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Medical Computers for Measuring Glucose and Blood Gas Levels in the Human Body

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Abstract
Measurement of glucose in the human body at work is important in the analysis of blood gases and its acid-alkaline state in surgery, resuscitation. New methods of blood glucose measurement to avoid invasive methods and increase accuracy for 4 most tested basic non-invasive glucose monitoring for continuous glucose monitoring of human body glucose from 1.5 ml blood sample taken with laboratory equipment was studied.

Keywords: glucose, non-invasive, spectroscopy, photometric, pulse oximetry .

According to the World Health Organization, approximately 451 million people worldwide have diabetes. Currently, there are 2 ways to control blood glucose levels to treat diabetes. The hexokinase method uses a 1.5 mL blood sample obtained using laboratory equipment, but is not considered a portable method. The finger prick method is the most commonly used method, which the patient can use at home and relies on an invasive finger prick to draw a drop of blood onto the test strip. New methods of blood glucose measurement are being explored to avoid invasive methods and increase accuracy [1]. There are 4 main non-invasive glucose monitoring methods that have been tested the most: optical spectroscopy (optical detection), photoacoustic spectroscopy (acoustic detection), electromagnetic sensing (electromagnetic detection) and nanomaterial-based sensing (electrochemical detection). Optical spectroscopy is based on the fact that "glucose reacts to the optical signal by absorbing light with a combination of certain specific tones and wavelengths in the mid-infrared and near-infrared regions of the spectrum." Blood glucose concentration can be measured using optical sensors such as photodiodes to detect the intensity of transmitted or reflected light. Optical detection can also be used to measure blood glucose using surface plasmon resonance (SPR). This method uses light rays that pass through a prism on the back of the metal surface and are bent at the detector. The method uses angular

displacement to determine blood glucose concentration, while direct measurement is performed by changing the angle of the SPR reflection intensity curve [2].

A hybrid approach to blood glucose measurement is photoacoustic glucose monitoring, which combines acoustic detection and optical excitation. Acoustic energy is converted from optical excitation energy through an energy conversion process. Local heating of the solution occurs due to the optical excitation of glucose molecules in the blood and leads to thermal expansion of the optical interaction region. These are then converted into electrical signals and can determine the glucose concentration. Electromagnetic sensors can also be used to measure the relative conductivity of blood. The blood plasma in human blood is highly polarized since 55%-90% of it is water, which also makes the relative permeability high. Thus, an increase or decrease in glucose concentration may be related to the dielectric constant of blood plasma. This gives the value of the glucose concentration as a measured electrical power. Nanomaterial sensing is the newest potential noninvasive method for measuring blood glucose levels. This technique can use body fluids such as urine, saliva, sweat, and tears to capture physiological data using existing biosensors. Nanomaterials can have a large surface area, increase sensitivity and selectivity, and increase catalytic activity, which is a prerequisite for accurate estimation of blood glucose levels.

The acid-alkaline state of the organism is a set of processes (physico-chemical, biological, biochemical) that ensure the relative constancy of the active reaction of the internal environment of the organism. Maintaining optimal acid-base status is a necessary condition for maintaining normal metabolism and activity of enzyme systems. A blood test for acid-base balance - based on the results of this study, the doctor can evaluate the functioning of the whole body. Analysis of blood gases and its acid-base status is important in the diagnosis of various conditions in surgery, resuscitation, anesthesiology, and plays an equally important role in treatment [3].

Determination of KOS indicators of blood **.** Any deviations in the acid-base state of the body indicate the development of a pathological process. As a rule, the study of blood gas content is prescribed when the patient is suspected of respiratory diseases or there are metabolic disorders. The results of repeated analyzes allow monitoring the dynamics and evaluating the effectiveness of the prescribed therapy.

Photometric glucometers. A change in the color of the test zone caused by the reaction of glucose with special substances applied to the strip is detected. These are called "first generation devices" whose technology is already outdated. Note that such devices are calibrated for whole capillary blood.

Electrochemical glucometers **.** Glycemic indicators are measured according to the magnitude of the current that occurs during the reaction of blood glucose with special substances in the test strip (amperometry). These instruments are the next generation and have technology that minimizes the influence of external factors on the result and provides a more accurate reading, especially over time. Most of these instruments are

plasma calibrated. There is another electrochemical method - coulometry. It consists in measuring the total charge of electrons emitted in the same process [4].

Non-invasive . (spectral, thermal, tonometric, ultrasound) - does not require punctures.

Blood gas test and pulse oximeter . Among the most accurate ways to determine how well the body is supplied with oxygen is the study of blood gases and pulse oximetry. The study of blood gases is used in diseases of the cardiovascular and respiratory systems. This is done to determine whether the body is saturated with oxygen. Research transfer very simple . Of this for puncture method is used in this blood directly _ from the artery is taken. Therefore , the method invasive to the category enters _ Artery puncture from being done then to him about 10-15 minutes during bandage application need _ This is blood of leaving prevention get for need _ Sample get in the process received example immediately to the laboratory analysis to do for is sent . This stage in the blood gas quantity is determined . Here _ carbonate anhydride , partially pressure , pH indicators , bicarbonates quantitative composition and red blood in their corpuscles of hemoglobin saturation mandatory respectively is determined [5] .

Normal values include: PaCO2 - 34-45 mm Hg; PaO2 - 75-100 mm Hg; SaO2 - 94-100%; pH of 7.35-7.45; HCO3 - 22-26 mEq/liter.

Pulse oximetry is the most convenient way to monitor the patient. This is especially important with the limited funds of the medical institution. Allows you to monitor several parameters of the patient's condition at the same time. At first, it was necessary to use the most accurate pulse oximeters in intensive care units, then everywhere. But proper use of pulse oximetry requires special skills. If used incorrectly in the general medicine department, it can threaten the life and health of the patient. Consider the principle of operation of the pulse oximeter, the features and possible limitations of the modern method, and also what alternatives are available to this method [4].

A pulse oximeter is a high-precision device that measures the level of oxygen saturation of arterial hemoglobin.

The technology is based on 2 principles: the absorption of light by hemoglobin and the pulsation of the light signal when passing through the tissues, which is caused by changes in the arterial bed. This component can be separated from non-pulsed by a special microprocessor. When used correctly, oximetry becomes the most useful method of monitoring the state of the cardiorespiratory system.

As a result, two indicators are displayed on the monitor: oxygen saturation of hemoglobin in arterial blood; heart rate (measured in 15 - 20 seconds).

A number of factors affect the correct operation of the instrument. These include external light, heart rate and rhythm, hand tremors, pathological hemoglobin. Reliability can also be affected by vasoconstriction, abnormal hemoglobin, and cardiac properties. A pulse oximeter only indicates the level of ventilation of the blood, not the level of ventilation. With the low qualification of the medical worker, this often creates

an incorrect picture when breathing oxygen. In this situation, there is a risk of missing the initial signs of hypoxia caused by airway obstruction.

How a pulse oximeter works: Oxygen is carried in the bloodstream mainly bound to hemoglobin. One hemoglobin molecule can carry 4 oxygen molecules and in this case it is 100% saturated. The average percentage of the saturation of the population of hemoglobin molecules in a certain volume of blood is the oxygen saturation of the blood [5].

Measuring the amount of glucose in the human body, analyzing blood gases and its acid-base status is important in the diagnosis of various conditions in surgery, resuscitation, anesthesiology, and plays an equally important role in treatment . The method of finger pricking was the most used, which then converts into electrical signals and can determine the concentration of glucose. Electromagnetic sensors can also be used to measure the relative conductivity of blood. The blood plasma in human blood is highly polarized since 55%-90% of it is water, which also makes the relative permeability high. Thus, it was studied whether the increase or decrease in glucose concentration could be related to the dielectric constant of blood plasma.

Books

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