

# Ventricular arrhythmias

## Definition

There most prevalent types of ventricular dysrhythmias are premature ventricular complexes (PVCs), ventricular tachycardia (VT), and ventricular fibrillation (VF).

*Premature ventricular complexes* are caused when an extra beat is created in the ventricles, and usually occurs before the next heart beat is suppose to begin, causing a thumping sensation in the chest. PVCs are expressed by prolonged QRS complexes seen on an electrocardiogram (ECG) and are usually benign.

*Ventricular tachycardia* is a potentially critical dysrhythmia characterized by three or more monomorphic QRS complexes at a rate greater than 100 beats per minute. Sustained VT must be treated quickly to prevent serious sequelae.

*Ventricular fibrillation* is a lethal dysrhythmia that is defined by an uncoordinated rhythm caused by ventricular dysfunction. If not corrected, VF is a fatal dysrhythmia.

## Pathophysiology

In normal conduction of the heart, an electrical impulse is created by the SA node located in the right atrium. The current spreads from the SA node to the AV node, down the bundle of His to the Purkinje fibers which innervate the ventricular myocardium.

An electrocardiogram records these impulses. A normal ECG consists of a P wave, which represents atrial depolarization (or contraction), a QRS complex that represents ventricular depolarization, and a T wave that reflects ventricular repolarization.

## Premature Ventricular Complexes

Instead of an electrical impulse created in the atrium, premature ventricular complexes are created in the ventricles. The ventricles depolarize without a signal disruption to the atria or SA nodes, causing a ventricular contraction that occurs before an anticipated sinus beat. PVCs are captured on an ECG by a lengthened QRS complex (> 0.10 seconds).

There are a multitude of potential causes for premature ventricular complexes. Common causes include electrolyte imbalance (especially hypokalemia and hypomagnesemia), drug overdose, alcohol, coronary artery disease, medications (such as albuterol) and increased adrenaline (such as from caffeine, anxiety, or exercise).

## Ventricular Tachycardia

Ventricular tachycardia arises in the ventricles. Potential VT causes include reentry of impulses at the site where normal tissue meets damaged myocardium after a myocardial infarction (MI), triggered activity (spontaneously generated heartbeat produced when an impulse is created just after repolarization) and automaticity (when a cell acquires the ability to inappropriately initiate an action potential leading to depolarization). Additionally, in the absence of disease or known cause, VT may be termed idiopathic. Two primary causes of idiopathic VT are right ventricular outflow tachycardia (RVOT) originating in the bundle of His and idiopathic left ventricular tachycardia (ILVT) arising from the left septum. It is important to note that in idiopathic VT, the aberrant impulse can arise from anywhere in the ventricles.

## Ventricular Fibrillation

Ventricular fibrillation is a potentially fatal dysrhythmia characterized by uncoordinated ventricular quivering that results in an ineffective contraction. Because blood is not being pumped to the tissues, sustained VF is an emergent condition that results in death if not corrected. VF is most commonly caused by damage to the ventricular myocardium, as seen after a MI, or as a sequelae to VT. As a precursor to VF, it is believed that accelerated ventricular tachycardia can cause ventricular depolarization to be fragmented into multiple reentry currents within the myocardium, leading to sustained disordered depolarizations.

## Epidemiology

### Premature Ventricular Contractions

PVCs are thought to be relatively common. They are thought to be present in 6-60% of middle aged adults, and the prevalence rate is directly related to increased age, male sex, African American ethnicity, presence of sinus tachycardia, and hypokalemia and hypomagnesemia. Ventricular Tachycardia & Ventricular Fibrillation

The risk for sudden cardiac death peaks between the ages 45 to 75 years. The risks associated with death due to underlying heart disease is higher in men and increases with age, hypertension, tachycardia, presence of dysrhythmias, increased weight, cigarette smoking and hypercholesterolemia. Additionally, studies have shown that 75% of patients who die from sudden cardiac death associated with VT/VF have had previous myocardial infarctions.

## **Signs and Symptoms**

### **Premature Ventricular Contractions**

Premature ventricular contractions may be asymptomatic, or may be felt as palpitations or thumping in the chest. It may be felt as a “skipped beat” or “missed beats”. Rarely, PVCs may decrease cardiac output, causing symptoms such as chest pain and shortness of breath.

### **Ventricular Tachycardia**

Because the ventricles depolarize at a rapid rate, blood may not fully fill the ventricles, causing decreased cardiac output. Symptoms can include chest pain, shortness of breath, dizziness, palpitations, and loss of consciousness. Patients may exhibit an altered level of consciousness, rapid heart rate, hypotension, and absent pulse. VT can rapidly lead to myocardial ischemia, infarction, and death if not treated.

### **Ventricular Fibrillation**

Patients in VF will not perfuse blood to their heart, brain, and other organs. They will rapidly lose consciousness, become pulseless and stop breathing. As VF is commonly caused by myocardial infarction, prior to VF, patients may experience symptoms of an MI such as chest pain, shortness of breath, dizziness, nausea, and palpitations. Other causes include electrocution, congenital heart disease, cardiomyopathy, heart surgery and coronary artery disease.

## **Diagnosis**

### **Premature Ventricular Contractions**

PVCs can be diagnosed with an electrocardiogram. PVCs are portrayed by a prolonged QRS complex > 0.10 seconds.

### **Ventricular Tachycardia**

VT is defined by the presence of three or more consecutive ventricular complexes at a rate greater than 100 beats/min. The ECG rhythm displays wide, monomorphic QRS complexes that lack p waves and t waves.

### **Ventricular Fibrillation**

VF is quickly diagnosed by an ECG reflecting a continuously fluctuating waveform with a lack of QRS complexes.

## **Treatment**

### **Premature Ventricular Contractions**

Most people with PVCs will not require treatment, however, if symptoms become bothersome treatments may include lifestyle changes such as smoking cessation and reducing alcohol consumption. Beta blockers may be prescribed to suppress PVCs, and other medications such as calcium channel blockers or antiarrhythmics may be used with severe symptoms.

### **Ventricular Tachycardia**

Treatment depends on the severity of symptoms. Emergent treatment may include anti-arrhythmic medications such as lidocaine, procainamide, or amiodarone; cardioversion, or cardiopulmonary resuscitation with defibrillation. Long term treatment may include anti-arrhythmic medication (procainamide, sotalol, or amiodarone), ablation, or devices such as an implantable cardioverter defibrillator (ICD) that will deliver a shock when VT is detected.

### **Ventricular Fibrillation**

Emergent treatment of VF consists of cardiopulmonary resuscitation with defibrillation, and administration of antiarrhythmic medications. Long-term treatment depends on the cause. If caused by scarring from a previous MI, medications may be recommended such as beta blockers, ACE inhibitors, calcium channel blockers or amiodarone. An ICD may be implanted to quickly convert VT/VF. Angioplasty and coronary artery stent placement may be performed if the cause is determined to be coronary artery disease. If ventricular tachycardia was the precursor, cardiac ablation may be done to destroy aberrant signal pathways.

## **External Links**

American Heart Association: [http://www.heart.org/HEARTORG/Conditions/Arrhythmia/AboutArrhythmia/Ventricular-Fibrillation\\_UCM\\_324063\\_Article.jsp](http://www.heart.org/HEARTORG/Conditions/Arrhythmia/AboutArrhythmia/Ventricular-Fibrillation_UCM_324063_Article.jsp)

Mayo Clinic – Premature Ventricular Contractions: <http://www.mayoclinic.org/diseases-conditions/premature-ventricular-contractions/basics/definition/con-20030205>

Mayo Clinic – Ventricular Tachycardia: <http://www.mayoclinic.org/diseases-conditions/ventricular-tachycardia/basics/definition/con-20036846>

Mayo Clinic – Ventricular Fibrillation: <http://www.mayoclinic.org/diseases-conditions/ventricular->

## References

Copstead, L., & Banaski, J. (2005). Pathophysiology. St. Louis, Missouri: Elsevier Saunders.

Keany, J. (2014). Premature Ventricular Contraction. Medscape. Retrieved from <http://emedicine.medscape.com/article/761148-overview#a0199>

The Mayo Clinic. (2011). Premature ventricular contractions (PVCs). Retrieved from <http://www.mayoclinic.org/diseases-conditions/premature-ventricular-contractions/basics/definition/con-20030205>

The Mayo Clinic. (2011). Ventricular fibrillation. Retrieved from <http://www.mayoclinic.org/diseases-conditions/ventricular-fibrillation/basics/definition/con-20034473>

The Mayo Clinic. (2012). Ventricular tachycardia. Retrieved from <http://www.mayoclinic.org/diseases-conditions/ventricular-tachycardia/basics/definition/con-20036846>

Medline Plus. (2012). Ventricular tachycardia. Retrieved from <http://www.nlm.nih.gov/medlineplus/ency/article/000187.htm>

PubMed Health. (2012). Ventricular fibrillation. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0004467/>

Simons, G., Klein, G., & Natale, A. (1997). Ventricular tachycardia: Pathophysiology and radiofrequency catheter ablation. *Pacing & Clinical Electrophysiology*, 20(2): 534-51. Retrieved from <http://web.b.ebscohost.com.ezproxy.colostate-pueblo.edu/ehost/detail?sid=40e9ba95-6041-4cc7-b8ef-ff2ecd43fc2d%40sessionmgr115&vid=16&hid=117&bdata=JnNpdGU9ZWVhvc3QtbGl2ZSZzY29wZT1zaXRl#db=rzh&AN=2009411074>

Simpson, R., Cascio, W., Schreiner, P., Crow, R., Rautaharju, P., & Heiss, G. (2002). Prevalence of premature ventricular contractions in a population of African American and white men and women: the Atherosclerosis Risk in Communities (ARIC) study. *American Heart Journal*, 143(3):535-40. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/11868062>