Intra-aortic balloon pump (IABP) therapy was first introduced in the 1960s for the treatment of cardiogenic shock. Since then it has assumed a pivotal role in the treatment of those with heart failure and myocardial ischaemia and, according to Reid and Cottrell, is the most widely used mechanical support. Cardiovascular nurses caring for these patients require skills and knowledge that enable prompt recognition and treatment of sometimes life-threatening complications associated with balloon pump therapy. This article provides an overview of the function of the pump, indications, potential complications and nursing care required.

How it works

IABP therapy is a method of mechanically assisting and supporting the coronary and systemic circulation in patients who have myocardial pump dysfunction or in those with coronary ischaemia and/or undergoing complex high-risk percutaneous coronary intervention. The IABP consists of a long polyurethane type catheter with a 10-15cm balloon at the end. This catheter is normally inserted via the femoral artery and passed into the descending thoracic aorta until the tip is positioned 2cm just below the left subclavian artery and the lower end of the balloon just above the renal arteries. The catheter tip is radiopaque so its position can be evaluated on x-ray. The catheter attaches to a pressurised flush system, similar to that of an arterial line, and also to the pump itself where helium is shuttled in and out of the catheter so that the balloon can inflate and deflate. The catheter comes in three sizes 34cc, 40cc, 50cc and is selected according to the height of the patient.

This type of therapy works by the balloon inflating and deflating in synchrony with the cardiac cycle. Therapy may be timed to 1:1, 1:2 or 1:3, implying that the balloon inflates and deflates according to each cardiac cycle, every second cardiac cycle or every third cardiac cycle respectively. Inflation occurs just as diastole begins (diastole represents the heart relaxing, the ventricles filling and getting ready for systole and the coronary arteries receiving their blood supply). Diastole is recognised as the presence of the dicrotic notch on the pressure waveform, which triggers balloon inflation. This results in the movement of blood in the aorta into the coronary and up to the carotid arteries, thus increasing coronary and cerebral perfusion (see Figure 1). Deflation occurs at the end of diastole just before systole, which results in aortic blood being displaced down toward the mesenteric and renal arteries, increasing perfusion to these organs, and thus reducing the afterload (the pressure in the aorta that the heart has to pump against) (see Figure 1). The net result of inflation and deflation is increased coronary and cerebral perfusion and reduced myocardial workload respectively.

Indications

The goal of IABP therapy is to improve myocardial oxygen supply and reduce myocardial oxygen demand. Although it was originally designed to support patients in cardiogenic shock the indications have expanded because of continued research. Table 1 lists the many indications for IABP therapy. The most common indications are low cardiac output due to left ventricular dysfunction and myocardial ischaemia. Other indications include septic shock, cardiac support for non-cardiac related surgery and support post correction of anatomical defects.

Nursing care

Prior to insertion of the IABP a baseline assessment is performed incorporating lower and upper limb perfusion. This serves as a baseline for assessments post insertion. Upper limb assessment is essential so that balloon migration obstructing blood flow down the left subclavian artery can be detected promptly. This assessment involves documentation of palpation of the relevant pulses, assessing capillary refill, temperature and colour of the limbs. A set of baseline vital signs is recorded – heart rate, blood pressure, respiratory rate, oxygen saturations and tempera-
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Table 1

Indications for IABP therapy

Increase coronary artery perfusion
• Refractory unstable angina
• Impending infarction
• Acute myocardial infarction
• Support during PCI
• Complications post myocardial infarction (VSD, papillary muscle rupture, acute mitral regurgitation)
• Myocardial contusion
• Ischaemia related intractable ventricular arrhythmias
• Bridge to cardiac surgery

Reduction in afterload
• Ventricular failure unresponsive to pharmacological therapy
• Cardiogenic shock
• Post-surgical myocardial dysfunction/low cardiac output syndrome
• Bridge to cardiac transplantation
• Bridge to other form of circulatory support

Table 2

Elements of nursing care

• Assess cardiovascular hourly, or more frequently depending on clinical acuity, noting mean arterial pressure, augmented pressure heart rate, oxygen saturation and perfusion state (lower and upper limb perfusion assessment)
• Assess and observe for any alteration in neurological status
• Confirm timing, ratio and trigger of intra aortic balloon pump hourly
• Strict intake and output record – aim for output 0.5ml/kg/hr – report any sudden decrease in urinary output (signs of decreased renal perfusion due to low cardiac output or migration of the catheter to the renal arteries obstructing blood flow)
• Ensure the transducer is level with the phlebostatic axis, flushed hourly and zeroed four hourly or on change of patient position. Always flush with the pump on standby
• Check all connections, observe the balloon catheter for presence of blood which may indicate balloon puncture/rupture hourly
• Monitor for signs of pulmonary oedema or ischaemia
• Monitor temperature two-to-four-hourly, observing for signs of infection such as erythema/inflammation and pain at the insertion site and a raised white cell count
• Observe for bleeding at cannulation sites, venepuncture sites, urinary catheter, and insertion site as a complication of anticoagulation therapy
• Educate the patient re importance of passive limb exercises, keeping the affected leg straight
• Encourage deep breathing exercises to promote adequate ventilation and lung expansion preventing the development of chest infections
• Provide skin care and pressure area care – may need a pressure relieving mattress and if needed two-hourly turns
• Assist with nutrition and hydration as patient should be no higher than 30° which is challenging when eating or drinking
• Provide on going psychological support and education as required

the blood into the coronary and carotid arteries), mean arterial pressure, temperature, respiratory rate and oxygen saturations. The aim is that the mean arterial pressure is maintained between 60-70mmHg which indicates adequate peripheral perfusion. This is confirmed by the patient being warm to touch, good capillary refill, no evidence of cerebral hypoxia and urinary output ≥ 0.5ml/kg/hr. Cardiovascular assessment is performed hourly or more frequently if haemodynamic status deteriorates.

Regarding the IABP, the pump should be checked hourly for correct settings such as timing, balloon inflating to its maximum capacity and that the trigger is at the correct setting. As with any invasive haemodynamic monitoring system the pressure bag should be inflated and maintained at 300mmHg, thus ensuring optimal flush system, which is required for line patency. The level of the transducer is at the phlebostatic axis that is confirmed using the spirit level and is changed as per patient position. Patient position is an important consideration if the IABP is to be effective. The patient should be no higher than 30°, which ensures patency of the balloon, continuous flow to the balloon, and reduces the risk of catheter kinking and obstructing the passage of helium into and out of the catheter.

Potential complications

When caring for patients receiving this therapy nurses must...
be alert for possible occurrence of complications. Table 3 lists the potential complications associated with IABP therapy. Thoroughness when obtaining the patient’s medical history is essential for recognising factors that predispose the patient to the development of complications. Reid and Cottrell list the following as risk factors: female gender, pre-existing peripheral arterial disease, older age, diabetes mellitus, smoker, hypertension and obesity. Limb ischaemia and bleeding are two complications associated with this therapy and will be discussed in detail.2

The primary causes of limb ischaemia are obstruction of a small or diseased femoral artery by the catheter, formation of thrombus from direct arterial injury during IABP insertion and thromboembolism. Prior to insertion a lower limb perfusion assessment involving both legs must be completed. This involves confirming presence of the pedal pulses – dorsalis pedis and posterior tibial in both feet, assessing capillary refill and temperature and observing the colour of the limbs (cyanosis, pale, mottled). There is no palpable dorsalis pedis in 8-10% of the general population and this should be documented on nursing assessment prior to IABP insertion.1 if the pulses are not palpable a doppler should be used to determine the presence of pulses that are difficult to palpate. This assessment is repeated during IABP therapy as per hospital guidelines. In our hospital it is completed hourly. Acute ischaemia of the limbs may produce the six Ps – pain, pallor, pulselessness, poikilothermia (cold), paraesthesia and paralysis.1 In cases of limb ischaemia occurring, removal of the balloon catheter restores perfusion, rarely a partial or full amputation is necessary.

Bleeding at the insertion site is commonly encountered and may be due to anticoagulation therapy or associated thrombocytopenia. Patients receiving IABP therapy are normally maintained on an anticoagulant regimen to avoid thrombus formation at the tip of the catheter or within the folds of the balloon. Thrombocytopenia can result from anticoagulation therapy or from platelet destruction due to mechanical trauma that occurs during inflation of the IABP catheter. Baseline full blood count and anti-coagulation screen should be reserved prior to and during therapy to observe for changes such as a decrease in haemoglobin and to monitor the effect of anticoagulation therapy prescribed.

The insertion site dressing should be transparent which enables visual inspection of the site. Change of dressing is as per clinical need and hospital guidelines, aseptic technique must be employed to minimise the risk of infection. Frequency of monitoring depends on patient’s clinical condition and as acuity determines. Indications of bleeding may manifest as oozing, bruising or haematoma formation at the insertion site or by swelling in the thigh area. Signs of retroperitoneal bleeding include the patient becoming hypotensive and complaining of back, flank or abdominal pain unrelied by changes in position. Treatment of bleeding includes applying pressure to the insertion site and administration of blood products as required.

### Table 3

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<th>Potential complications</th>
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<tr>
<td>• Infection at site of insertion</td>
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<td>• Haematoma and bleeding at insertion site</td>
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<tr>
<td>• Limb ischaemia, absent pulses and compartment syndrome</td>
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<tr>
<td>• Thrombocytopenia</td>
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<td>• Coagulation disturbances</td>
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<td>• Aortic dissection</td>
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<td>• Displacement of the balloon catheter obstructing left subclavian artery or renal artery perfusion</td>
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<td>• Vascular complications</td>
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<td>• Balloon leak, rupture, gas loss from the balloon</td>
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<td>• Timing issues</td>
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Nursing care involves checking the insertion site every hour for bleeding or haematoma formation and documenting findings. In addition the full blood count and anti-coagulation screen is observed for a decrease in haemoglobin and platelet count or evidence that the patient is receiving too high dose of anticoagulant.

### Weaning and removal

Once the patient’s condition has stabilised the IABP is considered for removal. This is preceded by a process of weaning the pump from 1:1 to 1:2 and finally 1:3, and observing the patient for ischaemic chest pain or development of heart failure symptoms such as breathlessness, hypotension and tachycardia. Once the patient is stable the IABP can be removed. Post removal the patient is kept on bed rest with the leg kept straight as per local guidelines.

Nursing care involves observing for recurrence of symptoms as well as checking the insertion site for haematoma formation or symptoms suggestive of retroperitoneal bleed every 15 minutes for the first hour, half hourly for the next two hours and thereafter hourly or as clinical acuity dictates. In addition lower limb perfusion is assessed at these times confirming adequate perfusion and presence of pedal pulses.

IABP is a form of circulatory support for those presenting with ischaemia or heart failure. Nursing care involves care of the pump as well as assessing patient from a cardiovascular and haemodynamic perspective.

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### References