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# The Treatment of Cardiovascular Disease

**Xinyang Li**

Beijing New Oriental Yangzhou Foreign Language School, Yangzhou, Jiangsu, China

zhangbaohua@ldy.edu.rs

**Abstract.** With the public's attention to public health and disease prevention and treatment, cardiovascular disease has gradually entered people's vision, and its treatment and prevention have become a topic of great concern in today's society. Cardiovascular disease is the leading cause of death in the world. There are many classification methods for cardiovascular diseases. This article mainly introduce cardiovascular diseases from the etiological classification. And cardiovascular diseases can seriously affect People's Daily life. Most cardiovascular diseases can be divided into two main groups according to their causative factors: congenital heart disease and acquired heart disease. This article will discuss the causes, treatment, prevention and control of two specific diseases (ventricular septal injury and coronary heart disease) in detail. For the ventricular septal injury, the main treatment is transthoracic closure surgery .For the coronary heart disease, the main treatment is Medical treatment and surgical treatment. Finally, the principles and limitations of each treatment for these two cardiovascular diseases are discussed and summarized. For medication, some medications can cause serious side effects such as dizziness, nausea and rash; Some patients may develop drug resistance after long-term drug treatment; The effectiveness of drug therapy varies from person to person due to differences in individual constitution and metabolic capacity. For surgical treatment, the main limitations are the limitation of indications, high requirements of surgical techniques, and difficult control of surgical risks.

**Keywords:** Cardiovascular disease, Coronary heart disease, ventricular septal defect, drug therapy, surgical treatment.

## 1. Introduction

In recent years, with the development of social science, technology and economy, more and more people have begun to pay attention to public health and disease prevention, control and treatment, of which cardiovascular disease is the most concerned by the public. Due to the decline of fertility rate and the aging trend of population, the incidence of cardiovascular disease is increasing year by year, and its prognosis is generally poor, which has a serious impact on the life expectancy and quality of life of patients, limits the daily activities of patients, and brings a heavy burden to patients and their families.Therefore, the effective prevention and treatment of cardiovascular diseases are now a more concerned issue. Cardiovascular disease is a general term for cardiovascular and cerebrovascular diseases, which includes a variety of circulatory diseases.Most cardiovascular diseases are chronic diseases accumulated over time, which are difficult to be detected or diagnosed in time through routine physical examination.Therefore, for some people who do not often have physical examination, the sudden risk of cardiovascular diseases is greater, and the risk coefficient is extremely high.At the same

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time, cardiovascular diseases are also difficult to cure. Due to the interference of various factors, the myocardial tissue of patients with such diseases is ischemia and hypoxia, which leads to a series of functional and structural damage.Due to the dysfunction of blood circulation in patients with cardiovascular diseases, the common symptoms of such diseases are chest pain, dyspnea, fatigue, palpitations, disturbance of consciousness, edema, and, if the effective circulation volume is decreased, oliguria may even occur.When cardiovascular diseases continue to deteriorate, they will cause irreversible organic damage to the corresponding target organs, such as myocardial infarction and cerebral infarction. The most serious case is that the treatment is not timely, leading to multiple organ failure, and eventually triggering respiratory arrest and fatal. According to World Health Organization (WHO) estimates, cardiovascular disease (CVD) has become the most important and largest cause of noncommunicable disease deaths globally, accounting for more than 50%. Worldwide, 17.6 million people died from cardiovascular diseases in 2012. Proportionally, this is estimated to account for 31.3% of global mortality, with ischaemic heart disease (IHD) accounting for 7.4 million deaths or 13.2%.In the United States, 4.8 million workers died from heart disease between 1990 and 2017 [1]. In 2019, CVDS were the leading cause of death in Asia, accounting for about two-fifths of all deaths in Asia [2]. There are several classification criteria for cardiovascular diseases, which are etiological classification, pathoanatomical classification and pathophysiological classification. The etiology category was divided into congenital cardiovascular disease and acquired cardiovascular disease. "Pathoanatomical categories include endocardial disease, cardiomyopathy, pericardial disease, and large vessel disease." The pathophysiological classification is based on the different pathophysiological changes, namely heart failure, shock, papillary muscle insufficiency, arrhythmia and cardiac tamponade.

## 2. Dissection of Cardiovascular Diseases

Cardiovascular diseases can be divided into two main categories based on their causes. One is congenital cardiovascular disease and the other is acquired cardiovascular disease. The so-called congenital cardiovascular disease refers to the fetus in the process of maternal development, the heart and large blood vessels appear defects or developmental arrest caused by lesions.

### *2.1. Congenital Heart Disease*

*2.1.1. The causes of congenital heart disease.* The causes of congenital heart disease mainly include genetic factors, drug use during early pregnancy, viral infection (especially rubella virus), environmental pollution, specific occupational exposure, consanguineous marriage, and radiation exposure. ventricular septal defect (VSD) is the most common type of congenital heart disease, accounting for 50% to 60% of all simple congenital heart diseases. At present, there is no specific drug for ventricular septal defect itself, and drug therapy is mainly used to treat its complications. Therefore, the treatment of ventricular septal defects mainly depends on surgery. The surgical treatment of VSD includes traditional surgical repair and interventional closure. Traditional direct surgical repair has some limitations such as large trauma, long recovery period, need for extracorporeal circulation support, and more complications. In 1967, Porstmann et al. first successfully used foam sponge to block PDA. Since then, a variety of interventional treatment methods have been developed for the treatment of PDA. With the continuous progress of interventional technology, especially the introduction of Amplatzer occluder in 1996, the success rate of interventional therapy has been significantly improved, and the complications have been reduced. Since the introduction of percutaneous interventional closure, it has been widely used in the treatment of VSD because of its minimally invasive, rapid postoperative recovery, short hospital stay, low operation cost and short operation time. However, interventional procedures require the use of radiation, which means that patients are exposed to radiation during the procedure. Although modern medical techniques have minimized the radiation dose, the risk of radiation still exists. In addition, not all types of atrial septal defects are amenable to interventional procedures. Conventional thoracotomy may still be necessary for some large or complex defects. In

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some cases, the patient may need to undergo surgical treatment again. Therefore, in 2006, domestic and foreign scholars jointly studied a new treatment method - transthoracic atrial septal defect closure. Compared with surgical operation, this method does not require complicated extracorporeal circulation process, reduces the trauma of patients, and saves medical resources. Compared with interventional therapy with percutaneous closure, this method is not limited by age, weight, peripheral vascular conditions, no radioactive radiation, and has a wider range of indications.

*2.1.2. The treatment of congenital heart disease.* Transthoracic atrial septal defect closure was performed under the direct vision of a cardiac surgeon, through a small incision in the chest intercostal space, under the state of normal heart beating, using the built-in echocardiography monitoring of the esophagus, with the help of a special delivery device, the occluder was placed precisely in the atrial septal defect to achieve therapeutic effect [3].

*2.1.3. The mechanism of congenital heart disease.* The size of the ventricular septal defect (VSD) and the pressure difference between the two ventricles together determine the amount and direction of the intracardiac shunt. In the early to middle stages of the disease, left ventricular pressure is high, resulting in a predominantly left-to-right intracardiac shunt, which increases blood flow to the pulmonary circulation and pulmonary artery pressure. During this process, the intima and media of small blood vessels in the lung become thickened, resulting in organic changes. In the late stage of disease, with the continuous increase of pulmonary artery pressure, the pressure of right ventricle gradually increases, the left-to-right shunt volume decreases, and the direction of shunt may change to bidirectional shunt. Finally, the right ventricular pressure exceeds the left ventricular pressure, resulting in a right-to-left shunt, which is called Eisemenger syndrome. Therefore, treatment with transthoracic occlusion can effectively reduce the pressure difference between the two ventricles, significantly improve cardiac function and reduce pulmonary artery pressure [4].

*2.1.4. The limitations of congenital heart disease treatment*

1) In the process of vascular interventional diagnosis and treatment, iatrogenic injury may cause acquired arteriovenous fistula, and its incidence is on the rise.
2) It is extremely rare that the occluder umbrella falls off during the operation, but it is not completely absent.
3) Arrhythmia is a common complication after VSD closure. According to studies, it is usually related to the stimulation of the bundle branch when the sheath tube and guide wire try to cross the VSD during the operation, the direct compression of the conduction bundle after the release of the occluder, or the inflammation and edema of the myocardial tissue involving the conduction bundle.
4) The occluder may affect the cardiac conduction system after implantation, leading to atrioventricular block. The main cause may be related to tissue edema and inflammation caused by the compression of the conduction bundle by the occlude [5].
5) Some studies indicated that the longer the CPB time, the more serious the residual shunt. Thus, the residual shunt profile with transthoracic closure is relatively minor, as compared with surgical repair with direct vision, which requires cardiopulmonary bypass [6]. However, if the occluder size is too small or there is other ventricular septal injury, it may affect hemodynamics and lead to mechanical hemolysis. In this case, device replacement or conversion to cardiopulmonary bypass should be considered.

*2.2. Acquired Cardiovascular Disease*

Acquired cardiovascular disease is mainly caused by the individual in daily life and occupational activities, due to bad living habits and dietary patterns, as well as the impact of adverse environmental factors, leading to pathological phenomena such as myocardial ischemia, which may lead to heart disease. Among all kinds of acquired cardiovascular diseases, coronary atherosclerotic heart disease is particularly common [7]. The rosclerosis is the formation of plaques of sediment and cholesterol in the

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arteries. These plaques build up on the arterial wall, leading to gradual narrowing of the arterial lumen, and may even block blood flow completely. Blockage of the coronary arteries, which deliver oxygen-rich blood to the heart muscle, prevents the heart muscle from receiving adequate blood supply, which may trigger angina or arrhythmias.

*2.2.1. Treatment of acquired cardiovascular disease.* Drug therapy constitutes the core of coronary heart disease treatment and plays a key role in the secondary prevention of coronary heart disease. The treatment mainly includes antiplatelet drugs, anti-myocardial ischemia drugs and statins.

*2.2.2. Mechanism of acquired cardiovascular disease*

1) The aggregation of platelets leads to narrowing of blood vessels, which impedes blood flow. Antiplatelet drugs can effectively inhibit the activation and aggregation of platelets, improve the fluidity of blood, and ensure the smooth flow of blood.
2) Antiplatelet drugs can reduce the formation of thrombosis. Platelets are the key blood coagulation components in the human body. When blood vessels are damaged, they will accumulate at the injured site and form thrombosis. By inhibiting platelet aggregation, antiplatelet drugs help reduce the risk of thrombosis.
3) Antiplatelet drugs have a positive effect on anti-atherosclerotic plaque. Atherosclerosis is a common vascular disease, which is one of the main causes of cardiovascular and cerebrovascular diseases. This class of drugs mitigates vascular damage by reducing the interaction of platelets with inflammatory cells within the plaque, preventing further plaque development and stabilizing existing plaques.
4) Antiplatelet drugs also have the function of lowering blood pressure. They improve endothelial function, dilators blood vessels, and reduce blood viscosity, thereby contributing to blood pressure reduction.
5) Antiplatelet drugs promote the recovery of vascular endothelial function. These drugs can enhance the elasticity and stability of the vascular wall, promote the repair and regeneration of vascular endothelial cells, and reduce the incidence of vascular diseases such as atherosclerosis. At present, the main antiplatelet drugs are aspirin,thromboxane A2 inhibitors, P2Y12 receptor antagonists, glycoprotein Ⅱb/Ⅲa inhibitors and phosphodiesterase inhibitors, such as aspirin enteric-coated tablets, clopidogrel bisulfate tablets, tirofiban hydrochloride sodium chloride injection and dipyridamole tablets.(8)

*2.2.3. Mechanism of anti-myocardial ischemia drugs*

1) This class of drugs can dilate venous vessels and arterial resistance vessels, reduce the pre - and post-load of the heart, thereby helping to maintain cardiac function and have a positive effect on ventricular remodeling.
2) They can dilate the coronary artery and increase the blood supply to the ischemic area. Early use of them can significantly reduce the size of myocardial infarction.
3) In addition, these drugs can reduce the incidence of heart failure and ventricular fibrillation.At present, anti-myocardial ischemia drugs mainly include antithrombotic agents, nitrates and β-blockers, such as clopidogrel bisulfate tablets, isosorbide dinitrate tablets and metoprolol tartrate tablets.

*2.2.4. Mechanism of statins*

1) Statins have significant lipid-regulating function, especially in reducing low-density lipoprotein cholesterol (LDL-C), followed by total cholesterol (TC), while reducing triglyceride (TG) to a lesser extent, and slightly increasing high-density lipoprotein cholesterol (HDL-C). Statins have similar chemical structures to hydroxymethylglutaryl-coenzyme A (HMG-CoA) and their affinity for HMG-CoA reductase is thousands of times greater than that of HMG-CoA, which leads to

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competitive inhibition of hydroxymethylglutaryl-coenzyme A reductase and thus hinders the synthesis of cholesterol [9].

2) Statins also have a variety of non-lipid-regulating effects, including improving vascular endothelial function, inhibiting the proliferation and migration of vascular smooth muscle cells, anti-oxidation, anti-inflammation, inhibiting platelet aggregation and anti-thrombosis, etc. These effects help to prevent the occurrence of atherosclerosis or stabilize and reduce atherosclerotic plaques. At present, the major statins include atorvastatin, simvastatin, lovastatin, pravastatin, and rosuvastatin.

*2.2.5. Surgical treatment of acquired cardiovascular disease.* Surgical treatment is mainly for coronary revascularization, including percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG).

*2.2.5.1. PCI.* Percutaneous coronary intervention (PCI) is performed by inserting a long, thin catheter into the opening of a coronary artery. A guidewire with a balloon is threaded through the catheter to the site of coronary stenosis. Stents included bare-metal stents, drug-eluting stents, and bioresorbable stents. Its mechanism of action is to open the originally narrow artery wall through the stent, restore normal blood flow, and thus relieve the symptoms of coronary heart disease. The advantages of percutaneous coronary intervention in the treatment of cardiovascular diseases include: less trauma, rapid recovery, significant effect, etc. The limitations include high technical requirements and high cost.

*2.2.5.2. Limitations of PCI*

1) Indications: It is suitable for patients with mild to moderate coronary heart disease, and the effect is poor for patients with severe coronary heart disease. In addition, for special types of CAD such as left main coronary artery disease and three-vessel disease, the treatment effect is not as good as other treatments.
2) Limitation of lesion location: It is suitable for stenosis or obstruction of the main coronary artery and its branches, while it is relatively difficult for coronary collateral vessel stenosis and the treatment effect is limited.
3) Surgical risks: For example, complications such as bleeding, thrombosis and arrhythmia may occur. In addition, it may cause allergic reactions or other adverse reactions.
4) High rate of restenosis: studies have shown that about 10% to 30% of patients will develop restenosis within 6 months after surgery. This may be caused by vascular endothelial cell proliferation, inflammatory response and other factors.
5) Long-term follow-up and management are needed, including drug therapy and lifestyle intervention. This has a certain impact on patient compliance and treatment effect.

*2.2.6. CABG.* Coronary artery bypass grafting (CABG), also known as bypass hand surgery, uses a graft to create a new vascular access between the root of the ascending aorta and the obstructed distal end of the diseased coronary artery, so that blood flow from the heart can pass through the bridge from the aorta, bypass the coronary artery lesion, and flow to the distal end of the coronary artery stenosis or obstruction. It reaches the ischemic myocardial region, thereby increasing coronary perfusion and myocardial oxygen supply [10].

*2.2.6.1. Limitations of CABG*

1) Surgical risk

CABG is an invasive procedure with certain risks. Complications such as bleeding, infection and pneumonia may occur during the operation. Serious complications such as cardiac arrest and myocardial infarction may also occur during the operation. Therefore, it is very important to choose the appropriate hospital and doctor for surgery.

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2) Risk of anesthesia

CABG surgery requires general anesthesia, which carries its own risks. Allergic reactions, respiratory problems, cardiac arrhythmias, etc., may occur. Anesthesia should be performed by an experienced anesthesiologist to ensure that the procedure is performed safely.

3) Process risk

CABG surgery is performed in the context of cardiac arrest, and the oxygen supply during the operation is affected and there is a certain risk. Complications such as thrombosis, bleeding and vascular injury may occur during the operation.

4) Risk of anticoagulation

CABG surgery requires the use of anticoagulants to prevent thrombosis, but it also increases the risk of bleeding. Clinically, precise control of the dose of anticoagulants is needed to ensure that patients do not suffer from excessive bleeding or thrombosis.

## 3. Discussion

This article describes in detail the two main treatment methods for congenital and acquired heart diseases and their corresponding limitations, and finds that most cardiovascular diseases can be prevented and controlled by surgical treatment. With the continuous progress of science and technology, the technology and accuracy of surgical treatment have been significantly improved, which can bring hope to more patients with cardiovascular diseases. The research significance of ventricular septal injury lies in the in-depth understanding of its etiology, pathophysiological mechanism and natural history, which can provide a basis for early diagnosis, intervention and optimal management. Hypertension is a major risk factor for cardiovascular disease, and more and more attention has been paid to the prevention and control of hypertension. Early diagnosis and effective treatment are of great significance to control blood pressure and reduce complications. It is also the leading cause of death in patients with chronic kidney disease. Blood pressure control is particularly important in patients with kidney disease because of their higher risk of cardiovascular disease. In summary, the future direction of cardiovascular disease treatment should be in the three directions of reducing drug tolerance ,reducing surgical risk and improving the accuracy of early diagnosis.

When the patient's drug tolerance increases, it means that the body's sensitivity to the drug is reduced, and the effect of taking the original dose of the drug is significantly weakened. It is necessary to increase the dose to obtain the corresponding therapeutic effect of the original dose, which is easy to lead to treatment failure. Taking large doses of drugs at the same time is easy to increase the stimulation of the intestinal tract, the metabolic burden of the liver and other hazards, and may even cause organic lesions in other organs. Therefore, it is necessary to reduce the tolerance of patients to cardiovascular drugs. High surgical risk increases the risk of surgical failure and leads to a variety of surgical sequelae such as surgical site infection, postoperative healing and thrombosis. Therefore, reducing the risk of surgery can avoid surgical sequelae and ensure the safety of patients. Some diseases have a greater probability of being cured only in the early stage, and when they are found in the later stage, the disease is likely to have progressed to a very serious stage. Accurate early diagnosis can help doctors take treatment measures earlier, effectively control the development of the disease, and improve the survival rate and quality of life of patients. This will not only help to improve the success rate of treatment, but also reduce the difficulty and cost of treatment.

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