, Thijs L, Li Y et al.* Ambulatory arterial stiffness index as a predictor of cardiovascular mortality in the Dublin outcome study. Hypertension 2006; 47: 365–370.
7. *Meaume S, Benetos A, Henry OF, et al.* Aortic pulse wave velocity predicts cardiovascular mortality in subjects > 70 years of age. Arterioscler Thromb Vasc Biol 2001; 21: 2046–2050.
8. *Schillaci G, Parati G.* Ambulatory arterial stiffness index: merits and limitations of a simple surrogate measure of arterial compliance. J Hypertension 2008; 26: 182–185.
9. *Siegelová J, Dusek J, Fiser B, et al.* Relationship between circadian blood pressure variation and age analyzed from 7-day ambulatory monitoring. J Hypertension 2006; 24 (Suppl 6): 122.
10. *Halberg F, Cornélissen G, Schwartzkopff O.* Seven day blood pressure measurement: Contraversion in single 24-h profiles of blood pressure and heart rate. In: Halberg F, Kenner T, Fišer B, Siegelová J. Noninvasive methods in cardiology, 2006: 10–26.
11. *Halberg F, Cornélissen G, Otsuka K, et al.* Why and how to implement 7-day/24-hour blood pressure monitoring? Geronto Geriatrics 2007; 8: 1–31.
12. *Siegelová J, Fiser B.* Variability of ambulatory arterial stiffness index and of 24-h blood pressure values in patients monitored for 6 consecutive days. *J Hypertension* 2008; 26: 1501–1502.
13. *Schillaci G, Parati G.* Reply to variability of ambulatory arterial stiffness index and of 24-h blood pressure values in patients monitored for 6 consecutive days. J Hypertension 2008; 26: 1502–1503.
14. *Schillaci G, Parati G, Pirro M et al.* Ambulatory arterial stiffness index is not a specific marker of reduced arterial compliance. Hypertension 2007; 49: 986–991.
15. *Henskens LH, Kroon AA, Van Oostenbrugge RJ et al.* Different classifications of nocturnal blood pressure dipping affect the prevalence of dippers and nondippers and the relation with target-organ damage. J Hypertension 2008; 26: 691–698.
16. *Schillaci G, Parati G, Pirro M et al.* Dipping safely into the ambulatory arterial stiffness index. *Hypertension* 2007; 50: e61.
17. *Schillaci G, Parati G, Pirro M et al.* Response to interstudy variability in the ambulatory arterial stiffness index. *Hypertension* 2007; 50: e66.
18. *Dechering DG, Adiyaman A, van der Steen M et al.* Interstudy variability in the ambulatory arterial stiffness index. *Hypertension* 2007; 50: e65.