



Research paper

The risk of coronary artery disease estimated non-invasively in patients with essential hypertension environmentally exposed to cigarette smoke



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ABSTRACT

Background: The relationship between environmental exposure of non-smokers to cigarette smoke and the coronary artery calcium scores has not been sufficiently documented. The aim of the study was to identify the relationship between environmental exposure to cigarette smoke and the risk of coronary artery disease (CAD) estimated non-invasively through measurement of coronary artery calcium score by computed tomography in patients with essential hypertension.

Material and methods: The study was conducted on 67 patients with essential hypertension, non-smokers environmentally exposed to cigarette smoke (group A) and on 67 patients with essential hypertension, non-smokers not exposed to cigarette smoke (group B), selected using the case to case. Environmental exposure to cigarette smoke was evaluated using a questionnaire. The risk of development of coronary artery disease was estimated non-invasively through measurement of coronary artery calcium score (CA_{CS}) by computed tomography.

Results: Group A was characterised by significantly higher CA_{CS} and left anterior descending (LAD_{CS}) calcium scores than group B. Compared to group B, group A had significantly higher percentage of patients with significant risk of CAD estimated on the basis of CA_{CS} values, and significantly lower percentage of patients with practically no risk of CAD estimated with the same method. Advanced age, peripheral artery diseases and environmental exposure to cigarette smoke are independent risk factors associated with increased CA_{CS} and LAD_{CS} values. In addition, higher BMI and hypercholesterolemia are independent risk factors for increased values of LAD_{CS}.

Conclusions: In patients with essential hypertension environmental exposure to cigarette smoke may result in elevated risk of coronary artery disease estimated non-invasively through measurement of coronary artery calcium score by computed tomography.

1. Introduction

Active smoking is a major risk factor associated with cardiovascular diseases (Siasos et al., 2014). The negative relationship between active cigarette smoking and the incidence of coronary artery disease is undisputed. In addition, it was documented that active cigarette smoking leads to aggravation of coronary artery disease and increased risk of complications of the disease and it has a negative impact on long-term prognosis (Inoue, 2004; Leone, 2003; Kamceva et al., 2016; Rigotti and Clair, 2013). Based on the research studies conducted so far, it seems probable that there is a relationship between environmental exposure to cigarette smoke and the incidence of coronary artery disease (Szpak

et al., 2013; Leone et al., 2004).

The method usually applied in diagnosis of severe narrowing of coronary arteries associated with coronary artery disease is invasive coronarography. The advances in diagnostic imaging of the last decade made it possible to develop non-invasive methods of assessment of coronary arteries. Coronary computed tomography angiography (CCTA), introduced into clinical practice after popularisation of multi-row CT scanners, has become a non-invasive alternative to classic coronarography (Lee et al., 2016; Thomas et al., 2016). The coincidence of results of CCTA and classic coronarography is currently a subject of numerous analyses and debates in radiology literature. Nowadays, it is believed that CCTA could be a good non-invasive alternative to classic

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coronography in some groups of patients (Shalev et al., 2016; Barbero et al., 2016; Kolossváry et al., 2016; Madhok and Aggarwal, 2014).

Coronary artery calcium score (CA_{CS}) is a mathematically estimated, quantitative, unit-free parameter of total amount of calcium in plaques found on artery walls. In clinical practice, the assessment of CA_{CS} is usually a prelude to CCTA test. In patients with contraindications to intravenous contrast agents or such for whom the balance of benefits and harms is negative, cardiac CT will be limited to assessment of CA_{CS}. Coronary artery calcium scoring is a non-invasive method that involves no contrast agent and an acceptable low dose of ionising radiation. CA_{CS} value does not correlate directly with the presence of narrowing in the coronary arteries nor their degree, but the results of research indicate that it allows for non-invasive determination of the risk of coronary artery disease (Alluri et al., 2015; Zeb and Budoff, 2015).

The relationship between environmental exposure of non-smokers to cigarette smoke and the coronary artery calcium scores has not been sufficiently documented in the research conducted so far. The relationship between exposure to cigarette smoke and the risk of development of coronary artery disease estimated on the basis of coronary artery calcium scores in a group of patients with isolated arterial hypertension has not been analysed before.

The aim of the present study was to identify the relationships between environmental exposure to cigarette smoke and the risk of development of coronary artery disease estimated non-invasively through measurement of coronary artery calcium score by computed tomography in patients with essential hypertension.

2. Material and methods

The research has been conducted in compliance with the principles of Good Clinical Practice and Declaration of Helsinki, on the basis of the consent from the local Bioethics Committee. The written consent has been obtained from all the patients taking part in the research. All data collected from the patients were anonymized.

The study covered a group of 134 patients. The subjects were selected for the sample through purposive sampling based on the case to case method. Group A (patients with hypertension environmentally exposed to cigarette smoke) was formed of 67 patients that satisfied the established qualification criteria: diagnosis and drug treatment of at least 5 years for essential hypertension, no history of cigarette smoking and history of environmental exposure to cigarette smoke. In the following step, every patient from group A was matched with a person with similar cardiovascular characteristics and no history of environmental exposure to cigarette smoke – those patients made up group B (patients with hypertension not exposed to cigarette smoke). The inclusion criteria to group B were: diagnosis and drug treatment of at least 5 years for essential hypertension, identical grade of hypertension according to ECS/ESH, comparable duration of hypertension (max. difference of 3 years), comparable course of treatment for hypertension (administration of antihypertensives from the same class of drugs), the same sex, similar age (max. difference of 3 years), comparable BMI (max. difference of 2 kg/m²), similar values of systolic blood pressure (max. difference of 10 mmHg), similar values of diastolic blood pressure (max. difference of 10 mmHg), similar total cholesterol levels (max. difference of 25 mg/dl), comparable triglyceride concentration (max. difference of 25 mg/dl), similar blood glucose levels (max. difference of 10 mg/dl), no history of cigarette smoking and no history of environmental exposure to cigarette smoke. History of environmental exposure to cigarette smoke was understood as: at least one hour every day in a room where people smoke and/or at least 30 min every day in the direct company of people smoking cigarette and/or living with person(s) who smoke at home. The clinical characteristics of the two groups of patients are presented in Table 1.

At the following stage of the study, the patients were divided into subgroups on the basis of the criterion of controlled hypertension and environmental exposure to cigarette smoke. The following values were

Table 1

Clinical characteristics of the examined groups: group A – patients with hypertension environmentally exposed to cigarette smoke; group B – patients with hypertension not exposed to cigarette smoke.

	Group A (n = 67)	Group B (n = 67)	p
Age (years)	62.96 ± 12.00	60.33 ± 12.74	0.221
Height (cm)	171.30 ± 10.25	171.19 ± 9.34	0.951
Body mass (kg)	83.79 ± 14.74	80.99 ± 15.09	0.278
BMI (kg/m ²)	28.57 ± 4.49	27.64 ± 4.73	0.244
Overweight (%)	31.3	31.2	0.990
Obesity (%)	29.7	38.8	0.267
Gender (%)			
Men	34.3	34.3	1.000
Women	65.7	65.7	1.000
Arterial hypertension (%)	100.0	100.0	1.000
Arterial hypertension (years)	10.48 ± 4.67	10.15 ± 3.64	0.650
Grades of arterial hypertension (%)			
Mild	32.8	32.8	1.000
Moderate	56.7	56.7	1.000
Severe	10.4	10.4	1.000
sBP (mmHg)	138.81 ± 19.03	135.15 ± 19.60	0.275
dBp (mmHg)	85.75 ± 11.62	85.97 ± 11.85	0.912
mBP (mmHg)	103.43 ± 13.33	102.36 ± 13.67	0.647
Diabetes mellitus (%)	10.4	13.4	
Glucose (mg/dl)	108.45 ± 40.42	108.31 ± 34.10	0.983
Peripheral artery diseases (%)	22.4	19.4	0.669
Hypercholesterolemia (%)	71.6	64.2	0.359
Hypertriglyceridemia (%)	50.7	52.2	0.862
Total cholesterol (mg/dl)	224.81 ± 47.02	217.48 ± 49.98	0.384
Triglycerides (mg/dl)	184.84 ± 157.98	168.36 ± 87.44	0.456
Environmental exposure to cigarette smoke (%)	100.0	–	–
Number of hours of exposure to cigarette smoke per day	4.07 ± 2.60	–	–

BMI – body mass index; dBp – diastolic blood pressure; mBP – mean blood pressure; sBP – systolic blood pressure.

adopted as control criteria for hypertension: in the majority of patients systolic blood pressure < 140 mmHg and diastolic blood pressure < 90 mmHg, in patients with type 2 diabetes systolic blood pressure < 140 mmHg and diastolic blood pressure < 85 mmHg, in patients over 80 systolic blood pressure < 150 mmHg and diastolic blood pressure of < 90 mmHg. The above cut-off points served as the basis for the following comparisons: subgroup A1–patients with controlled hypertension environmentally exposed to cigarette smoke (n = 28) with subgroup B1–patients with controlled hypertension not exposed to cigarette smoke (n = 31), and subgroup A2–patients with non-controlled hypertension environmentally exposed to cigarette smoke (n = 39) with subgroup B2–patients with non-controlled hypertension not exposed to cigarette smoke (n = 36). The clinical characteristics of the subgroups of patients are presented in Table 2.

The study involved a questionnaire, basic anthropometric measurements, blood pressure measurements, determination of total cholesterol levels, triglyceride levels, blood glucose levels and coronary artery calcium scoring by computed tomography.

The survey has been conducted on the basis of own poll form. The questionnaire included questions about the health of respondents (with special attention given to hypertension), their medical history, family history and environmental history. The questionnaire also included questions about their eating habits, diet, physical activity and used stimulants i.e. cigarette, alcohol and coffee. The survey research has been conducted by researchers who accompanied people participating in the project when they were completing the survey form and they provided relevant clarifications concerning particular questions in the survey.

The body mass index (BMI) was calculated as the ratio of mass expressed in kilograms to the square of the body height expressed in metres. BMI of ≥ 25 kg/m² – < 30 kg/m² indicated overweight. BMI of ≥ 30 kg/m² indicated obesity. The Korotkov method was used to

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