MEDICAL ENGINEERING: NEW TECHNOLOGIES IN THE DIAGNOSIS OF CORONARY HEART DISEASE

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Abstract. Aim: The aim of this project was to study gas analysis methods and the selection of equipment for diagnosing coronary heart disease. Materials and methods: Was examined 80 men aged 30-65 years were divided into the following 3 main groups: I (control) - healthy men aged 30-45 years – 20 people, II - Acute myocardial infarction without a Q wave (NQMI) – 25 people aged 32-60 years, group III – Postinfarction cardiosclerosis (PIC) with stable angina pectoris FC II-IV – 35 persons aged 35-65 years. Results: The highest level of amine in explosives was in group II - 579 + 261 x 10^- 9 g/l, which was 68.24% higher than the control group. Group III had a decrease in amine levels to 17.7 + 2.2 x 1.10^ - 9 g / l compared to group II, and 13.91% more than group I. Therefore, the results of analysis showed that with NQMI the yield of volatile amines in B increased.Conclusion: . Our work has identified a difference in the removal of amines from explosives that can become a reliable indicator for an early diagnosis of pre-infarction conditions.

Key words: Exhaled air, coronary heart disease, diethylamine, gas analysis, volatile biogenic amines.

INTRODUCTION

The impact of cardiovascular diseases (CVD) on human health presents serious challenges for both clinicians and public health professionals.

In many cases, cardiovascular disease (CVD) develops silently, with its clinical symptoms appearing at a later stage. Due to this, patients are often unaware of the condition and die suddenly. It is extremely rare for doctors to have the chance to examine a patient before their cardiovascular system has been seriously affected.

From this, it follows that not only medical treatments can solve the problem of death due to CVD. However, there is a need for significant changes in diagnostic methods, even though they are based on established clinical guidelines [1,2,5]. Early diagnosis of coronary heart disease (CHD) is a crucial task of modern cardiology. Over 75% of cases of acute myocardial infarction (AMI) occur within the first few hours of the onset of symptoms. According to recent literature sources, in order to better understand atherosclerosis and CHD, it is essential to study biogenic amines such as adrenaline, serotonin and norepinephrine, as well as their precursors and metabolic products, and the enzymes involved in their production. It has been found that in patients with CHD and AMI, the activity of monoamine oxidase (MAO) enzymes is reduced by approximately 2.5 and 3.5 times respectively. However, although modern enzyme analysis techniques allow for the determination of pre-infarction conditions, their limitations include the invasive nature of the procedures used and the lack of specificity in diagnosing CHD. Therefore, at present,

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exhaled air analysis (EB) is receiving increased attention as a promising, non-invasive technology for diagnosing coronary heart disease [8,13].

The aim of this project was to study gas analysis methods and the selection of equipment for diagnosing coronary heart disease. We also aimed to develop a method for sampling exhaled air and analyzing the results.

MATERIALS AND METHODS

To obtain a BB sample in a hospital setting, 80 examined men aged 30-65 years were divided into the following 3 main groups: I (control) – healthy men aged 30-45 years – 20 people; II - patients with coronary heart disease. Acute myocardial infarction without a Q wave (NQMI) – 25 people aged 32-60 years; group III – patients with coronary heart disease. Postinfarction cardiosclerosis (PIC) with stable angina pectoris FC II-IV – 35 persons aged 35-65 years.

The diagnosis for all patients is based on clinical observation, laboratory analysis, and functional diagnostics. Patients who have been treated for coronary heart disease have undergone outpatient and inpatient therapy for 3 to 15 years. BB samples are obtained using special traps and bidistilled water as an absorber, in a volume of 200 mL. During the collection of a hypoxemic BB sample, patients' conditions are monitored using an electronic device, "Amulet-9," and according to ECG parameters (heart rate and ST interval). There is a slight increase in heart rate (between 8 and 15 beats per minute) during intravenous sampling. There are no signs of worsened coronary insufficiency in any of the patients during intravenous sampling.The samples of bidistilled water obtained from the explosives of the studied amines were poured into a special degassing unit equipped with a thermal heater prior to being examined by a gas analyzer. Degassing was performed at a temperature of approximately 450 degrees Celsius. The gas stream containing a mixture of volatile biogenic amines was directed into the surface ionization sensor of an amine gas analyzer. The flow rate (10 liters per minute) and pressure (800 millimeters of mercury) of the gas were monitored using an Argus Spiromonitor.

The amine gas analyzer, developed by specialists from the Institute of Electronics at the Academy of Sciences in Uzbekistan, allows for the detection of amine content in gas mixtures up to 10 to 10 grams per liter [12,14]. In previous studies, we have detected the presence of diethylamine in explosive substances in patients with PICA [10,12]. To calibrate this gas analyzer for detection of diethylamine, we used a pharmaceutical preparation of a 25 percent solution of nicotinic acid diethylamide. We acted on this drug with sodium hydroxide and heated it to split off diethylamine. We passed diethylamine through distilled water to obtain various solutions with concentrations of 10^-4, 10^-5, 10^-6, 10^-7, and 10^-8 grams per liter. These solutions were used to calibrate the analyzer. The resulting calibration coefficient for diethylamine is 3 x 10^(-2).The calculation of the concentration of diethylamine based on the readings from the gas analyzer was done using the following formula: $C = K * J$, where J is the reading from the gas analyzer (in grams per liter) and C is the concentration of diethylamine in the gas mixture.

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RESULTS

Table 1. The content of diethylamine in exhaled air in healthy and patients with coronary heart disease.

№ Groups	Diagnosis	**The content of amines in explosives *10-9 g/l**
1.	Healthy	74±2,5
2.	NQMI	579±261
3.	(PIC). Stable angina pectoris FC II-IV	177±22

The table shows the average values and confidence interval for the amine content in explosives, for all examined groups, at t = 2 according to the student's criterion ($p < 0.05$). As can be seen from the table, the highest level of amine in explosives was in group II - 579 + 261 x 10^- 9 g/l, which was 68.24% higher than the control group. Group III had a decrease in amine levels to 17.7 + 2.2 x 1.10^ - 9 g / l compared to group II, and 13.91% more than group I. Therefore, the results of analysis showed that with NQMI the yield of volatile amines in B increased. At the same time, there was a statistically significant difference in the average value of diethylamine between myocardial infarction and control (t = 2.08). However, there were significant differences in variance of measured parameters between NMI and control (mK = 2,5; mNQMI = 261,0).

DISCUSSION

The increased content of diethylamine in explosives seems to be associated with a disruption of the metabolism of biogenic amines in patients with AMI (arterial medial injury). To identify the mechanisms of metabolic disturbances of biogenic amines, clinical observations must be conducted according to our methodology during the course of the development and treatment of ASMI.

The results indicate the possibility of diagnosing coronary heart disease based on the measurement of amine levels in explosives of patients with this condition. For an early diagnosis of coronary heart disease, a more in-depth analysis of amine content in explosives should be performed.

It is reasonable to suggest that the implementation of non-invasive diagnostic methods would bring significant benefits in recognizing several difficult-to-detect diseases, as well as greatly enhance and make the examination process for patients more comfortable. Analyzing explosives is a novel area of medical diagnostics. Despite the reliability of the pentane reference point, its use in cardiology has been associated with difficulties in differentiating diseases. Our proposed method for diagnosing coronary heart disease through the examination of volatile amines, especially diethylamine, in explosives, does not have those disadvantages. The advantage of this method lies in its complete safety, the lack of the need

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for surgery (performed on an outpatient basis), the accuracy, the possibility for mass testing, the absolute guarantee of not transferring infection from a patient to the laboratory assistant, and the low cost of the test. Our work has identified a difference in the removal of amines from explosives that can become a reliable indicator for an early diagnosis of pre-infarction conditions.

CONCLUSION

1. A new method has been developed for diagnosing coronary heart disease using an amine gas analyzer. Due to its high sensitivity, this method enables the diagnosis of various forms of the disease in an early stage.
2. In patients with acute myocardial infarction, a significant increase in the level of volatile metabolites of biogenic amines has been found in exhaled air. This finding has great importance in understanding the mechanisms underlying the development of this pathology.

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