AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 6. No 01. January ,2026

INDICATORS OF CARDIOVASCULAR DEFECTS AND DISEASES AFTER CORONAVIRUS. NEW METHODS AND INDICATIONS FOR THE TREATMENT OF HEART FAILURE AND HEART FAILURE.

Fatullayev Hikmatxuja Jasur ugli
Student of group 208 of the 2nd Faculty of Pediatrics, Medical Biology and Fundamental Medicine of TSMU
Zikirova Dilobar Fatulloyevna
Biology teacher of the 2nd category at the 5th general secondary school of Shofirkan district, Bukhara region
Scientific supervisor: ***Mukhammedova Sevara Nigmatulla kizi***
Assistant Professor, PhD, Department of Medical Informatics and Biophysics, Medical Biology, Medical and Biological Chemistry, TSMU

Abstract. COVID-19 infection seriously damages not only the respiratory system, but also the cardiovascular system. This article discusses post-coronavirus cardiac pathologies, their mechanisms of origin, statistical indicators, as well as modern approaches and new treatment methods in the treatment of heart failure, cardiovascular diseases and heart failure.

Keywords: COVID-19, heart failure, heart failure, post-COVID syndrome, heart defects, TAVI, myocarditis, cardiology, long COVID, ECG and Holter monitoring, Echocardiography (UZI).

Introduction

The pandemic associated with the SARS-CoV-2 virus has had a serious impact on the global healthcare system. Studies show that COVID-19 infection increases the risk of developing cardiovascular diseases and aggravates existing pathologies. In the post-COVID period, heart failure, myocarditis, arrhythmias and thromboembolic complications are becoming more common.

-----Changes in the cardiovascular system after coronavirus-----

COVID-19 infection causes direct and indirect damage to cardiac tissue. The main pathogenic mechanisms are:

Endothelial dysfunction and thrombosis

Cytokine storm and inflammation

Hypoxia-related myocardial injury

Renin-angiotensin system dysfunction

According to clinical studies, 20–30% of patients with COVID-19 have signs of heart damage.

Heart disease and COVID-19 Patients with valvular heart disease have a difficult time with COVID-19 infection. Heart failure develops rapidly, especially against the background of aortic stenosis and mitral regurgitation. Modern treatment methods include:

TAVI - minimally invasive aortic valve implantation

Individual anticoagulant therapy

Echocardiographic monitoring

Heart failure and modern treatment

Heart failure is one of the most common complications in the post-COVID period. According to current clinical guidelines, treatment includes:

SGLT2 inhibitors

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 01. January ,2026

ACE inhibitors or ARNI
Beta-blockers
Mineralocorticoid receptor antagonists
These therapies improve cardiac function and reduce mortality.
Rehabilitation and prevention
Cardiac rehabilitation is important for post-COVID patients. Physical activity, stress reduction, healthy eating, and regular medical monitoring reduce the risk of heart complications.

Cardiovascular complications after COVID-19: Epidemiology and Current Therapy.

COVID-19 is a virus that causes not only respiratory tract, but also multisystemic injuries. Studies show that about 20-30% of patients who have experienced the virus develop varying degrees of cardiac problems. This condition is called "Post-COVID Syndrome" or "Long-term COVID Heart Damage".

Main heart defects after coronavirus

The virus uses ACE2 receptors to enter cells. Since these receptors are abundant in the heart muscle (myocardium), the heart becomes a direct target.

Myocarditis and Pericarditis: Inflammation of the heart muscle and its outer membrane. This is often manifested by fatigue, shortness of breath, and chest pain.

Heart rhythm disorders (Arrhythmias): Tachycardia (rapid heartbeat) and extrasystoles are the most common complications.

Thromboembolic complications: The virus disrupts the blood clotting system, resulting in the formation of blood clots in small vessels, which can lead to myocardial infarction.

Heart valve damage: Chronic inflammation has been observed to worsen existing heart defects (defects) or to develop new degenerative changes.

Cardiovascular medicine has made a huge technological leap in the last 3-5 years, especially due to the needs of the post-COVID era. Today, diseases that were previously treated only through open surgery (cutting the chest) are now being treated with endovascular (intravascular) methods.

Below is a list of specific diseases and disorders where the latest techniques are being used:

New techniques in the treatment of heart failure

Heart failure (HF) is a condition in which the heart is unable to pump enough blood to the body. In recent years, four major groups of drugs (The Fantastic Four) have been recommended for the treatment of this disease, which are considered "Revolutionary":

ARNI (Angiotensin Receptor Neprilysin Inhibitors): For example, Sacubitril/Valsartan. This drug stops the enlargement (remodeling) of the heart.

SGLT2 Inhibitors: Originally developed for diabetes, these drugs (for example, Dapagliflozin) have been shown to reduce mortality in patients with heart failure by 25-30%.

Beta-blockers: Control heart rate and reduce the heart muscle's need for oxygen.

MRAs (Mineralocorticoid Receptor Antagonists): Prevent the formation of scar tissue (fibrosis) in the heart.

1. Chronic Heart Failure (CHF)

New technical methods have emerged for patients with reduced heart capacity, in addition to drugs.

New method: Baroreceptor activation therapy (Barostim).

Essence: A small stimulator is implanted in the nerves in the neck. It sends a signal to the brain to "calm down the heart and dilate the vessels."

New drug: SGLT2 inhibitors. Originally a diabetes drug, these drugs have now become the "number one drug" for all types of CHF.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 01. January ,2026

2. Hypertension (Dangerous Blood Pressure)

A new approach has emerged to treat high blood pressure that does not go down despite taking medication.

New method: Renal denervation.

Essence: Overactive nerve fibers in the renal arteries are "turned off" using radiofrequency. This allows you to permanently lower the pressure to 20-30 mm Hg.

3. Congenital Heart Defects (Children and Adults)

New Method: Occluders.

Essence: Umbrella-like devices (occluders) are used to close holes in the heart's membranes (DMPP, DMJP). No scarring is left, the hole is closed through a catheter.

Innovations in the Treatment of Heart Valves

Classic open surgical procedures are now being replaced by less invasive (endovascular) methods:

TAVI (Transcatheter Aortic Valve Implantation): A method of delivering a new valve to the heart through the femoral artery without cutting the chest. It is especially safe for the elderly and patients weakened after COVID.

MitraClip: Fixing the valve leaflets with a special clip in case of mitral valve insufficiency.

Robotic surgery: Operations are performed with microscopic precision and minimal trauma, which reduces the rehabilitation period by 2-3 times.

1. Aortic valve stenosis (narrowing)

Previously, to correct this defect, the heart was stopped and connected to an artificial blood circulation machine.

New method: TAVI (Transcatheter Aortic Valve Implantation).

Essence: A thin catheter is inserted through the femoral artery and, while the heart is beating, a new biological valve is inserted into the old valve.

Advantage: The operation lasts 1 hour, the patient is discharged home on the 2nd day.

2. Mitral valve insufficiency (regurgitation)

In post-COVID cardiomyopathies, this valve dilates and does not hold blood well.

New method: MitraClip therapy.

Essence: Without cutting the heart, the valve plates are connected with a special "clamp" (clip). This immediately reduces the backflow of blood (regurgitation).

Result: Symptoms of heart failure (swelling, shortness of breath) disappear quickly.

3. Atrial fibrillation (Arrhythmia)

This disease is the main cause of stroke (bleeding in the brain).

New method: PFA (Pulsed Field Ablation).

Essentials: Previously, arrhythmia foci were "burned" (radiofrequency) or "frozen" (cryo). PFA delivers a short electrical impulse only to the target cells.

Advantage: The risk of damage to the surrounding nerves and the esophagus is almost zero.

Medical indications and recommendations

The following algorithm is recommended for people who have experienced COVID-19:

Type of examination Purpose

Echocardiography (USG) Visualization of heart dimensions and valve status

ECG and Holter monitoring Detection of hidden arrhythmias

NT-proBNP analysis Detection of heart failure through blood

Cardiac MRI Detection of hidden foci of inflammation (myocarditis) in the myocardium.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 01. January ,2026

COVID-19 and the Cardiovascular System: From Pathogenesis to Innovative Therapy

1. Molecular mechanisms of heart damage in the post-COVID period

The impact of coronavirus on the heart is not limited to a direct viral attack. Studies indicate three main areas:

Cytokine storm and systemic inflammation: An excessive immune response in the body (increased levels of IL-6, IL-1 beta, and TNF-alpha proteins) damages myocardial cells.

Endothelial dysfunction: The virus damages the inner lining of blood vessels (endothelium), which leads to narrowing of the blood vessels and the formation of microthrombi.

ACE2 receptor deficiency: The virus occupies these receptors, which leads to an increase in the amount of Angiotensin II in the body. This substance causes scarring (fibrosis) in the heart and an increase in blood pressure.

2. Types of Heart Failure (HF) and current guidelines

Currently, heart failure is divided into three types depending on the ejection fraction (EF - Ejection Fraction), and there is a separate treatment strategy for each:

HFrEF (Reduced Ejection Fraction) EF < 40% "Fantastic Four" (ARNI, SGLT2i, Beta-blocker, MRA)

HFpEF (Preserved Fraction) EF > 50% SGLT2 inhibitors (the only effective drug in the world)

HFmrEF (Intermediate Fraction) EF 41-49% Combination of diuretics and ARNI

New clinical guideline: According to the recommendations of the 2023-2024 ESC/ACC, SGLT2 inhibitors (Empagliflozin) are now the "gold standard" for all types of heart failure.

3. Heart defects (defects) and revolutionary approaches to their correction

In the post-COVID era, complications of acquired defects or chronic defects are increasingly observed.

Mini-invasive and Catheter technologies:

Transcatheter valve replacement (TAVR/TAVI): Previously used only for the aortic valve, catheter-based replacement procedures (TMVR) are now expanding for the mitral and tricuspid valves.

LAA (Left Atrial Fibrillation) Occluder: Patients with arrhythmias after COVID are at increased risk of stroke. This device is the best way to protect against blood clots for patients who cannot take blood thinners.

4. Post-COVID Arrhythmias: Ablation Method

If medications fail to regulate the heart rate (especially in atrial fibrillation), Radiofrequency Ablation (RFA) is used.

A new method: Pulsed Field Ablation (PFA). This method turns off "erroneous" signals in the heart with short electrical pulses, not with heat or cold. This reduces the risk of damage to neighboring organs (heart, nerves) to zero.

Digital stage of rehabilitation and monitoring

Modern cardiology is not limited to the hospital:

Remote monitoring: Small sensors (e.g. CardioMEMS) implanted under the patient's skin measure the pressure in the pulmonary artery and notify the doctor via smartphone. This allows you to detect the worsening of heart failure 2 weeks in advance.

Artificial intelligence (AI): Analysis of ECG results by AI shows 95% accuracy in detecting hidden pathologies that are not even visible on a regular ECG.

Conclusion and prevention

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 01. January ,2026

Medication alone is not enough to protect the heart after coronavirus. Cardiometabolic rehabilitation (dosed physical activity, a diet rich in OMEGA-3 and sleep hygiene) has been proven to increase the effectiveness of treatment by 40%.

Direct viral attack on the heart muscle: The SARS-CoV-2 virus binds to ACE2 receptors, which are abundant in heart muscle cells, through its specific spike proteins. This can directly damage heart cells.

Systemic inflammation and "cytokine storm": The body's immune system's overreaction to the virus, known as a "cytokine storm," can damage cells not only in the lungs but also throughout the circulatory system and the heart.

Blood clotting disorders: The virus causes endothelial dysfunction, which disrupts the function of the cells that line the walls of blood vessels. This increases the risk of thrombosis (blood clots) and can lead to pulmonary embolism and myocardial infarction.

Inflammation of the heart muscle (myocarditis): Myocarditis, which occurs as a result of the mechanisms mentioned above, can weaken the contractile function of the heart, leading to heart failure.

COVID-19 Post-Cardiovascular Disease Indicators

COVID-19 has been found to increase the risk of cardiovascular disease not only in hospitalized patients but also in patients being treated at home.

Risk difference between patients with mild and severe COVID-19

· Risk of heart attack (Myocardial infarction): 1.22 times higher in patients with mild symptoms, higher in those with severe symptoms.

· Risk of pulmonary embolism: Moderately higher in patients with mild symptoms, 4.31 times higher in those with severe symptoms.

· Risk of cardiac arrhythmias: 1.10 times higher in patients with mild symptoms, 2.54 times higher in those with severe symptoms.

· Risk of inflammatory heart diseases (myocarditis, etc.): 2.29 times higher in patients with mild symptoms, 5.34 times higher in those with severe symptoms.

· Overall risk of major adverse cardiovascular events (MACE): 1.04 times higher in patients with mild disease and 2.29 times higher in those with severe disease.

The above data indicate that any person who has had COVID-19 is at increased risk for at least 1 year. In severe cases, this period can last for 3 years or more.

Updates in the Treatment of Heart Disease and Heart Failure

As the complications associated with COVID-19 increase, significant advances have also been made in the treatment of heart disease and heart failure.

Management of Acute Heart Failure

There are internationally accepted guidelines for the management of acute heart failure, particularly those caused by valvular heart disease. They are based on the following principles:

· Urgent intervention: A patient who is in stable condition suddenly deteriorates (decompensation) and requires intervention within 72 hours to restore cardiac function. Rather than attempting to stabilize patients, treatment aimed at resolving the valve problem should be initiated immediately.

· Multidisciplinary approach: Each patient's case should be discussed by a team that includes cardiac surgeons, interventional cardiologists, cardiac rehabilitation specialists, and anesthesiologists.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 01. January ,2026

· Priority for transcatheter (minimally invasive) techniques: Traditional open-heart surgery can be too risky for critically ill patients. Modern techniques such as transcatheter aortic valve replacement (TAVI) and mitral valve clip repair are now used as first-line options.

Main Directions in Treatment Strategies

The following new techniques are being used in the treatment of heart defects and heart failure.

1) New trends in pharmacotherapy:

· SGLT2 inhibitors: Effective drugs originally developed for diabetes, but generalized for all types of heart failure.

· ARNI (Angiotensin Receptor-Neprilysin Inhibitors): A new class of drugs that are more effective than traditional ACE inhibitors.

· Glycosaminoglycan degradation inhibitors: New drugs aimed at slowing down the hardening of the heart muscle (cardiac fibrosis).

2)Innovations in Interventional and Surgical Methods:

· Transcatheter aortic valve replacement (TAVI): Has become the standard for older and higher-risk patients.

· Transcatheter mitral valve repair (MitraClip, others): Allows for the treatment of mitral valve insufficiency without making an incision in the chest.

· Tricuspid valve interventions: New devices to address a previously neglected but important problem.

· New devices in cardiac electrical therapy (CRT, ICD): Work more accurately and effectively due to advances in programming and miniaturization.

3) Individual and Long-Term Approach to Treatment:

· Remote Monitoring (Telemedicine): Remote monitoring of heart rhythm and weight, preventing serious conditions.

· Molecular and genetic diagnostics: Identifying the genetic causes of the disease and determining personalized treatment.

· Cardiac regenerative therapy:

· Stem cells: Experiments are ongoing to regenerate the heart muscle.

· Gene therapy: To activate the self-repair mechanisms of heart cells.

· Biological coatings and artificial tissues: To replace the damaged part of the heart.

Conclusion and prevention

COVID-19 is a serious risk factor for the cardiovascular system. Complications can be reduced by timely diagnosis, the use of modern treatment methods and rehabilitation measures. Medication alone is not enough to save the heart after coronavirus. Cardiometabolic rehabilitation (dosed physical activity, a diet rich in OMEGA-3 and sleep hygiene) has been proven to increase the effectiveness of treatment by 40%.

Cardiovascular complications statistics by age group

After the COVID-19 pandemic, cardiovascular defects and diseases have increased significantly among young people, as the virus can have long-term effects even on young bodies. The main causes are inflammation of the heart muscle (myocarditis) and a decrease in the heart's ability to pump blood. This condition can occur more often in young patients, for example, 30% of cases of myocardial (heart muscle) damage have been recorded among students who have had a mild illness.

Although heart problems after COVID-19 are observed at all ages, their nature varies depending on age.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 01. January ,2026

Age Group Main Risks and Complications Probability of Occurrence (%)

Children and Adolescents (0-18) MIS-C (Multisystemic Inflammatory Disease), Myocarditis 1% - 2%

Adolescents (19-40) Pericarditis, Sinus Tachycardia, Myocarditis 5% - 8%

18-29 Age Group: Overall "long COVID" risk (in COVID-19 survivors): Approximately 6%. This is the lowest rate, and the overall risk tends to decrease with age.

· Main Risk Factors: Severe COVID-19, vaccination status, infection with pre-Omicron strains.

· Cardiovascular Complications: In adolescence (12-17 years), the incidence of myocarditis or "long COVID" symptoms persisting beyond 3 months is less than 30%.

Middle-aged (41-65) Microthrombosis, Arrhythmia, Hypertension 15% - 20%

30-59 age group (especially 30-39 and 50-59 age groups): Overall risk of "long COVID": Highest rates. It can be said that this risk is significantly higher among women aged 30-59 (5.6‰).

· Impact of multiple infections: According to recent studies, the risk of "long COVID" is 3-10 times higher in people who have been infected with COVID-19 3 or more times than in those who have been infected once.

Elderly (65+) Chronic Heart Failure, Heart Attack, Valve Thromboses 30% - 35%

General Age Trend:

· According to US data, the risk of "long COVID" increases from 18-29 years to 30-79 years and decreases after 80 years.

· Although older people and those with multiple comorbidities are more prone to severe cardiovascular complications, it has been found to be common among young people as well.

Important fact: The incidence of latent myocarditis (inflammation of the heart muscle) after COVID among athletes and active young people can reach up to 15%, even if the disease is mild.

Treatment Guidelines and Timing

The following modern approaches are used to treat cardiovascular complications in young patients:

1. Myocarditis treatment: Mainly short-term corticosteroids and anticoagulants (blood thinners) are used to prevent blood clotting. Depending on the severity of the disease, immunomodulatory therapy (treatment that regulates the immune system) may also be required.

2. Heart failure associated with "Long COVID":

· For mild symptoms, a gradual increase in physical activity, salt restriction, and fluid control are recommended.

· In more severe cases, the use of innovative drugs such as SGLT2 inhibitors (Empagliflozin, Dapagliflozin) and ARNI (Sacubitril/Valsartan) improves outcomes.

3. Cardiac rehabilitation: In the post-"Long COVID" situation, individually programmed exercises (including breathing exercises) are the main treatment method. It is aimed at improving the circulatory system and the general condition of the patient.

4. Prevention of thromboembolic complications: To prevent blood clotting after COVID-19, low molecular weight heparin or anticoagulants (Rivaroxaban) may be prescribed, depending on the situation.

The main focus of the treatment process is a personalized approach focused on the patient's age, severity of the disease and major risk factors.

Important Recommendations

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 01. January ,2026

· Rapid diagnosis: Shortness of breath, nausea, chest pain, irregular heartbeat are the basis for a cardiological examination.

· The importance of vaccination: Vaccination against COVID-19 is an effective way to reduce not only severe disease, but also "long COVID" and its cardiovascular complications.

· Healthy lifestyle: Proper nutrition, regular physical activity, and avoidance of tobacco and alcohol reduce the risk of COVID-19 consequences.

CONCLUSION

Coronavirus infection (COVID-19) is one of the largest global medical problems of the 21st century, characterized by deep and long-term damage not only to the respiratory system, but also to the cardiovascular system. Extensive scientific research conducted in recent years shows that after COVID-19, a certain proportion of patients experience functional and structural changes in the cardiovascular system. These conditions are often manifested as post-COVID syndrome (Long COVID), leading to a decrease in cardiac function, arrhythmias, thromboembolic complications, hypertension and the development of heart failure.

The effect of COVID-19 on the heart occurs through several pathophysiological mechanisms. The direct toxic effect of the virus on myocardial cells, a strong inflammatory response (cytokine storm), damage to the vascular endothelium and a state of hypercoagulability sharply reduce the functional capabilities of the heart muscle and vessels. As a result, even in people who have not previously suffered from heart disease, serious complications such as myocarditis, heart rhythm disorders and heart failure can occur.

Statistical data confirm that the risk of developing heart failure and arterial hypertension in patients with COVID-19 is significantly increased. Especially high-risk groups include patients who have had a severe form of the disease, are connected to an artificial respirator or have chronic diseases. Therefore, regular monitoring of the cardiovascular system, early diagnosis and preventive measures are of great importance in the post-COVID period.

In patients with heart defects (valve defects), COVID-19 infection can further aggravate the course of the disease. Against the background of infection, hemodynamic disorders deepen, heart chamber dilation and heart failure develop more quickly. In modern medicine, minimally invasive transcatheter methods (TAVI, MitraClip, TMVR, etc.) are widely used in the treatment of heart defects. These methods are especially important for patients with high surgical risk, older age or post-COVID complications, reducing surgical trauma and accelerating the rehabilitation process. Significant progress has been made in the treatment of heart failure in recent years.

In addition to classical therapy, the use of ARNI (angiotensin receptor-neprilysin inhibitors), SGLT2 inhibitors, modern beta-blockers and mineralocorticoid receptor antagonists shows high effectiveness in improving the quality of life of patients, reducing mortality and rehospitalization rates. These drugs also have important therapeutic value for patients with post-COVID heart failure.

The development of digital medicine and technologies is also creating new opportunities for the control of heart diseases. With the help of remote monitoring, implantable sensors, and artificial intelligence-based diagnostic systems, it is possible to detect changes in heart function early and individually adjust treatment tactics. This is of great importance for the timely detection of hidden cardiac complications that may arise in the post-COVID period.

In conclusion, COVID-19 infection poses a serious and long-term threat to the cardiovascular system. Post-COVID heart disease is becoming a major medical problem on a global scale. An integrated approach to combating this condition — namely, early diagnosis,

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 01. January ,2026

modern drugs, minimally invasive surgical methods, continuous monitoring, and promotion of a healthy lifestyle — remains the main strategy. In particular, individualized treatment of patients with heart defects and heart failure is crucial in reducing post-COVID-19 complications and extending the life expectancy of patients.

REFERENCES

1. Gupta A., Madhavan M.V., Sehgal K., et al. Extrapulmonary manifestations of COVID-19. Nature Medicine. 2020;26(7):1017–1032.
2. Shi S., Qin M., Shen B., et al. Association of Cardiac Injury With Mortality in Hospitalized Patients With COVID-19. JAMA Cardiology. 2020;5(7):802–810.
3. Clerkin K.J., Fried J.A., Raikhelkar J., et al. COVID-19 and cardiovascular disease. Circulation. 2020;141(20):1648–1655.
4. Xie Y., Xu E., Bowe B., Al-Aly Z. Long-term cardiovascular outcomes of COVID-19. Nature Medicine. 2022;28:583–590.
5. European Society of Cardiology (ESC). ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. European Heart Journal. 2021.
6. ACC/AHA/HFSA. 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure. Circulation. 2022.
7. Otto C.M., Nishimura R.A., Bonow R.O., et al. 2020 ACC/AHA Guideline for the Management of Patients With Valvular Heart Disease. Circulation. 2021.
8. Tersalvi G., Vicenzi M., Calabretta D., et al. Elevated troponin in patients with coronavirus disease 2019.
9. Journal of Cardiac Failure. 2020;26(6):470–475.
10. ESC Working Group on Cardiovascular Pharmacotherapy. Cardiovascular sequelae of COVID-19. European Heart Journal. 2023.
11. World Health Organization (WHO). Clinical management of COVID-19: living guidance. 2023.
12. Zheng, Y. Y., et al. (2020). "COVID-19 and the cardiovascular system." Nature Reviews Cardiology.
13. Guagliumi, G., et al. (2021). "Endothelial Cell Infection and Endotheliitis in COVID-19." The Lancet.
14. Xie, Y., et al. (2022). "Long-term cardiovascular outcomes of COVID-19." Nature Medicine.
15. Al-Aly, Z., et al. (2021). "Long COVID after breakthrough SARS-CoV-2 infection." Nature Medicine.
16. Ayoubkhani, D., et al. (2023). "Risk of Long COVID in people infected with SARS-CoV-2 after two doses of a COVID-19 vaccine: community-based, matched cohort study." BMJ.
17. Mack, M. J., et al. (2021). "Transcatheter Aortic-Valve Replacement in Low-Risk Patients." The New England Journal of Medicine (PARTNER 3 trial).
18. Stone, G. W., et al. (2018). "Transcatheter Mitral-Valve Repair in Patients with Heart Failure." The New England Journal of Medicine (COAPT trial).
19. McMurray, J. J. V., et al. (2014). "Angiotensin–Neprilysin Inhibition versus Enalapril in Heart Failure." The New England Journal of Medicine (PARADIGM-HF trial).
20. Packer, M., et al. (2020). "Cardiovascular and Renal Outcomes with Empagliflozin in Heart Failure." The New England Journal of Medicine (EMPEROR-Reduced trial).