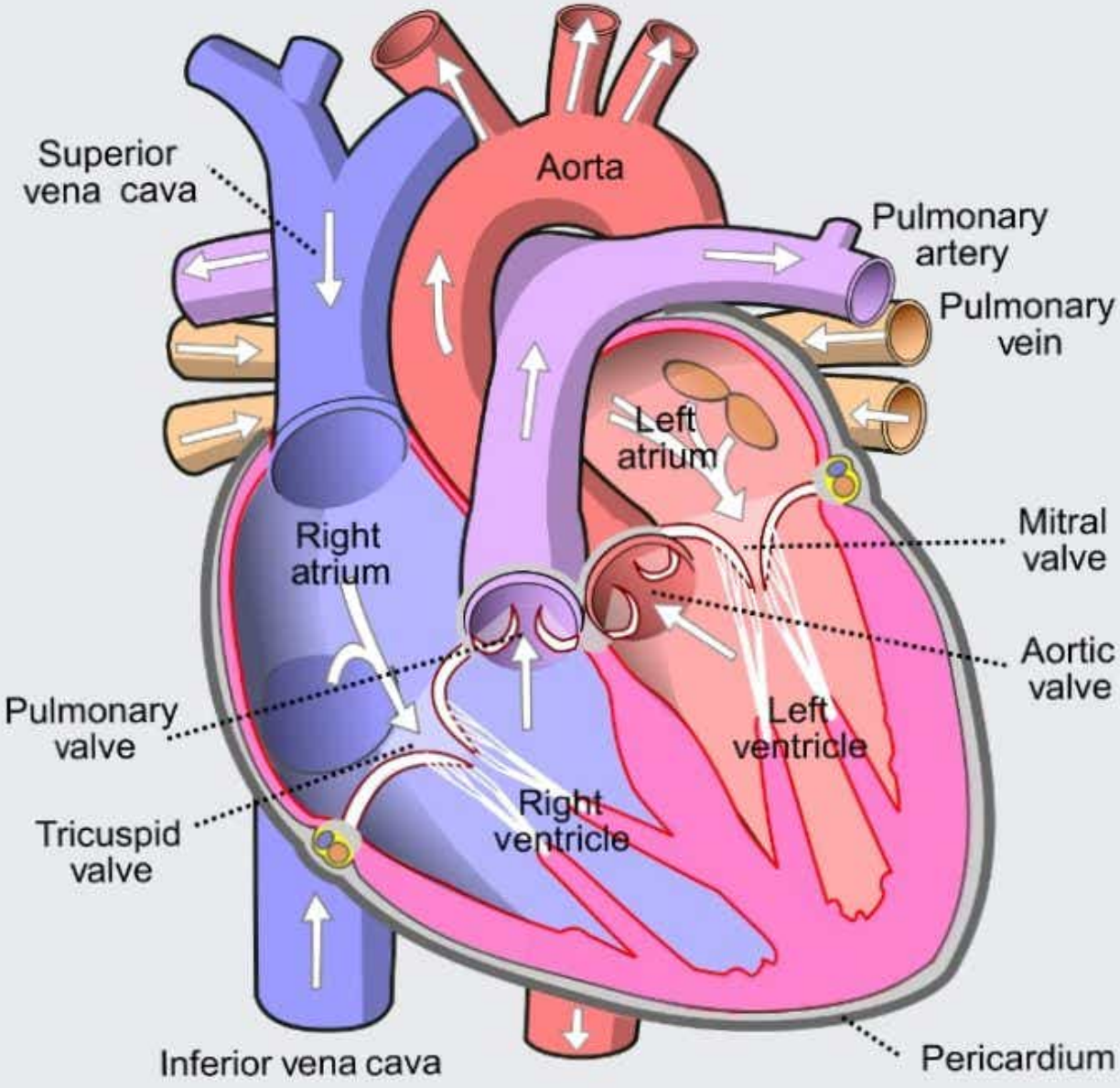
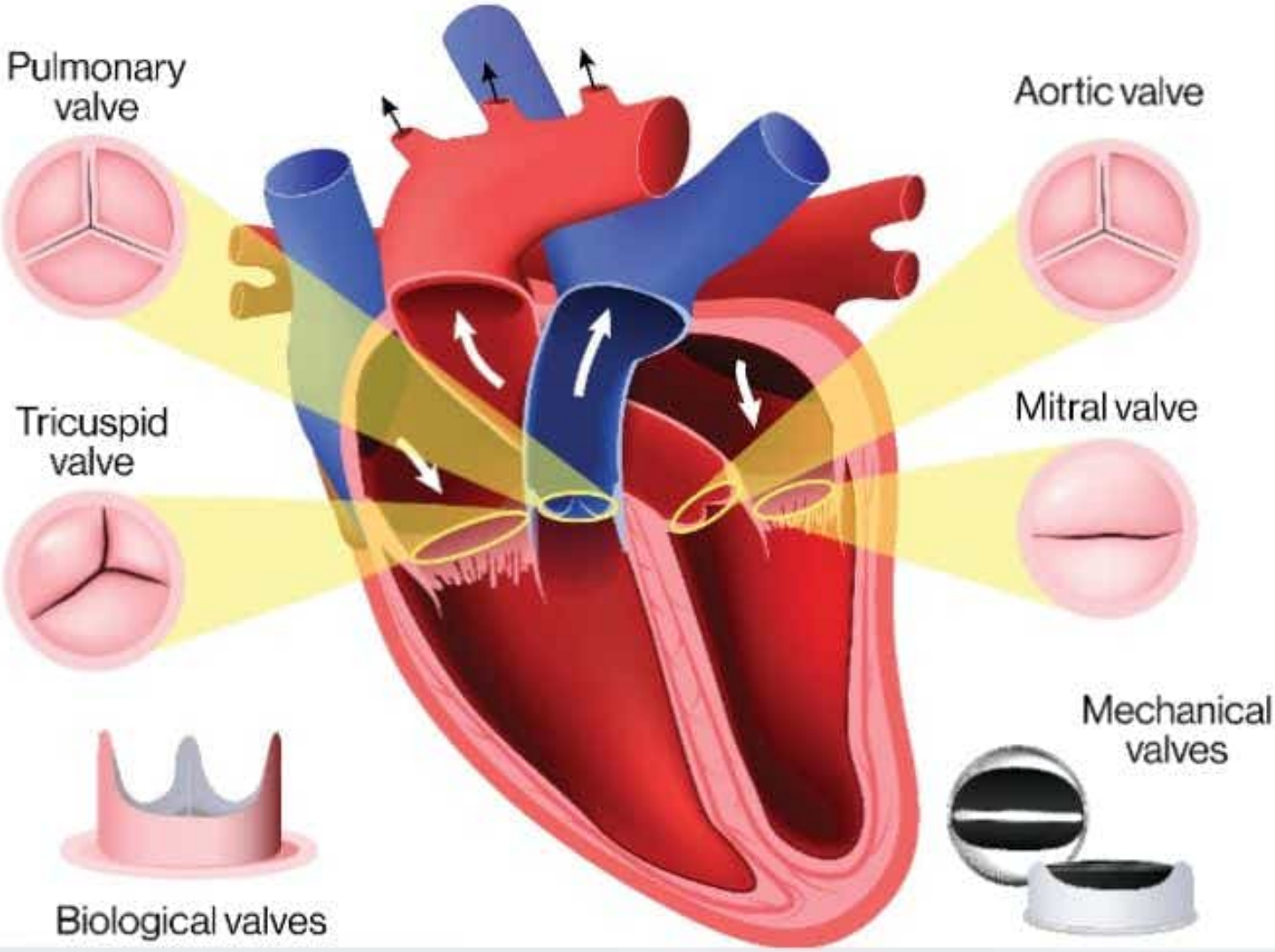

Superior vena cava
Aorta
Pulmonary artery
Pulmonary vein
Left atrium
Mitral valve
Right atrium
Aortic valve
Pulmonary valve
Left ventricle
Right ventricle
Tricuspid valve
Inferior vena cava
Pericardium

Heart valve


Pulmonary valve
Aortic valve
Tricuspid valve
Mitral valve
Mechanical valves
Biological valves

electronics are worn externally. Without any major surgery and without any
infection this circuit can work for a long time. The transmitter part can be made in
of a dollar and hanged in the neck. A small receiving antenna and a passive detector
(without battery) in the form of a pill (radio pill) can be surgically placed inside the
with the stimulating electrode at the ventricular muscle.

Figure 5.13 shows the block diagram of a telemetry type RF energised pace
A free running multivibrator generates the desired pulses at the rate of 70 beats/minu
the pulses are used to turn a R.F. oscillator of frequency 2 MHz. The pulses modulate
R.F. oscillations. The modulated R.F.waves are amplified and transmitted through
transmitter coil. The receiver coil receives these modulated R.F. waves. The capacitor
rectifier, connected to the receiver coil which is placed beneath the skin remove the
carrier. Thus the output of the rectifier diode is used to stimulate the heart muscle. Bu
type is also not liked by the cardiac patients.

5.4 ARTIFICIAL HEART VALVES

Today cardiac surgery has advanced tremendously to enable repair of all congen
heart defects, replacement of damaged valves and bypassing of coronary blocks. About
1000 babies is born with deformed heart and 1/3 of them die in infancy. The improper
functioning of the heart is due to various defects like hole in the heart, atrial septal defect
and ventricular septal defects. In several cases like pulmonary stenosis, the valves or
major vessels are narrow. When the major vessels of the heart are wrongly connected,
there is mixing of pure and impure blood. This accounts for the blue colour of the baby.
These defects must be corrected as early as possible to save the life of the patient. For aged
people, the mitral valve and aortic valve can be affected. The tricuspid valve may be affected
at a later stage. Badly diseased valve has to be replaced by an artificial valve. There are two
types of valves:

i) **Prosthetic valves**: These are made from high grade plastics and metal. They need
long coagulating agent (i.e.) blood thinning agent. The average durability of these
valves is about 8 to 10 years.

ii) **Tissue valves**: These may be either homograft or heterograft. Homograft valves are
taken from human beings. Heterograft valves are taken from animals. Here blood
thinning agent is not necessary. The average durability of these valves is smaller than
the prosthetic valves. Only the prothetic or mechancial valves are discussed here.

5.4.1 Requirements for the design of artificial heart valves

i) When the artificial heart valve is in contact with the blood, there would not
be any hemolysis or blood clots.

ii) The valve material must be tough enough to withstand the heart beat rate throughout the life of the patient.

iii) It should be designed small, light, reliable and efficient enough to enable it to be inserted surgically into the heart.

Different natural heart valves

Since the left side of the heart is the one which normally functions with much higher ...ure differentials, the left heart valves are usually failed to function properly. The ***mitral*** ...e is located between the left atrium and the left ventricle and the ***aortic valve*** is located ...een the left ventricle and aorta. Occasionally the ***tricuspid valve*** which is located ...een the right ventricle and right atrium will fail. The procedure in valve replacement ...ves opening the chest (thoracotomy), placing the heart on bypass using a heart-lung ...chine, cutting through the heart muscle to expose the valve, excising the diseased valve ...d the surrounding tissue and attaching a prosthetic valve in its place.

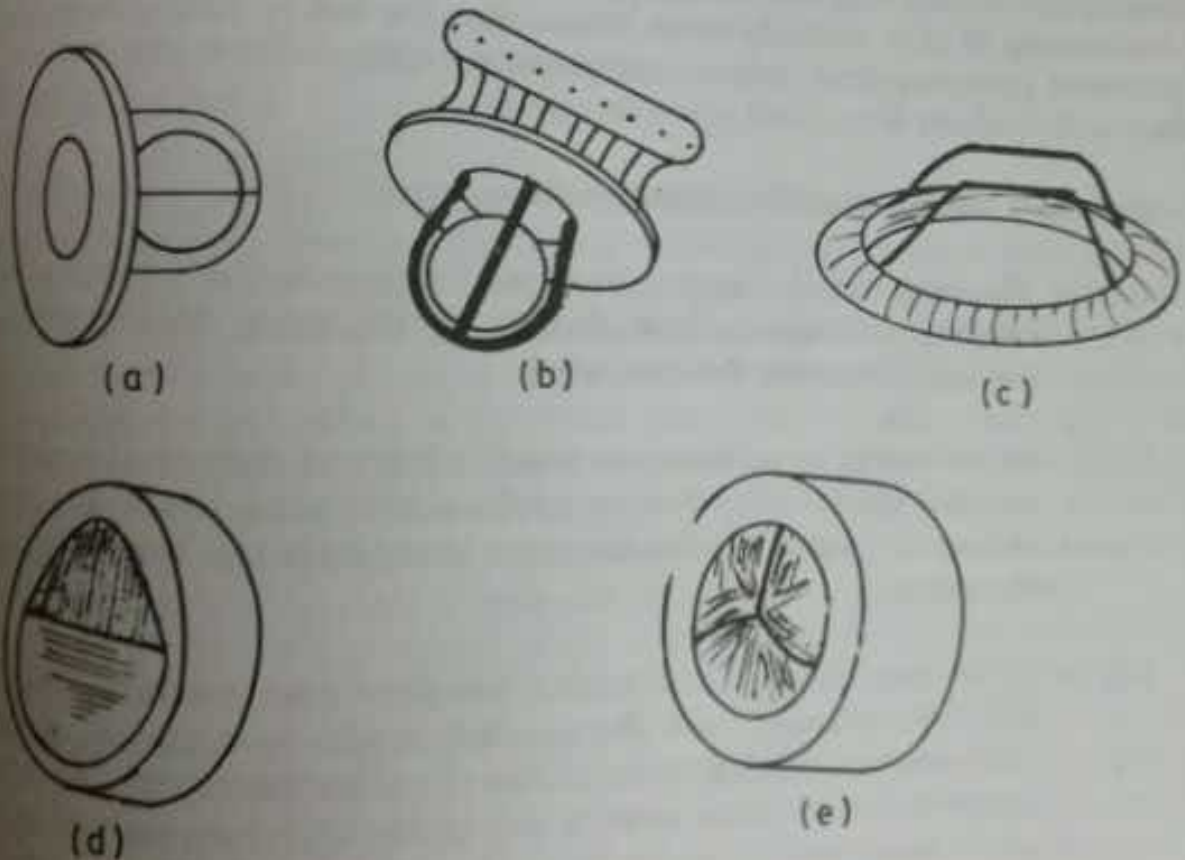


Fig.5.14. Different types of artificial heart valves

a) **Starr - Edwards mitral valve**
b) **Magovern - Cromie aortic valve**
c) **Kay-Shiley mitral disc valve**
d) **Gott butterfly mitral valve**
e) **Leaflet valve**

5.4.3 Different types of artificial heart valves

Most of the artificial heart valves are check valves of the caged-ball (Starr-Edwards type) or caged-disc (Alaskan type) variety. The ball or disc is made from silicone rubber and is surrounded by either Dacron or Teflon forms the connecting surface which is sewn to the natural seat from which the pathologic valve is removed. Starr and Edwards have used a mitral valve using a ball made of silastic 372 rubber (Figure 5.14(a)). The Starr-Edwards aortic valve has large orifice and small regurgitation. It has large opening resistance. The closure of that valve is in a very slow manner. The Magovern-Cromie aortic valve (Figure 5.14(b)) differs from others such that there is a series of needle like projections which are screwed out during the installation procedure. These attach themselves to the ring of tissue around the valve and form the fixation. Its main advantage is that time consuming sewing of the valve to the tissue is eliminated and the operation can be performed in much less time. In the Kay Shiley mitral valve (Figure 5.14(c)) a caged disc replaces the silastic ball. This type is anatomically more suitable than other types. Gott butterfly mitral valve (Figure 5.14(d)) has quick opening and closing and large orifice. It has a disadvantage that it has great regurgitation. Similarly the leaflet valve (Figure 5.14(e)) used as mitral valve has same functioning of Gott butterfly valve. Now-a-days the ball or disc is made of hollow solid polymers (polypropylene, polyoxymethylene, polychlorotrifluro ethylene, etc.), metals (titanium and vitallium alloys) and pyrolytic carbon.

5.4.4 Problems regarding artificial heart valves

i) The early use of silicone rubber was found undesirable because of the swelling and dimensional changes of the valve. Further hemolysis and regurgitation were also produced.

ii) In the aortic area, there are calcification and rupture of pericardial patch within a few months when the artificial heart valve is used as a substitute for the aortic cusps. Calcification starts at the base and impairs the mobility of the valve.

iii) In the Starr-Edwards aortic ball valve, there are some variations in the size of ball after some months. Further this results in migration of the ball and embolization. The silicone rubber becomes susceptible to wear. During implantation of valve, abnormality of implantation results a tight fit at the aortic root which alters the blood flow velocities. Similar variations have been observed in the Starr-Edwards mitral valve. In the mitral area, the major problem with artificial valves has been the high incidence of thromboembolic (blocking of blood vessels) complications.

iv) In some cases at the mitral site, the blood is slowly squeezing out which results clotting of blood. The blood clotting can even affect the operation

the valve. The fabric coverings of both seat and cage show promise toward replacing the clot with tissue ingrowth.

v) In some occasions, the ball itself has become deformed causing incompetency of the valve which decreases the normal operating efficiency. In few cases, the ball has actually escaped from its cage with tragic results.

vi) There are some cases in which the blood leaks around the insertion site causing a small degree of insufficiency and clot formation.

vii) Surrounding the insertion site there are mal formation and tissue growth which reduce the opening and closing actions of the valve.

viii) Infection at the implantation site is usually fatal, although survivals have been reported after removal and replacement of the infected valve.

Despite these drawbacks thousands of people owe their lives to these artificial plastic ...ular replacements.

DEFIBRILLATORS

A defibrillator is an electronic device that creates a sustained myocardial ...arisation of a patient's heart in order to stop ventricular fibrillation or atrial fibrillation. ...ricular fibrillation is a serious cardiac emergency resulting from asynchronous ...raction of the heart muscles. This uncoordinated movement of ventricle walls of the ...t may result from coronary occlusion, electric shock or abnormalities of body chemistry. ...ause of this irregular contraction of the muscle fibers, the ventricles simply quiver rather ...e pump the blood effectively. This results in a steep fall of cardiac output and can lead ...ath if adequate steps are not taken promptly. During fibrillation, the heart muscle fibers ...e continuously stimulated by adjacent cells so that there is no synchronised succession of ...ns that follow the heart action. Ventricular fibrillation can be converted to a more ...ent rhythm by applying a high voltage shock to the heart. This sudden surge of voltage ...s the heart causes all muscle fibers to contract simultaneously. Possibly the fibers may ...n respond to normal physiological pacemaker pulses. The instrument for administering ...electric shock is called ***defibrillator***. If the heart does not recover spontaneously after ...ering the shock to the heart using a defibrillator, then a pacemaker may be employed ...ain the rhythmic contraction of the myocardium. The sudden cardiac arrest can be ...ted using a defibrillator and 80% of the patients will be cured from the cardiac arrest if ...tment is given within one minute of the attack. An atrial fibrillation causes reduced ...c output but is usually not fatal. It happens for the young people who are always ...ing and can even be cured by drug therapy.