THE MAIN PROSPECTS OF CARDIAC SURGERY: THE APPLICATION OF MINIMALLY INVASIVE PROCEDURES

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Annotation: *This article explores the modern development trends in cardiac surgery, particularly the advantages, technological capabilities, and effects of minimally invasive procedures on patient recovery. The study analyzes intervention methods on heart valves, coronary vessels, and other complex structures without causing significant trauma. Furthermore, it highlights the importance of ongoing scientific developments and clinical projects both in Uzbekistan and globally.*

Keywords: *cardiac surgery, minimally invasive procedures, heart valve, robotic-assisted surgery, coronary bypass, endoscopic technologies.*

Introduction. Cardiovascular diseases are among the leading global health problems today, posing serious risks not only to individual patients but also to societies and national economies. According to the World Health Organization, cardiovascular diseases account for nearly one-third of all deaths and claim millions of lives annually. Factors such as aging, urban stress, unhealthy diet, low physical activity, and smoking have contributed to the rise of these conditions.

In this context, cardiac surgery has become one of the most important and strategic fields in modern medicine. Although traditional open-heart surgeries are highly effective, they often involve large incisions, long recovery periods, and higher risks of infection and complications—especially for elderly or comorbid patients. Therefore, minimally invasive cardiac surgery has rapidly evolved in recent years.

These techniques, performed through small incisions using endoscopic equipment and robotic systems, help accelerate recovery, reduce pain, and improve quality of life.

Modern minimally invasive cardiac methods. Today, minimally invasive cardiac surgery includes various procedures such as transcatheter aortic valve implantation (TAVI), coronary angioplasty and stenting, mitral valve reconstruction, endovascular stent-grafting, and robot-assisted surgeries. The success rate of these methods is very high, and patients recover much faster compared to traditional open-heart operations.

Additionally, this approach is cost-effective for healthcare systems, as it shortens hospital stays and reduces expenses. Future prospects in cardiac surgery are closely linked with the broader adoption of minimally invasive technologies. The integration of endoscopic and robotic systems, high-resolution 3D imaging, and AI-based navigation and prediction tools is transforming cardiac surgery into a safer, more precise, and highly efficient discipline.

Anatomy and structure of the heart. The heart is a muscular, cone-shaped organ located in the chest cavity on the left side above the diaphragm. Its main function is to

ensure continuous blood circulation throughout the body. It consists of four chambers—right atrium, right ventricle, left atrium, and left ventricle—each with a specific structure and hemodynamic role.

The synchronized functioning of these chambers enables the continuous supply of oxygenated blood to tissues and the removal of carbon dioxide-rich venous blood to the lungs.

Each valve (tricuspid, pulmonary, mitral, and aortic) regulates unidirectional blood flow and prevents backflow. The coordinated contraction of the heart (systole and diastole) ensures effective pumping of blood.

The heart wall consists of three layers—endocardium, myocardium, and epicardium—which collectively maintain its mechanical strength, elasticity, and rhythm. The myocardium, being the thickest muscular layer, generates the force needed for blood ejection, while the endocardium provides a smooth inner lining to prevent clot formation.

Physiological characteristics of the heart. The heart has unique properties distinguishing it from other muscles, including automaticity, conductivity, and rhythmic activity.

Automaticity allows the heart to generate its own electrical impulses without external nervous stimulation.

Conductivity ensures these impulses are transmitted synchronously through the atria and ventricles via specialized structures such as the sinoatrial node, atrioventricular node, His bundle, and Purkinje fibers.

Rhythmic activity maintains regular contractions—normally 60–80 beats per minute in a healthy adult—regulated by the autonomic nervous system and hormones like adrenaline.

Disruptions in these functions can cause arrhythmias, conduction blocks, or heart failure, requiring medical or technological interventions such as pacemakers.

Conclusion. Cardiac surgery remains one of the most vital and strategic branches of modern medicine. Considering that cardiovascular diseases are still the leading cause of mortality and disability worldwide, innovations in this field are of immense importance to global health.

The widespread introduction of minimally invasive cardiac surgery represents a new era of advancement. These techniques not only improve surgical outcomes but also significantly enhance patients' quality of life—reducing pain, complications, and recovery time.

Furthermore, the integration of robotics, endovascular technologies, high-resolution imaging, 3D navigation, and artificial intelligence is making cardiac surgery safer and more precise. In the future, the combination of biomedical materials, regenerative medicine, and genetic technologies with minimally invasive methods will revolutionize the treatment of cardiovascular diseases—making therapies more effective and patient-centered.