

## **Cardiopulmonary bypass**

Modern cardiac and great vessel surgery became feasible with the development of cardiopulmonary bypass. Venous blood is extracted via cannula inserted into the right atrium or venae cavae and drained to reservoir. It is then pumped through an oxygenator, which adds O<sub>2</sub> and removes CO<sub>2</sub>, and through a heat exchanger coil so that its temperature can be varied. Finally, the blood is returned to the arterial circulation via a cannula in the ascending aorta. Full anticoagulation with intravenous heparin is required to prevent blood clotting in the tubing, oxygenator and pump mechanisms.

Cardiopulmonary bypass carries several risks. Cerebral damage occurs in about 1% of cases due to intracerebral bleeding, embolization of micro bubbles or arterial debris, or in adequate cerebral perfusion. There is also significant activation of systemic inflammatory mechanism, with cytokine release, complement activation and white cell stimulation. Coagulopathy and hemolysis are associated with prolonged bypass.

## **ACQUIRED CARDIAC DISEASE**

Surgical intervention may be required in the management of:

- Ischemic heart disease
- Cardiac valve disease
- Pericardial pathology
- Cardiac trauma.

### **Ischemic heart disease**

Ischemic heart disease encompasses coronary artery disease and its complication, principally acute mitral regurgitation, ventricular septal defect and left ventricular aneurysm.

### **Coronary artery disease**

This is caused by coronary atheroma. Most patients will present for surgery because of angina or previous myocardial infarction (MI).

#### **Indications**

Elective surgery is indicated primarily for the control of angina that is refractory to medical treatment and which is caused by disease that is unsuitable for angioplasty and stent insertion. Surgery improves long term survival for patients with three-vessel disease or left main stem disease particularly when left ventricular function is also impaired.

Emergency surgery is required mainly for failed interventional procedures that have caused coronary occlusion.

## **Cardiac valvular disease**

Valve disease may obstruct forward flow (stenosis) or permit reverse flow (incompetence/reflux/regurgitation), or both. The aortic and /or mitral valves are primarily affected. Primary tricuspid pathology is rare and pulmonary valve disease is virtually unknown. Formerly, rheumatic fever following streptococcal infection is the most common etiological factor.

### **Assessment**

Echocardiography provides useful data that can calculate the effective orifice areas of stenotic mitral and aortic valves; also it provides data on forward gradients using Doppler techniques and can indicate regurgitation. Coronary arteriography is indicated in patients of middle age or older.

### **Surgical management**

Options include valve replacement or repair. Replacement utilizes either a mechanical or biological prosthesis. Repair is relatively uncommon and is largely restricted to the mitral and aortic tricuspid valves. Mostly the surgeon is concerned with the correction of valvular incompetence. The mechanical valves should last indefinitely, but patients require lifelong warfarin to prevent thrombotic occlusion or embolism. Biological valves are derived from:

- Glutaraldehyde-preserved porcine aortic valves mounted on a frame (stent).
- Glutaraldehyde- preserved bovine pericardium formed into a three leaflet valve and mounted on a stent.
- Human aortic root homograft removed from cadaveric hearts and preserved in antibiotic solution.

Warfarin usually not required with biological valves. However, such valves deteriorate over time and after 10-20 years will need to be replaced. So such valves used in old age patients (above 70 years). In young women intending to have children it is usual to advise a biological valve, with the intention of replacing it with a mechanical devise when the valve fails. This avoids problems with warfarin during pregnancy (placental separation and abortion, and teratogenicity).

## **Endocarditis**

Abnormal native heart valves and artificial valves are prone to subacute bacterial endocarditis, and prosthetic valve endocarditis, respectively. Antibiotic prophylaxis is required to cover any surgical or dental procedure. If infection does develop, prolonged parenteral antibiotic therapy may be effective. However, surgery may be required if the infection not responds or if the valve develops large paravalvular leak or annular abscess.

## **Pericardial pathology**

### **Pericardial Effusion**

In chronic pericardial effusion, the pericardial sac will stretch and clinical effects of the accumulated fluid may modest. In contrast, a rapidly evolving effusion will prevent the heart from filling in diastole (tamponade) and lead to a low stroke volume. The raised intrapericardial pressure leads to elevation of atrial pressure, and hence the central venous pressure rises in order to maintain a filling gradient. A pericardial effusion can often be drained through a catheter placed under echocardiographic guidance. Surgical drainage is likely to be required in infection, malignancy with reasonable life expectancy, and chronic effusion. Chronic effusions are often drained into left pleural cavity. This achieved by creating a window in the left lateral pericardium via an open left thoracotomy.

### **Pericardial constriction**

Chronic pericardial inflammation, often from tuberculosis, may heal by intense fibrosis and calcification. This leads to chronic tamponade. Surgery is undertaken via a median sternotomy to remove the parietal pericardium and any fibrotic visceral pericardium.

### **Post-Operative care of cardiac surgery patient**

Post-operatively, patients are routinely ventilated for several hours until they are fully rewarmed and have satisfactory hemodynamics, pulmonary gas exchange and acid-base status. Urine output is copious and potassium levels are, therefore, checked frequently and potassium administered intravenously to correct urinary lose. Invasive measurement of arterial and central venous pressure is standard. Pulmonary artery catheters are frequently used to measure pulmonary artery pressure, pulmonary artery capillary wedge pressure and cardiac output.

### **Complications**

Other than the catastrophes of death or stroke, established complications include:

- Low cardiac output

- Arrhythmias
- Fluid accumulation
- Short-term memory impairment
- Wound infection
- Pulmonary infection.

**Recovery time**

Patient undergoing routine elective coronary or valve surgery will usually leave acute hospital care within 1 week. Those requiring more extensive surgery or emergency procedures may take longer to recover. Most patients will have undergone a median sternotomy. This wound heals quickly and well and, as the sternal edges are approximated securely by wire or heavy sutures, chest discomfort eases rapidly. Leg vein donor sites may take longer to heal, particularly around the knee. By 2 weeks the patient should be able to walk a few hundred meters, and by 3 months should have returned to full activity, including work.