

## PHARMACOLOGICALLY INDUCED SYMPATHETIC OR PARASYMPATHETIC INFLUENCE UPON CROSS SPECTRUM OF BASIC PHYSIOLOGICAL FUNCTIONS

S. Danev , E. Datzov , S. Svetoslavov

Spontaneous variability of blood pressure and R-R interval time can be expressed by its standard deviation. However, this measure does not give reliable information about the real source of these fluctuations. Spectral and cross spectral analyses are more informative, as has been shown for the analysis of heart rate variability [1] and for the relationship between the variations in heart rate and blood pressure [2]. It is a well established fact, that oscillations in the activity of brain centers regulating blood pressure, respiration and body temperature are reflected by heart rate, and consequently by the frequency spectrum of heart rhythm [3-7]. Independent study of heart rate and blood pressure variations is less informative than the assessment of their reciprocal correlation by comparison of their frequency spectra (coherence) [2].

The main purpose of the study was to assess the drift in autonomic equilibrium by spectral amplitude coherence and phase of R-R intervals and blood pressure spectra. The sympathetic effect was achieved by Atropine administration, as typical antimuscarinic agent. The sympatholytic effect was achieved by Obsidan administration.

**Materials and methods. Study design.** The study was conducted in two sequential phases 1) administration of oral dose of Atropine (1 amp. 0.1 %, 1 ml two consecutive days) required to produce sympathetic effect and 2) the oral uptake of Obsidan (3x1 tabl. 25 mg first day, 1 tabl. second day) required to produce beta-adrenergic blockade (decrease of the overall sympathetic tone and of the heart inotropic function).

**S u b j e c t s.** Twelve practically healthy female students aged 19-25 years (mean age 22.1 years) were studied. Measurement was performed at rest in a quiet room for a period of 10 minutes. Every subject was measuring three times: before administration, in the first day and in the second day after Atropine or Obsidan administration. Beat-to-beat blood pressure (BP) and R-R intervals (RRI) were obtained noninvasively by plethysmographic signal from the left middle finger of the hand (diagnostic polyphysiological complex KTD-8). A procedure similar to this proposed by Penaz [8] was used. The finger arterial - pressure signal, sampled at 200 Hz, was digitally lowpass filtered by a five point rectangular moving average filter, and down-sampled to 100 Hz. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) values were determined as maximums and minimums of consecutive plethysmographic waves. The RRI were also derived from the plethysmographic signal ( the times between two successive systolic upstrokes of the pressure signal ). Power spectra of the areas under the spectral curve between 0.01 Hz - 0.5 Hz were calculated from these beat-to-beat values, using a Digital Fourier Transform. In order to assure of better visual control of the recording's quality the RRI and BP were displayed on a monitor. Pearson correlation coefficients were employed for data comparison. Artefact correction based on an interpolation algorithm was also provided. The relationship between fluctuations in SBP, DBP and corresponding changes in RRI time was expressed in terms of spectral amplitude coherence and phase. The amplitude coherence is equivalent to the variance in a linear regression analysis. The phase represents the time delay (in seconds) between the signals in the zone of the biggest coherence. Coherence was calculated by variation analysis of the amplitude and phase characteristics of the obtained cross spectra. The amplitude correlation coefficients were calculated for the spectral frequencies 0.01 Hz - 0.5 Hz .

**Results and discussion.** The effect of oral administration of Atropine and Obsidan on correlation coefficients in amplitude coherence cross spectra (ACCS) of RRI and BP are shown on Table 1. Statistical analysis revealed a significant decrease of correlation coefficients in ACCS of RRI to SBP and RRI to DBP comparing before and after Atropine administration ( $P < 0.05$ ). There exists also a significant increase of correlation coefficients in ACCS of RRI to SBP ( $P < 0.05$ ) and RRI to DBP ( $P < 0.01$ ) comparing before and after Obsidan administration. The ACCS between RRI and SBP in a healthy female person before and after Atropine and Obsidan administration are shown on Fig. 1.

There were not observed statistically significant phase differences in cross spectra of RRI and BP comparing before and after Atropine or Obsidan administration .

The present study shows that low doses of oral Atropine (blocking of "N" holinoreceptors of postsynaptic membrane) are decreasing the vagal influence upon RRI and BP fluctuations whereas low doses of Obsidan (blocking of beta-adrenoreceptors) are decreasing the sympathetical influence upon RRI and BP fluctuations. This was reflected by the ACCS between RRI and BP which is supporting the idea to use frequency domain measures of RRI and BP and their relationships as an objective criterion for assessment of different physiological phenomena involving autonomic disequilibrium as: work-related stress, fatigue, deterioration in common functional state, effect of pharmacological treatments, control in the area of alternative medical practice etc. [9]. The mathematical algorithm for computing RRI and BP variables developed by us is proposed to the scientists dealing with such a kind of problems.

## REFERENCES

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National Center of Hygiene,  
Medical Ecology and Nutrition  
D. Nestorov Blv., N 15  
1431 Sofia, Bulgaria

Table 1

Mean values ( $\pm$  SD ) of correlation coefficients of amplitude coherence cross spectra in "Atropine" and "Obsidan" experimental conditions in twelve female persons.

Cross spectrum	Before administration	After Atropine administration	After Obsidan administration
RRI to SBP	0.78 $\pm 0.23$	0.70* $\pm 0.19$	0.88* $\pm 0.20$
RRI to DBP	0.76 $\pm 0.21$	0.67* $\pm 0.17$	0.92** $\pm 0.28$

RRI - R-R intervals; SBP - systolic blood pressure; DBP - diastolic blood pressure.

\*P < 0.05; \*\*P < 0.01.

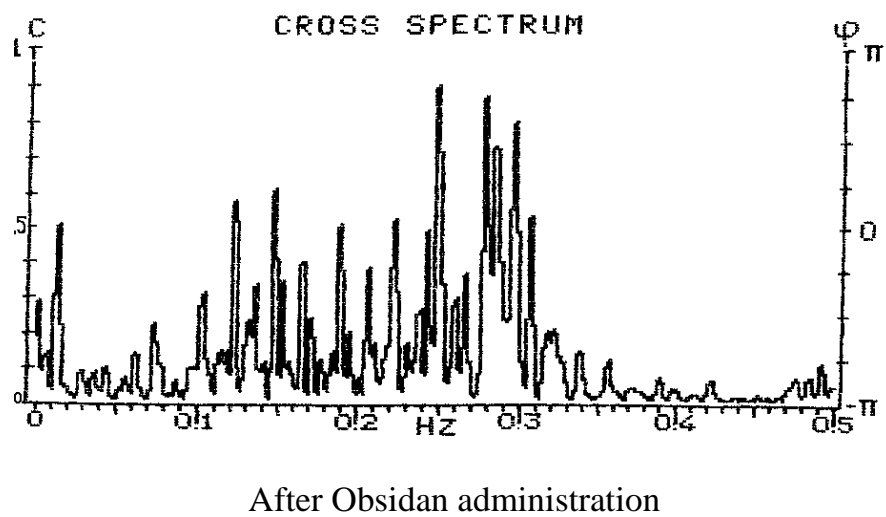
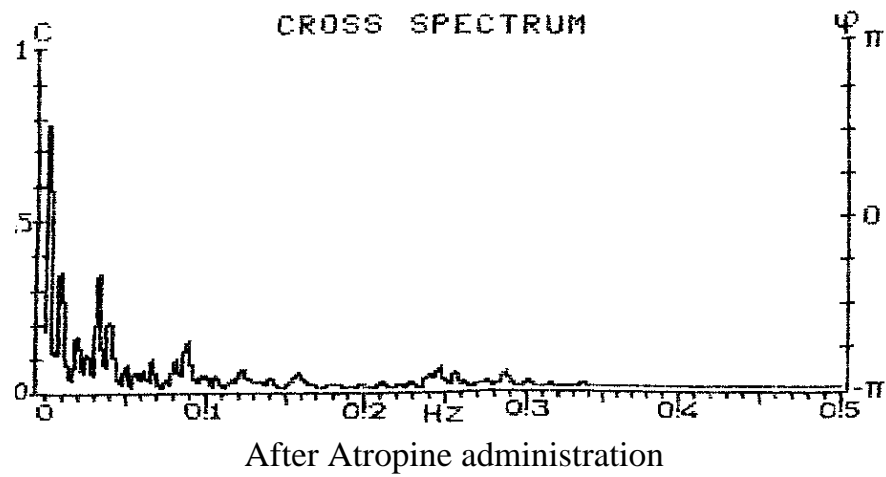
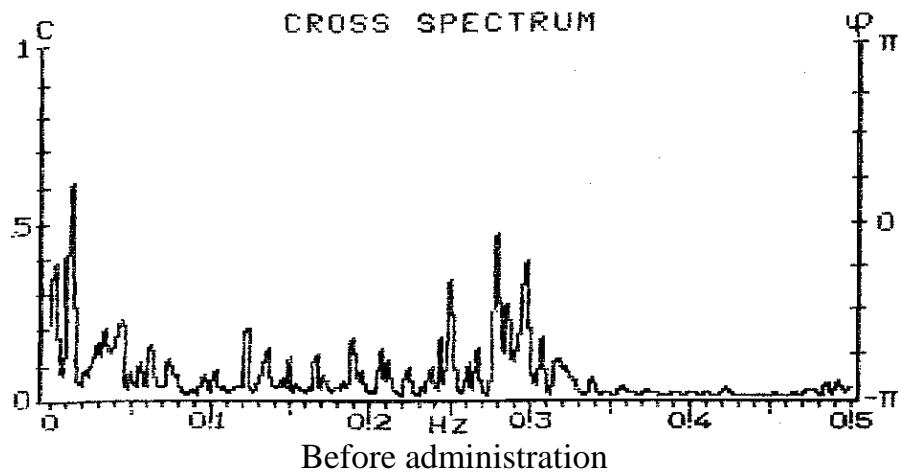


Fig. 1. Amplitude coherence cross spectra between R-R intervals and systolic blood pressure in a healthy 23 years old female person with manipulated vagal to sympathetical equilibrium by provoking sympathetic effect (Atropine administration) and sympathicolytic effect (Obsidan administration).