A BRIEF LOOK AT THE ROLE OF MATHEMATICS IN MEDICAL PROGRESS

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ABSTRACT

Every day we see new developments in medical science, and considering that the level of public health and the information of different sections of society has improved compared to the past, we see that today people are more willing to use more accurate methods in the field of medicine to diagnose and treat diseases, so the use of mathematical knowledge in medicine as an important tool has attracted the attention of doctors. The purpose of this article is to highlight several applications of mathematics in medicine, including cardiovascular disease, diabetes, surgery, cancer, and medical imaging.

Keywords: mathematical medicine, cancer, Diabetes mellitus, Diabetes, Cardiovascular diseases, computational surgery

Introduction

As an inescapable element in the fabric of existence, mathematics has always lived with mankind and can be seen in various fields of life. The special order that governs the rotation of the wheel, from the rotation of the earth around the sun to the weaving of a spider's web, is all mathematical stories. From a historical perspective, one can understand the role of mathematics in the progress of various sciences and realize that mathematics has been used as a powerful tool in all these developments. Mathematics is not exempt from this, and it can even be said that many doctors were great mathematicians in the old days. Mathematics has a long history in medical research. Even in the ancient world, scientists and philosophers tried to find harmony in the structure of the human body. For example, the golden section is used to describe the relationships between different parts of the body [1]. As numerous studies have shown, mathematical modeling is a powerful tool for testing hypotheses, verifying experiments, and simulating the dynamics of complex systems [2]. On the other hand, these models can fundamentally improve both drug development and hospital technology [3]. Considering the above, it can be said that one of the most important parts of medicine is mathematics, because all the equations, graphs, statistics, and mathematics that

we learned in school and university help us understand the important aspects of medicine in general [4].

Cardiovascular diseases

Cardiovascular diseases are one of the most common causes of death in developing and developed countries. The latest scientific research in this case shows that continuous and round-the-clock screening for timely diagnosis and prognosis of health status with the aim of improving the quality of life and reducing complications can reduce cardiovascular diseases [5].

One of the important things to overcome this problem is the mathematical modeling of blood flow and electrical activity of the heart, which has attracted the attention of medical mathematics researchers in the past decades, and so many studies have been conducted on it. [3].

Many people in the community are examined using an electrocardiograph (ECG) when they suspect or have a heart problem.

An ECG is a simple heart test that measures the size and rhythm of electrical signals in the heart through electrodes placed on the patient's chest, legs, and arms to ensure heart health.

This data is then shown on graph paper (Figure 1A). An ECG chart has a certain shape, and different peaks and troughs are denoted by different letters. The atria, or upper chambers of the heart, contract during the P wave. QRS indicates the contraction of the ventricles (lower parts of the heart). The R wave represents the largest wave, as the ventricles are the largest part of the heart, and represents the final part of the cycle with the T wave. In order to understand whether the heart is working properly or not, one must carefully examine the different parts of the ECG chart. If these waves appear abnormal in shape or timing, the heart may be functioning abnormally (Figure 1). The distance between the R waves indicates the heart rate. A fast heart rate is called tachycardia, and a slow heart rate is called bradycardia. Both disorders can even be life-threatening.

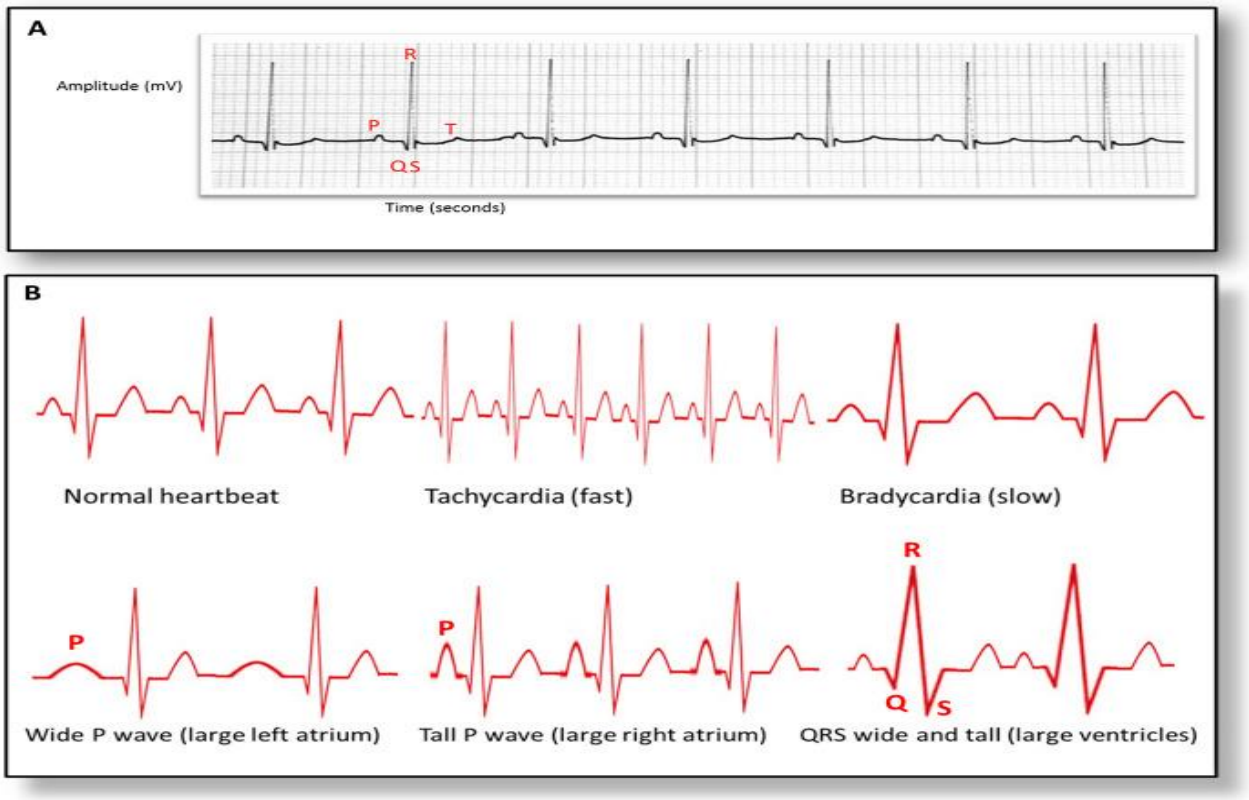

Figure 1. Comparison of healthy and diseased hearts.

An abnormally wide P wave can mean left atrial enlargement, while a longer P wave can mean right atrial enlargement, and abnormalities in the T wave can have many causes, are quite common, and do not always cause significant problems. If the QRS complex is wide and long, the ventricles may be enlarged. This is known as cardiomegaly and can be a sign of a heart tissue infection, heart failure, or high blood pressure [4].

Cancer

Cancer is one of the deadliest diseases in the world, and it is the second cause of death in the world after cardiovascular diseases [8]. According to World Health Organization research in 2018, out of 9.6 million deaths, 1 in 6 were caused by cancer. Nearly 70 percent of deaths in developing countries are predicted to be caused by cancer.

Cancer disease generally starts with genetic mutations and leads to an abnormal increase in cells and the rate of cell proliferation. A number of researchers are engaged in research to find a suitable and low-cost solution to treat people with cancer and improve their immune systems, which will enable them to fight cancer [7].

The scientific research conducted in this case proves that mathematical models are very useful for the precise understanding

of the mechanisms and processes of cancer and have been used to suggest new tests, propose different treatment methods, and change the risk prognosis [6].

Among the mathematical models that are used to treat and control cancer, we can mention the logistic and Gompertz models, which are more useful than other mathematical models [7].

Diabetes

Glucose, or sugar, that is received as a result of nutrition is very important and valuable for the human body because the cells of the body use it as a fuel and energy source. However, sometimes a situation occurs in which the human blood glucose level exceeds the normal range (75–110 mg/dl) for a long time, causing people to develop diabetes [10].

Diabetes is one of the metabolic diseases that many people in the world suffer from. This disease occurs with chronic hyperglycemia due to defects in insulin secretion, insulin action, or both [9]. In 2017, approximately 4 million people died from diabetes, and approximately 425 million adults were diagnosed with diabetes.

Statistical research shows that by 2045, the number of people with diabetes will reach 629 million. In the world, more than 1,106,500 children have type 1 diabetes, and more than 21 million babies are affected by this disease during pregnancy. About 352 million people in the world are at risk of developing type 2 diabetes. Due to the increasing number of deaths brought on by diabetes, India fell from number 11 in the world in 2005 to number 7 in 2016. According to study estimates, there are around 70 million diabetics in India. Research shows that this number will more than double in the next ten years [10].

Diabetes is a chronic disease that occurs as a result of increased blood sugar levels in humans. Mathematics plays a fundamental and very important role in the diagnosis, monitoring, and treatment of blood diabetes, as well as investigating its complications.

One of the mathematical applications in blood diabetes is to calculate the dose of blood sugar-controlling drugs. The dose of blood sugar control drugs should be determined based on the patient's blood sugar level. For example, if the patient's blood sugar level is higher than the limit, the dose of the drug should be increased. Mathematical methods such as statistical analysis and feedback control are used to determine the appropriate dose of medicine. Also, mathematics is used in predicting and preventing the complications of diabetes. For example, using mathematical models, it is possible to predict how changes in blood sugar levels can affect the health of a patient's blood vessels and nerves. Also, mathematics is very important in determining the limits of normal

blood sugar levels and diagnosing diseases according to blood sugar levels. Using mathematical and statistical analysis, it is possible to determine the normal ranges of blood sugar levels, and by examining the patient's blood sugar levels, the diagnosis of diabetes can be confirmed or rejected. In general, mathematical and statistical modeling is very important and effective in the diagnosis, prediction, and treatment of blood diabetes [11].

Computational surgery

In recent years, mathematics has played an important role in medical planning and modeling and has achieved tangible successes in various departments such as craniofacial surgery, liver surgery and orthopedic surgery [13]. Computational surgery is defined as a completely new science whose aim is to modernize surgery using new technologies and accurate calculations Today's advances in the field of surgery can be attributed to the use of mathematical calculation techniques and the introduction of new technologies in this field. Consider, for instance, how advances in medical imaging and robotics have increased the effectiveness of diagnosis or how the research of crucial domains that influence the outcomes of surgical operations, such as genetics and physiology, heavily depends on computational methods.

The biggest challenges in modern medicine are based on a deep understanding of the biological processes that play a role in their regulation. Medicine is mainly based on biological systems, and it seems complicated to achieve deep knowledge of them. Complexity means that biological systems are often regulated by non-linear processes, which are more difficult to replicate precisely. It is worth remembering that the inherent complexity of the underlying "bricks" that biological systems are made of cannot help us understand the systems themselves. One should think about the complexity of the structure of a cell and try to show its complexity at higher levels such as an organ, a tissue, or a complete system.

Mathematical models play an essential role in various sciences, including medicine, and significantly improve public knowledge and strengthen medical research. Mathematical models are able to reproduce certain events by taking into account the complexity of various regulating factors and allowing researchers to better understand the effect of external factors and stimuli on the system. As we know, mathematical models are also suitable for computer simulation.

As a result, it is simple to model in Silico the reaction of a biological system to various situations, and on a larger scale, it is possible to anticipate in advance how a certain approach would perform over the long run. Predicting in advance a clinical or experimental result and having the ability to

study it is one of the advantages associated with modern medicine.

It should be remembered that biological experiments are time-consuming and expensive, and the ability to mathematically simulate a system is considered very important to reduce costs and time. Mathematical models can easily check the effects of disturbances applied to the system. Disturbances in medicine can be seen in different areas, including a specific surgery, a drug, the use of a prosthesis, etc. Therefore, it can be said that mathematics plays a significant role in computational surgery [12].

Other applications of mathematics in medicine

In order to examine different parts of the body, such as teeth, heart structure, blood vessels, bones, or other organs, doctors and medical specialists may want to take pictures if necessary. For this purpose, various methods of imaging from inside or outside the body are used, including computed tomography (CT), ultrasound, X-ray, magnetic resonance imaging (MRI), etc., which requires an urgent need for mathematics. And these measurements must be done very precisely because the smallest mistake in medicine can cause confusion for doctors or even the death of the patient [4].

Although we are less aware that dentists use mathematics to calculate the dosage of anesthetics, convert numbers, measure teeth for root canals, keep budgets, etc., There are many cognitive factors that you have to consider as a dentist use. Using shapes and rotating objects in your head is what dentists do with your teeth. Using a mirror and working on an inverted tooth requires a lot of geometry (like the angles of a pool game). You must make sure that you drill with the long axis of the tooth and measure the length of the root of the tooth. Geometry plays the main role here [14].

Conclusions

From the research conducted on the role of mathematics in medicine, we have come to the conclusion that mathematics is used as a powerful tool in the diagnosis and treatment of various diseases and plays a very important role in this field.

Therefore, the existence of a close relationship between a doctor and a mathematician helps to treat diseases better, and doctors can use mathematical problems to diagnose and treat diseases in a more fundamental way.

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