

## CASE STUDY

## CLINICAL CASE OF GAISBÖCK SYNDROME CAUSED BY HOOKAH AND TOBACCO SMOKING: “ZEBRA” OR “HORSE”?

DOI: 10.36740/WLek202201229

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### ABSTRACT

The role of smoking, in particular hookah smoking, in the development of hypoxia and, as its consequence, – polycythemia with subsequent development of hypertension is often underestimated; modification of this risk factor can lead to the normalization of blood pressure, hemoglobin and hematocrit levels, as well as red blood cell count.

A case of a 31 years old man, Caucasian, applied to the General Therapeutic Clinic of the National Military Medical Clinical Center “Main Military Clinical Center” (Kyiv, Ukraine), with hypertension and secondary polycythemia associated with cigarette and hookah smoking is presented.

**KEY WORDS:** hypertension, polycythemia, narghile smoking, cigarette smoking.

Wiad Lek. 2022;75(1 p.2):324-326

### INTRODUCTION

One of the causes of secondary hypertension is polycythemia. At the same time, there are a lot of different causes of polycythemia: associated directly with blood disease (polycythemia vera) or caused by other clinical conditions, including erythrocytosis of a hypoxic nature (stay in high mountain regions, lung disease, Pickwick syndrome, congenital heart disease, carbon monoxide poisoning, sleep apnea, etc.), erythrocytosis due to endocrine diseases and tumor processes in the kidney area, relative erythrocytosis during dehydration, alcohol abuse, stress [1, 2]. One of the clinical manifestations of secondary polycythemia is Gaisböck syndrome, which is known as a combination of polycythemia and mild hypertension. This syndrome was described for the first time in 1905 as a presence of increased hematocrit in patients with hypertension [3]. Currently, it is believed that Gaisböck syndrome is associated with a higher cardiovascular risk [4]. This syndrome is often accompanied by abnormalities in lipid profile, plasma renin levels, serum uric acid levels, as well as obesity, smoking, and is most common among men [4, 5].

Polycythemia contributes to an increase in blood pressure (BP) levels mainly due to an increase in total peripheral vascular resistance due to an increase in blood viscosity. In addition, the negative effect can be aggravated by the presence of a systemic inflammatory response and endothelial dysfunction [5]. Understanding the cause that results in development of polycythemia, which in turn contributes to the development of mild hypertension, gives physician the opportunity to modify this risk factor and, in some cases, to optimize blood test parameters and blood pressure levels of the patient with Gaisböck syndrome [6].

The aim of this case study was to demonstrate the important role of not only tobacco smoking, but also hookah smoking, in the development of secondary polycythemia and associated hypertension, as well as the effectiveness of lifestyle changes, in particular, cessation of tobacco and hookah smoking in normalizing blood pressure levels and blood test parameters.

### CASE REPORT

A man, 31 years old, Caucasian, applied to the General Therapeutic Clinic of the National Military Medical Clinical Center “Main Military Clinical Center” (Kyiv, Ukraine) due to blood pressure increase. Written informed consent was obtained from the patient before he had started in the study in accordance with the provisions of the Helsinki Declaration; the study protocol had been agreed with the Bioethics Commission of National Military Medical Clinical Centre “Main Military Clinical Hospital” and Ukrainian Military Medical Academy. Patient smoked up to 15 cigarettes a day, as well as a hookah 3-4 times a week. Family history of cardiovascular disease was not burdened.

Physical findings: first degree obesity (body mass index of 31.17 kg/m<sup>2</sup>), blood pressure on the right arm was 140/85 mm Hg, on the left arm – 137/85 mm Hg, heart rate was 110 beats per minute, rhythmic.

Palpation revealed a slight increase in the liver size, the liver edge was sharp, elastic. The spleen was not enlarged by percussion, its palpation was not available. The rest of the physical data were normal.

**Table I.** The dynamics of the patient's blood parameters after lifestyle modification and cessation of smoking cigarettes and hookah

Parameter	At the time of first presentation	After 12 months
Erythrocyte sedimentation rate, mm/h	2	5
White blood cells, x10 <sup>9</sup> /L	11.05	7.7
Red blood cells, x10 <sup>12</sup> /L	5.37	4.97
Platelets, x10 <sup>9</sup> /L	378	278
Hemoglobin, g/L	166	150
Hematocrit, %	47.4	43.4

According to the electrocardiogram (ECG), sinus tachycardia was detected, as well as incomplete blockade of the right bundle branch. There are no ECG signs of left ventricular hypertrophy.

According to echocardiography: 3 mm prolapse of the anterior cusp of the mitral valve without regurgitation, left ventricular (LV) ejection fraction of 64%, LV diastolic dysfunction is absent, LV myocardial mass index of 104 g/m<sup>2</sup>.

According to the data of ambulatory blood pressure monitoring, the presence of hypertension was confirmed: the average blood pressure was 134/83 mm Hg, the average daytime blood pressure was 138/87 mm Hg, the average nighttime blood pressure was 118/71 mm Hg, and the profile of the patient was "dipper".

According to the ultrasound examination of the abdominal organs, there was a slight increase in the size of the liver without splenomegaly.

Thus, the patient was diagnosed with mild hypertension without signs of target organs involvement. The young age of the patient suggested a search for a secondary cause of hypertension, therefore a comprehensive laboratory examination was carried out.

The serum levels of thyroid stimulating hormone (TSH) and thyroid hormones were normal (TSH 1.13  $\mu$ IU/mL, free triiodothyronine 4.03 pg/mL, free thyroxine 1.3 ng/dL), creatinine – 76  $\mu$ mol/L, glomerular filtration rate – 112 mL/min/1.73 m<sup>2</sup>, fasting plasma glucose – 5.84 mmol/L. There was detected a mild dyslipidemia: total cholesterol – 5.2 mmol/L, low density lipoproteins – 3.16 mmol/L, high density lipoproteins – 0.96 mmol/L, triglycerides – 2.4 mmol/L. However, the greatest changes were noted in the patient's blood test: white blood cells – 11.05x10<sup>9</sup>/L, red blood cells – 5.37x10<sup>12</sup>/l, platelets – 378x10<sup>9</sup>/L, hemoglobin 166 g/L, hematocrit 47.4%. Repeated analyzes showed a hemoglobin level in the range of 166–180 g/L, hematocrit – range of 47.4–49.5%.

Thus, the patient showed signs of polycythemia, the cause of which had to be established. We conducted a sequential examination of the patient [1]. Dehydration was ruled out as a possible cause of such blood test results. The level of erythropoietin was slightly reduced (3.6 mIU/mL, lower laboratory threshold for normal value was 4.3 mIU/mL), however, a peripheral blood test for the Janus kinase 2 (JAK2) V617F mutation was negative.

Taking into consideration that the severity of polycythemia in this case was mild, it was assumed that the cause of blood changes of the patient is hypoxia caused by tobacco and hookah smoking. Unfortunately, we were not able to carry out a carboxyhemoglobin/carbon monoxide determination to support this assumption. However, the patient was recommended to

quit smoking, modify his lifestyle with an emphasis on dietary adjustments and increased physical activity, in particular in the fresh air. Bisoprolol was prescribed at a dose of 5 mg/day with aim to control sinus tachycardia and hypertension.

Re-examination of the patient in order to assess his progress in the correction of cardiovascular risk factors, as well as re-assess the blood counts, was carried out after 3 months. The patient carefully followed all the doctor's prescriptions and stopped not only hookah smoking, but completely stopped cigarette smoking immediately after receiving such a recommendation. For 3 months, the patient significantly changed his lifestyle, lost 4 kg weight, was actively involved in sports. The blood pressure level was within 115-130/65-80 mm Hg, heart rate 60-70 beats per minute during therapy with bisoprolol 2.5 mg/day. A positive dynamics of blood parameters was noted: red blood cells count of 5.08x10<sup>12</sup>/l, hemoglobin of 157 g/L).

Due to the periodic decrease in blood pressure below the recommended for both systolic (120 mm Hg) and diastolic (70 mm Hg) blood pressure, we decided to withdraw bisoprolol, while the blood pressure without treatment was within the limits recommended by the European Society of Cardiology (120-130/70-79 mm Hg [7]) with a heart rate 60-70 beats per minute at rest.

After 12 months: the patient's body mass index was 26.5 kg/m<sup>2</sup>, he didn't smoke, blood pressure and heart rate were normal, peripheral blood test demonstrated normal values (Table I), there were no signs of dyslipidemia.

There are no data on the incidence of the combination of polycythemia and hypertension in the absence of splenomegaly, namely, Gaisböck syndrome. Although polycythemia is a known cause of secondary hypertension, Gaisböck syndrome is not commonly recognised as a common occurrence; rather, it is perceived as a "zebra". However, in a recent analysis of the National Inpatient Sample 2009-2010 database, which contains data for a significant proportion of patients in the United States at the time of discharge from hospital, Krishnamoorthy et al. [5] found that the incidence of hypertension among patients with polycythemia (for 37,922 identified cases of polycythemia) is 61.4%, which is significantly more frequent than in the group of patients without this pathology (46%,  $p < 0.0001$ ). It should be emphasised that patients with polycythemia were 2 times more likely smokers (25.6 vs. 12.8%,  $p < 0.0001$ ). They had significantly more often hyperlipidemia, obesity, heart failure, diagnosed coronary artery disease, cases of in-hospital mortality, circulatory arrest, and acute coronary syndrome compared with the patients without polycythemia in this study [5]. The authors found that polycythemia was a determinant of the hypertension risk in both

unadjusted [odds ratio 2.43 (2.32–2.55)] and adjusted by for age, sex, race, tobacco smoking, diabetes, hyperlipidemia, and obesity [odds ratio 1.37 (1.28–1.45)] analyses, both values  $p < 0.001$ .

Polycythemia, which predisposes hypertension development, can be caused by various clinical conditions. One of the causes of polycythemia as a result of prolonged hypoxia may be smoking [1]. However, recently, publications began to appear on the development of polycythemia caused by smoking not only tobacco products, but also hookah smoking [8], and even electronic cigarette smoking [6]. Smoking, including hookahs and electronic cigarettes, despite the efforts of health systems in different countries, remains a widespread habit, which justifies the need to take this factor into account when searching for the causes of polycythemia. It should be noted that in the clinical case, presented by Okuni-Watanabe et al. [6], the rejection of the use of electronic cigarettes resulted in a significant improvement in peripheral blood test parameters. Therefore, the Gaisböck syndrome associated with cigarette and hookah smoking should most likely not be considered a “zebra”. We meet such patients quite often in our clinical practice, but, in most cases, it is difficult to achieve a full-fledged lifestyle modification to achieve the best clinical result.

The presented clinical case is intriguing by the fact that polycythemia accompanied by mild hypertension in a young patient was most likely associated with smoking, and a full-fledged lifestyle modification, including cessation of both hookah and cigarette smoking, led to complete convalescence, namely, absence of sympathicotonia (sinus tachycardia) signs, normalization of blood pressure levels and indicators of peripheral blood test. Moreover, after a short course of beta-blocker (3 months), there was no need for further drug treatment of hypertension.

## CONCLUSIONS

When examining patients with hypertension and signs of Gaisböck syndrome, it is important to pay attention to smoking state of the patient, including hookah smoking, as a possible cause of polycythemia, since the elimination of the initial risk factor (smoking) results in cascading positive effects up to the possibility of normalization of peripheral blood test and blood pressure parameters at the initial stages.

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*This article was written according to the results obtained during the research work «Epidemiological, therapeutic and pharmaco-economic features of topical therapeutic pathology of servicemen and employees of the Armed Forces of Ukraine in the conditions of the Joint Forces Operation, «Vydnoкраj», state registration N 012U101854.*

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## Conflict of interest:

*The Authors declare no conflict of interest.*

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**Received:** 09.02.2021

**Accepted:** 28.08.2021

**A** – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article



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