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Effects of cigarette smoke on Holter ECG recordings in patients with arterial hypertension. Part 2: Parameters of heart rate turbulence

Paweł Gać, Małgorzata Sobieszczańska*

Department of Pathophysiology, Wroclaw Medical University, Marcinkowskiego 1, PL 50-368 Wrocław, Poland

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ABSTRACT

The studies aimed at evaluation of cigarette smoke effect on heart rate turbulence (HRT) in patients with arterial hypertension (AH). 223 consecutive individuals were qualified to the studies. The following groups of patients not suffering from other disease which may affect HRT were distinguished: 1 – patients with AH ($n = 145$); 2 – patients without AH ($n = 48$). In group 1 the following patient subgroups were studied: A – active smokers ($n = 42$), B – non-smokers exposed to cigarette smoke ($n = 30$), C – non-smokers not exposed to tobacco smoke ($n = 34$), D – former smokers who had quit smoking ($n = 26$). In every participant HRT analysis was conducted. Subgroup A manifested significantly higher values of TO and lower values of TS as compared to analogous values obtained in subgroups B–D. Subgroups B and D were characterized also by significantly higher values of TO and lower values of TS as compared to subgroup C. Active and passive cigarette smoking were found to represent independent risk factors for an abnormal HRT.

Conclusion: Both active and passive exposure to tobacco smoke induces causes abnormal HRT in patients with arterial hypertension.

1. Introduction

Epidemic of tobacco smoking represents one of the most significant health problems in contemporary world. Smoking of cigarettes and of other tobacco products represents the most frequent theoretically preventable cause of death. In 20th century tobacco smoking contributed to death of around 100 millions of people (WHO, 2008). At present, according to World Health Organization (WHO) data, tobacco use induces worldwide deaths of 5 million individuals annually (WHO, 2012).

Basing on numerous cohort studies, including Framingham Hearth Study (FHS), Multiple Risk Factor Intervention Trial (MRFIT), Chicago Heart Association Detection Project in Industry (CHA), and international, randomized clinical trials (e.g. PURSUIT, GUSTO I, IIb, III, IV ACS and V, CAPTURE, PARAGON A and B, EPILOG, EPIC, CAVEAT I and IMPACT II) cigarette smoking was demonstrated to represent the principal risk factor of cardiovascular diseases (Hausberg et al., 2002; Khot et al., 2003). Nevertheless, the accessible literature contains just individual papers documenting derangement of autonomous nervous system as a possible mechanism through which active smoking of cigarettes affects circulatory system (Dinas et al., 2013). Such a potential seems to require confirmation. On the other hand, effect of passive exposure to tobacco smoke on human body has not been till now sufficiently clarified and requires investigations aimed at defining its mechanisms.

The available references contain insufficient data related to significance of active and passive exposure to tobacco smoke

* *Corresponding author*. Tel.: +48 71 784 12 47; fax: +48 71 784 12 47.
E-mail address: pawelgac@interia.pl (P. Gać).
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for intensity of cardiovascular complications of arterial hypertension. The role of cigarette smoke in manifestation and intensity of derangements in autonomous nervous system seems interesting.

Heart rate turbulence (HRT) should be regarded to provide a new, useful, non-invasive method of evaluation related to autonomous control of heart rate (Schmidt et al., 1999). HRT represents a physiological reaction of sinoatrial node to a premature ventricular contraction. HRT represents a two-stage phenomenon: the premature ventricular contraction is directly followed by a short phase of acceleration with the successive slowing down of heart rate (Bauer et al., 2008). Accordingly, the principal analysis of HRT encompasses two numerical parameters: turbulence onset (TO) and turbulence slope (TS), characterizing, respectively, the acceleration phase and slowing-down phase of cardiac rhythm (Bauer et al., 2008). In development of HRT a basoreceptor reflex is of importance, resulting from a short-term disturbance in arterial blood pressure due to premature ventricular contraction (low amplitude during the premature stimulation and a high amplitude in the subsequent, normal stimulation) (Guzik and Schmidt, 2002). In normal conditions with undisturbed control of heart rate, recognition of the short-term disturbance in arterial blood pressure by basoreceptors results in an immediate reaction of the heart in the form of HRT. A deranged autonomous cardiac activity would result in the mechanism in reduction of the baroreceptor reflex and a reduced HRT (Wichterle et al., 2002).

The studies aimed at evaluation of cigarette smoke effect on parameters of HRT analysis in patients with a diagnosed arterial hypertension, actively or passively exposed to tobacco smoke.

2. Materials and methods

2.1. Study population

The studies were conducted on 223 consecutive individuals, among which the accepted criteria allowed to distinguish two groups: group I of individuals with pharmacologically treated arterial hypertension and group II of individuals free of arterial hypertension. Criteria of patient's inclusion to group I encompassed age of 18–65 years and a diagnosed arterial hypertension treated with hypotensive agents. In group 2 the inclusion criteria involved age of 18–65 years, normal values of arterial blood pressure (<140/90 mmHg) in anamnesis and optimum values of arterial blood pressure (<120/80 mmHg) in measurement conducted upon qualification for the studies. The criteria allowed to include 158 individuals to group I, 54 individuals to group II while 11 individuals were excluded since they failed to exhaust the qualifying criteria.

At the next stage the individuals were excluded from the studies, in whom coexistence of diseases or disturbances, which might affect the evaluated HRT, was noted. The exclusion criteria included secondary arterial hypertension, diabetes mellitus, hyperthyroidism, renal insufficiency, neurological diseases, electrolyte disturbances, atrial fibrillation and heart rate disturbances exceeding 10% of evolutions in Holter's ECG record. The recruitment finally resulted in 145 patients in group 1, suffering from arterial hypertension, treated pharmacologically and not suffering from other diseases which might affect HRT and in 48 persons of group 2, free of arterial hypertension or diseases which might affect HRT. The principal clinical parameters in the two groups and characteristics of hypotensive treatment in group 1 are presented in Table 1. Characteristics of exposure to cigarette smoke in groups 1 and 2 are presented in Table 2.

The principal stage of studies in group I permitted to distinguish the following subgroups: subgroup A of individuals with pharmacologically treated arterial hypertension who actively smoked cigarettes; subgroup B of individuals with pharmacologically treated arterial hypertension who were passively exposed to cigarette smoke, subgroup C of individuals with pharmacologically treated arterial hypertension who were non-smokers and were not exposed to cigarette smoke, subgroup D of individuals with pharmacologically treated arterial hypertension who abandoned the addiction of cigarette smoking. The criterion of active cigarette smoking, qualifying patients to be included into subgroup A, involved smoking of at least a single cigarette a day within at least the recent year. The criteria of passive exposure to tobacco smoke, permitting to qualify patients to subgroup B, included smoking no cigarettes and staying for at least one hour in rooms in which cigarettes are being smoked, staying for at least 30 min a day in direct vicinity of smokers or living in a household with an individual/individuals smoking cigarettes at home. Subgroup C included individuals who did not smoke and did not exhaust the criteria for inclusion to subgroup B. The persons who abandoned the habit of cigarette smoking included individuals who in the past smoked at least a cigarette a day for at least one year but currently did not smoke for at least the recent 5 years. The persons who fulfilled the above criterion of abandoning the habit of cigarette smoking were included to subgroup D. The above criteria permitted to divide the population of 145 individuals in group 1 to 42 persons in subgroup A, 30 persons in subgroup B, 34 persons in subgroup C, 26 persons in subgroup D while 13 persons were excluded from the studies since they did not exhaust the criteria qualifying for inclusion to the distinguished groups. Principal clinical parameters and characteristics of the hypotensive treatment in subgroups A, B, C and D are presented in Table 3.

2.2. Questionnaire analyses and basic measurements

The written informed consent was obtained from all patients taking part in the study. Among all the individuals included in the analysis a questionnaire was conducted, related to current condition of health (with particular attention given to treatment of arterial hypertension) and morbid past, alimentary habits, applied diet, physical activity and used condiments (tobacco, alcohol, coffee). Body stature and weight were measured and arterial blood pressure (RR) was estimated twice using Korotkov's technique. Body mass index (BMI) and mean values of two measurements of systolic and diastolic arterial blood pressure were calculated.