

## **Investigation of cardiac arrhythmia and evaluation of its symptoms, diagnosis and treatment**

**Hamidreza Zeraatkah**

Master of Internal Surgery Nursing, Kashan University of Medical Sciences

**Mahdi Jafari**

Nursing expert, Islamic Azad University, Najaf Abad branch

**Roya Haghighat Jou**

Nursing expert, Islamic Azad University, Najaf Abad branch

### **Abstract**

Irregular and abnormal heartbeat is called arrhythmia. Your heart may beat too fast or not have a regular beat pattern when you are resting. Arrhythmias can be benign or serious, with or without symptoms. There are many methods to treat arrhythmias, the prognosis will be very different depending on the type of arrhythmia. Cardiac arrhythmia is one of the types of heart diseases that can happen due to various factors, including high blood pressure and imbalance in body electrolytes. Lifestyle changes such as reducing stress and avoiding triggers such as extreme stress and anxiety can help manage and prevent irregular heartbeat. Cardiac arrhythmia or heart rhythm disorder is usually caused by improper functioning of the electrical messages coordinating the heart rate and leads to an increase or decrease in the rate or its irregularity. Cardiac arrhythmias may be described as fluttering or palpitations, which are sometimes harmless. However, some arrhythmias may be accompanied by distressing and, in some cases, fatal signs and symptoms. Treatment of cardiac arrhythmia often results in controlling or eliminating fast, slow, or irregular beats. In addition, since bothersome arrhythmias are often exacerbated by heart problems, they can be prevented from developing with lifestyle changes. In this article, we will review cardiac arrhythmia, its symptoms, diagnosis and treatment.

**Keywords:** Heart disease, cardiac arrhythmia, blood pressure, Holter, treatment.

## Introduction

Our heart, as a center of spontaneous beat generation, is under the influence of sympathetic and parasympathetic nerves that change the rhythm, regularity and number of heart beats per minute according to environmental conditions. This indefatigable organ pumps about 5 liters of blood continuously throughout the body and ensures the flow of life in our body. Even the thought of the smallest problem for this organ can threaten our life. Every year, 17.5 million people in the world die due to cardiovascular diseases. A statistic that is significantly reduced by lifestyle changes, early diagnosis of heart disorders and their timely treatment (such as cardiac arrhythmia). On the other hand, there may be conditions for the heart that may be harmless in most cases, but in the long run and without supervision can lead to sudden deaths. One of these conditions is a disturbance in the heartbeat, which is called arrhythmia.

Cardiac arrhythmia or heart rhythm disorder is usually caused by improper functioning of the electrical messages coordinating the heart rate and leads to an increase or decrease in the rate or its irregularity. Cardiac arrhythmias may be described as fluttering or palpitations, which are sometimes harmless. However, some arrhythmias may be accompanied by distressing and, in some cases, fatal signs and symptoms. Treatment of cardiac arrhythmia often results in controlling or eliminating fast, slow, or irregular beats. In addition, since bothersome arrhythmias are often exacerbated by heart problems, they can be prevented from developing with lifestyle changes.

## Cardiac Arrhythmia

Arrhythmia or irregular heartbeat is a problem in the speed or rhythm of the heartbeat. The heartbeat rhythm may be too fast, too slow, or irregular. It is normal for the heart rate to increase during physical activity and slow down during rest or sleep. It is also normal to feel occasional throbbing. But a frequent irregular rhythm may mean the heart isn't pumping enough blood around the body. Following this complication, we may feel dizzy, faint (passing out), or have other symptoms. All types of arrhythmia can be treated with medication or methods to control the irregular heart rhythm. Untreated arrhythmia can damage the heart, brain or other vital organs or cause death. Arrhythmia, also called dysrhythmia, is an abnormal heartbeat. Arrhythmias start in different parts of the heart and can be very fast, very slow or just irregular. Naturally, the heart beats regularly and harmoniously. Problems with different parts of the heart or even the blood being pumped by the heart can affect the normal heartbeat. Having a normal heartbeat is very important because the heart supplies nutrients and oxygen to your entire body through the blood it pumps.

Cardiac arrhythmia is a medical diagnosis based on the irregularity of the normal heart rhythm. In patients with cardiac arrhythmia, there is a disorder in the way of electrical conduction between two sinus nodes and atrio-ventricular node. In a simpler language, in response to what cardiac arrhythmia is, it should be said that when the heart rhythm is not transferred well from the sinus node to the atrioventricular node in the first stimulation, the initial diagnosis will be cardiac arrhythmia. Of course, the diagnosis of the dangerous severity of cardiac arrhythmia in different patients requires detailed investigations with electrocardiogram (ECG), stress test, echo or TTE, positron emission tomography (PET) scan, and Holter monitor. There is no exact criterion to determine the most dangerous cardiac arrhythmia. However, it can be said that the majority of people are involved in the treatment of tachycardia, fibrillation and bradycardia, respectively, compared to common cardiac arrhythmias. Each of the cardiac arrhythmias by reducing the heart rate to less than 60 beats, increasing the normal heart rate to more than 100 beats per minute and irregularity in the heart rhythm cause problems such as decreased consciousness and lack of oxygen in the body organs. Each heart has two atria at the top and two ventricles at the bottom, the right atrium is responsible for controlling the heartbeat. The sinus node, or SA, is a natural pacemaker that dictates each beat by generating electrical signals. With the contraction of the atria, blood flows into the ventricles, and with another set of electrical

signals, the conditions for the contraction of the ventricles and the discharge of oxygenated blood from them to other organs of the body are provided. All these events take place in one beat, and a healthy heart beats between 60 and 100 per minute. But sometimes due to factors such as damage to the heart, its weakening, or stress and nervous tension, the heartbeat becomes irregular; This irregularity can show itself as a decrease or increase in heartbeats. Cardiac arrhythmia is the name given to this condition.

If the number of heartbeats is higher than normal, the heart arrhythmia is tachycardia. If the heart beats less than normal, the person has bradycardia cardiac arrhythmia. Another type of arrhythmia is called premature heartbeat or ectopy. Arrhythmia treatment is very important for its acute cases and any neglect can even cause a person's death.

## Symptoms of cardiac arrhythmia

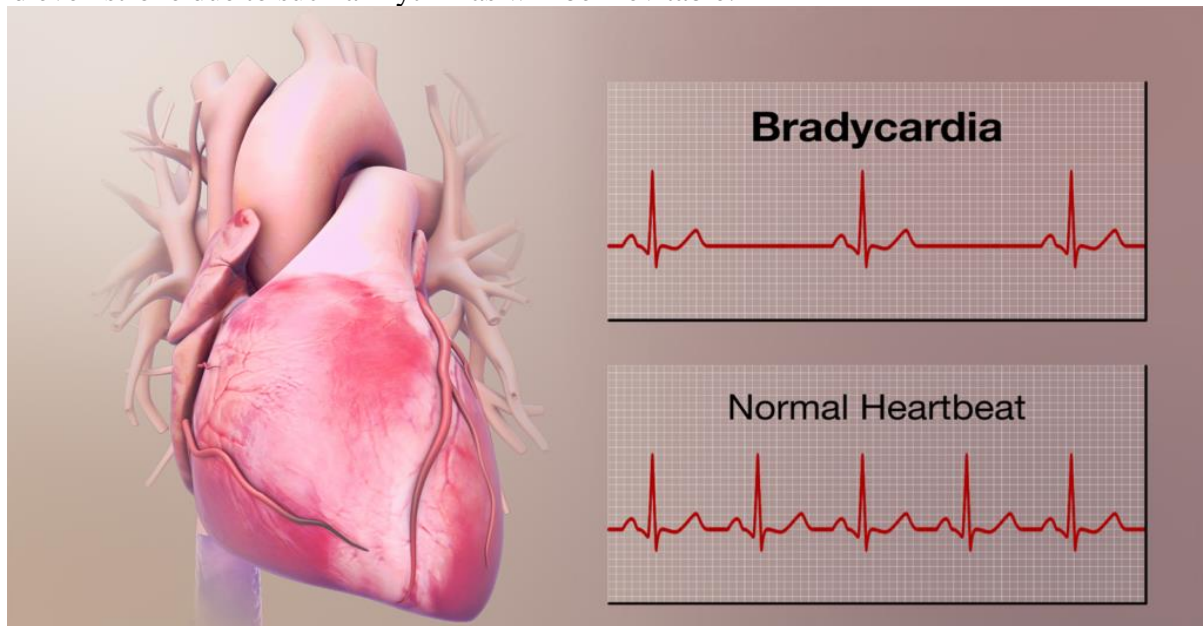
Cardiac arrhythmia may not have any symptoms. But performing some basic tests and preparing heart tapes will determine its diagnosis. Whether a person is suffering from tachycardia or bradycardia will affect the type of symptoms. For example, in the case of tachycardia arrhythmia, the following symptoms are seen:

- Dizziness
- Shortness of breath
- Severe and sudden weakness
- Fainting or syncope
- Feeling pain in the chest

If a person has bradycardia arrhythmia, he may experience the following symptoms:

- Feeling pain in the chest
- Lack of concentration or confusion
- Feeling tired and dizzy
- Severe heart palpitations and shortness of breath
- Inability to perform normal sports movements
- Fainting
- Abnormal sweating

It should be noted that sometimes, even though symptoms are observed, the problem of arrhythmia is not serious and does not require treatment. Meanwhile, some dangerous and threatening arrhythmias do not show any symptoms. As a result, the occurrence of heart failure and even stroke due to such arrhythmias will be inevitable.



## Cause of cardiac arrhythmia

Certain conditions can cause cardiac arrhythmia. These conditions include the following:

- An ongoing heart attack
- Scar formation in the heart as a result of a heart attack
- Changes in the structure of the heart, for example due to cardiomyopathy
- Clogged heart arteries (coronary artery disease)
- High blood pressure Hypert thyroidism Hypothyroidism (hypothyroidism)
- Diabetes
- Sleep apnea
- Smoking
- Excessive consumption of alcohol or caffeine
- Drug abuse
- Stress and anxiety
- Some special medicines and supplements such as cold medicines, anti-allergy and non-prescription supplements
- Genetic factors

## Cardiac arrhythmia risk factors

Some conditions and diseases may increase the possibility of cardiac arrhythmia. These conditions are:

- Coronary artery disease
- Heart problems and history of heart surgery
- Cardiovascular stenosis
- Heart attack
- Abnormal condition of valves
- Heart failure
- Cardiomyopathy (heart muscle disease) and other heart injuries

In addition to the above, there are other risk factors that can cause heart arrhythmia:

- **High blood pressure:** High blood pressure increases the risk of coronary artery disease. Also, by increasing the thickness and stiffness of the walls of the ventricles, it can change the transmission of electrical messages in the heart.
- **Congenital heart disease:** the presence of heart problems from birth may change the heart rhythm.
- **Thyroid problems:** hyperthyroidism or hypothyroidism increases the risk of arrhythmia.
- **Diabetes:** The possibility of developing high blood pressure and coronary artery disease increases in uncontrolled diabetes.
- **Obstructive sleep apnea:** In this case, a person's breathing stops for a few seconds during sleep, which can cause bradycardia, atrial fibrillation, and other types of arrhythmias.
- **Water and electrolyte disorder:** electrolytes in the blood such as sodium, potassium and magnesium help to produce and transmit electrical messages in the heart. Very high or very low levels of these electrolytes affect the heart's electrical messages and cause cardiac arrhythmia.

Other factors that increase the likelihood of cardiac arrhythmia include:

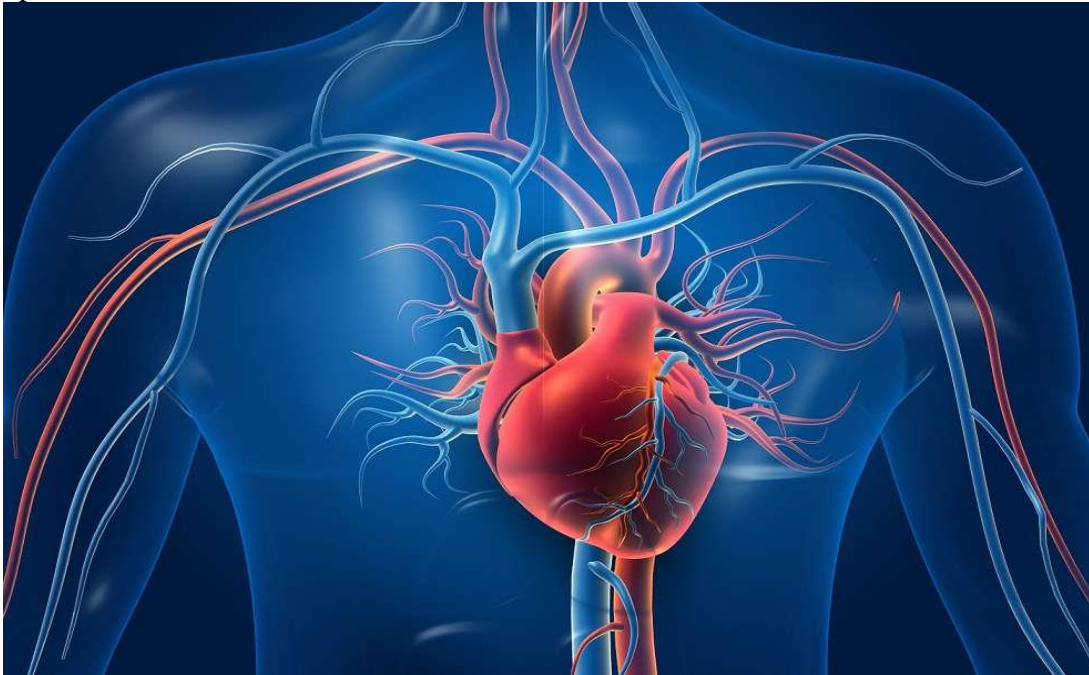
- **Medicines and supplements:** Some over-the-counter cough and cold medicines can cause arrhythmias.
- **Excessive consumption of alcohol:** excessive consumption of alcohol increases the possibility of atrial fibrillation by affecting the electrical signals of the heart.
- **Caffeine, nicotine and drugs:** caffeine, nicotine and other stimulants increase heart rate and cause more serious arrhythmias. Drugs, with their strong effect on the heart, cause various arrhythmias and sometimes sudden death due to ventricular fibrillation.

## Complications of cardiac arrhythmia



Certain types of arrhythmias may be associated with the following complications:

- **Stroke:** Heart failure increases the possibility of blood clot formation. Due to the breaking of this clot and its transfer from the heart to the brain, the blood flow of this sensitive and vital organ is disrupted and a stroke occurs. The risk of stroke increases in heart patients over 65 years old who have arrhythmia. Certain medications, such as anticoagulants, can reduce the risk of stroke or damage to other vital organs caused by blood clots. The doctor will consider the possibility of prescribing these drugs depending on the type of arrhythmia and the risk of blood clot formation.
- **Heart failure:** lack of effective blood pumping by the heart with bradycardia or tachycardia (such as atrial fibrillation) causes failure in the long term. Sometimes, controlling heart rate can help improve heart failure and function.



## Diagnosis of cardiac arrhythmia

Tests are performed to diagnose heart disease or determine its cause. To diagnose arrhythmia, the doctor first performs a physical examination. You must provide the specialist with complete information about your medical history and symptoms. Your doctor may recommend tests to check for irregular heartbeats and conditions, such as heart disease or thyroid disease, that are causing the condition. Tests for cardiac arrhythmias may include:

- **ECG:** In this method, sensors are attached to the chest and sometimes arms and legs. ECG sensors monitor the heart rate and record the time of each electrical phase.
- **Holter monitor:** This small and portable device is used to record the heart's function over a long period of time (24 or 48 hours) and it records the heart's activity during daily tasks.
- **Echocardiography:** In this non-invasive test, a device is placed on the chest. This device uses sound waves to form an image of the heart. Heart echo can check the size, structure and movement of the heart.
- **Testing of cardiac factors**

If the specialist does not accurately diagnose arrhythmia with these methods, he uses other methods. These methods include:

- **Exercise test:** sometimes the arrhythmia worsens with exercise. For this reason, they use stress test or exercise test to diagnose this disease. In this test, a person runs on a treadmill or works with a stationary bike, and the heart's function is monitored during exercise.

• Tilt table test: If a person has fainted, this method is used to check the cause. The patient lies on a table and his heart rate and blood pressure are monitored. Then, the table is slowly moved from horizontal to vertical, and during this, the reaction of the heart to the angle change is evaluated.

#### **-Electrocardiography (ECG)**

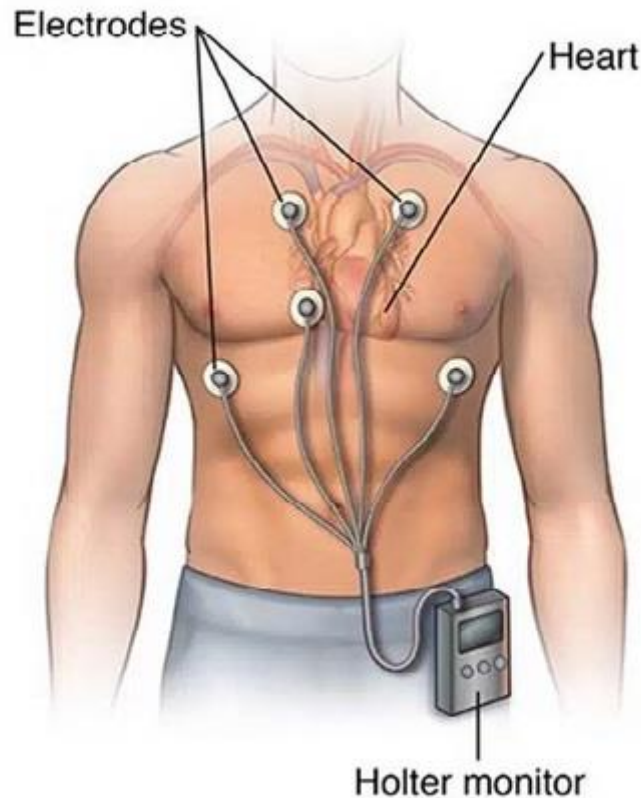
More than 100 years have passed since the invention of the first electrocardiography device by Willem Einthoven. Perhaps the winner of the Nobel Prize in Medicine in 1924 was aware of the importance of his invention in the diagnosis of cardiovascular diseases; But he never had an idea of the remarkable development of this device in the future and in a few years. The device that Inthon first introduced to the medical community was very different from today's electrocardiography devices in terms of appearance and function. However, both serve the same purpose, which is to record the electrical activity of the heart. An electrocardiography can provide clear information about the condition of the patient's heart and various conditions of heart diseases such as arrhythmias, coronary artery disease, heart attacks and cardiomyopathy and help the doctor in the accurate diagnosis of these diseases (arrhythmia).

#### **-Cardiac monitoring for arrhythmia detection**

The patient may go to the doctor and state that these symptoms appear only in certain conditions, and it is very difficult to diagnose the type of his disease while resting and in the doctor's office. This is where doctors use different monitoring methods to better understand a person's condition. Heart monitoring is one of the best ways to monitor heart diseases, especially different types of arrhythmia. There are various tools to monitor a person's heart condition, which are prescribed for cardiac arrhythmia patients at the discretion of the doctor.

#### **- Holter Monitoring**

This device was first built and marketed in 1962 by two experimental physicists named "Norman J. Holter" and "Bill Glascock" and after 13 years of continuous efforts to produce and develop cardiac monitoring devices. This device can be considered as the starting point for the production of various types of cardiac monitoring devices today. The prototype of the device consisted of several electrodes connected by a wire to the data collection device and hung around the patient's neck. Today's examples of cardiac monitoring devices can be considered inspired by the early version of the Holter device; Because there are many basic similarities between them. But their main function is to monitor and record the electrical activity of the heart. Doctors use these data to control hidden signs and symptoms of heart disease or to find out the correct functioning of a type of heart medicine in the body. In addition to detecting and recording the hidden signs of a heart disease (cardiac arrhythmia), the Holter device can also perform a monitoring task to ensure the health of patients. It is also used to monitor people with coronary artery disease, those who have had heart surgery or are at risk of having another stroke. After prescribing this device by the doctor, the electrodes are installed in the doctor's office. This device records the rhythm and heart rate of the patient in a period of 24 to 72 hours and stores it in its memory. Then, when the patient goes to the treatment center, this information is available to the doctor and is interpreted according to the patient's condition.



## Arrhythmia prevention

Cardiac arrhythmia prevention is divided into two main categories:

### •Prevention of heart disorders

- Treat or eliminate, if possible, risk factors that may lead to cardiovascular disease or cardiac arrhythmia.
- Choose a healthy lifestyle. Living a healthy lifestyle is the best way to reduce the risk of heart disease. Regular exercise and eating a healthy, low-fat diet with plenty of vegetables, fruits, and other vitamin-rich foods are the cornerstones of a healthy life.
- Maintain a healthy weight. Maintaining a healthy weight can protect you from previous diseases.
- Quit smoking and avoid secondhand smoke. Smoking is responsible for one third of cardiovascular diseases.
- Avoid or limit caffeine, alcohol, and other substances that may contribute to arrhythmia or heart disease.
- Avoid unnecessary stress such as anger, anxiety or fear and find ways to manage or control stressful situations that cannot be avoided.
- Have regular physical examinations and report any unusual symptoms to your doctor immediately.

### •Monitor and treat any existing heart problems

- Treat or, if possible, eliminate risk factors that may lead to cardiovascular disease or cardiac arrhythmia.
- Make healthy lifestyle choices. Living a healthy lifestyle is the best way to reduce the risk of heart disease. Regular exercise and eating a healthy, low-fat diet with plenty of vegetables, fruits, and other vitamin-rich foods are the cornerstones of a healthy life.

-Maintain a healthy weight. Maintaining a healthy weight can protect you from previous diseases.

-Quit smoking and avoid secondhand smoke. Smoking is responsible for one third of cardiovascular diseases.

-Avoid or limit caffeine, alcohol, and other substances that may contribute to arrhythmias or heart disease.

-Avoid unnecessary stress such as anger, anxiety or fear and find ways to manage or control stressful situations that cannot be avoided.

-Have regular physical exams and report any unusual symptoms to your doctor right away.

### Treatment of cardiac arrhythmia

Depending on the type of cardiac arrhythmia, different treatments may be needed. Arrhythmia usually requires treatment only when it exposes a person to the dangerous complications mentioned earlier.

#### 1. Treatment of bradycardia

If the underlying cause of bradycardia is unclear or untreatable, doctors often use an intracardiac pacemaker to correct the problem. Because there is no good drug to reliably increase the heart rate. A pacemaker is a small device that is usually placed near the neck. One or two wires containing electrodes are removed from the pacemaker and enter the patient's heart. If the heart rate slows down or stops, the pacemaker will send electrical stimulation messages to the heart to keep it beating.

#### 2. Tachycardia treatment

In the treatment of tachycardia, one of the following methods is used:

- **Vagus nerve maneuvers:** a number of supraventricular arrhythmias can be eliminated by using a series of maneuvers such as holding the breath and forcing, immersing the head in ice water or coughing. These maneuvers reduce the heart rate by affecting the nervous system that controls the heart rate. However, vagal maneuvers do not respond to all types of arrhythmias.

- **Use of antiarrhythmic drugs:** Using the best antiarrhythmic drug can help treat many types of tachycardia and return the heart rate to a normal range. In order to reduce the side effects of antiarrhythmic drugs, these drugs should be taken exactly as prescribed by the doctor. If a person is suffering from atrial fibrillation, the doctor may also prescribe anticoagulants to prevent the formation of blood clots.

- **Cardioversion:** If a person has a certain arrhythmia such as atrial fibrillation, the doctor may use cardioversion. Cardioversion can be done using medication or a procedure. In the procedure, an electric shock is applied to the heart using pads that are placed in the chest. The entered electrical current affects the electrical messages of the heart and restores its rhythm to a normal state.

- **Catheter burning:** In this method, the doctor sends one or several catheters through the vessels to the heart. The electrodes located at the top of these catheters use heat, extreme cold or radio energy to burn the tissue of the origin of the arrhythmia and thus block the path of its creation.

#### 3. Implantable tools

Cultivable tools may also be used in the treatment of heart arrhythmia. These tools include:

- **Pacemaker:** A pacemaker is an implantable device that helps control an irregular heartbeat. In this method, using a very small surgery, a small instrument is placed under the skin adjacent to the collarbone. An insulated wire exits the pacemaker and enters the heart, where it remains permanently. When the pacemaker detects an abnormal rhythm, it sends electrical messages to the heart to stimulate it and return it to a normal rhythm.

- **Implantable cardioverter-defibrillator (ICD):** Doctors use this method in cases where a person is at risk of developing dangerous arrhythmias in the lower chambers of the heart, such as tachycardia or ventricular fibrillation. If the person has a history of cardiac arrest or is at risk for it, the doctor will most likely use an ICD. An ICD is a battery-powered device that is implanted under the skin near the collarbone like a pacemaker. The ICD constantly monitors the patient's



heart rhythm, and if an abnormal rhythm is detected, it corrects the rhythm by sending low or high-energy electric shocks to the heart. This tool does not prevent the occurrence of arrhythmia, but removes it after it occurs.

#### 4. Surgery

In some cases, surgery is the only treatment for arrhythmia. Surgical procedures include:

- **Maze method (spiral):** In this method, the surgeon cuts several points of the atria to leave a spiral tissue pattern (scar) in the heart. Since the scar tissue is unable to transmit electrical messages, it will prevent the transmission of stray electrical messages to the cause of the arrhythmia. This method is effective, but because it requires surgery, it is usually considered the last step of treatment. It is only used for people who do not respond to other treatments or have to have heart surgery for other reasons.
- **Coronary artery bypass surgery:** If the person has severe coronary artery disease in addition to arrhythmia, the doctor will use coronary artery bypass surgery. This action can help improve blood flow to the heart.

### Conclusion

Some heart diseases are less noisy than others. On the other hand, it is possible that some of them appear in a more complicated and dangerous form. Cardiac arrhythmia is one of the heart diseases that most people underestimate. But you must take the necessary measures to treat it so that it does not cause any problems for your health. Cardiac arrhythmia means the up and down of heart rate and actually its irregularity. When your heart beats irregularly, it can cause serious problems. The burden of cardiac arrhythmias is expected to increase in LMICs. There is a paucity of data on the epidemiology of cardiac arrhythmias particular in SSA. Guideline-directed management of cardiac arrhythmias in LMICs is challenging because of the paucity of skilled personnel, lack of basic infrastructure, and the lack of device and ablative therapy for the treatment of cardiac arrhythmias.

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