Postoperative care of the adult cardiac surgical patient

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Abstract

Most patients are ready to be transferred to a ward after 24–48 hours on a cardiac intensive care unit (CICU); however, several potential complications can occur during this period. The risks during transfer from theatre to CICU increase if a long distance is involved. A thorough handover to nursing staff is mandatory. Problems with blood pressure and arrhythmias are common on the CICU. Patients undergoing hypothermic cardiopulmonary bypass are at greater risk of hypothermia postoperatively. Multiple factors can cause postoperative cardiac surgical bleeding. Despite efforts to correct clotting abnormalities, patients occasionally need to return to theatre because of mediastinal bleeding or cardiac tamponade. The avoidance of multiorgan failure by maintaining good tissue perfusion and oxygenation is the main aim of perioperative care and through the initial postoperative period. Avoidance or treatment of a low cardiac output state often necessitates cardiac output monitoring and the use of inotropes, vasoactive drugs or mechanical assist devices such as an intra-aortic balloon pump. Established organ failure leads to a longer stay on a CICU, a growing proportion of patients having a protracted critical care stay.

Keywords Cardiac; cardiac intensive care unit; cardiac output monitoring; care; critical; intensive; postoperative; resuscitation; surgery

Royal College of Anaesthetists CPD Matrix: 3G00

Learning objectives

After reading this article, you should:

- know five causes of hypotension after cardiac surgery
- be able to list the cardinal symptoms and signs of cardiac tamponade
- understand the difference in resuscitation if cardiac arrest occurs immediately after cardiac surgery

First 24 hours after cardiac surgery

Transfer and handover

Transfer from theatre to a cardiac intensive care unit (CICU) can be a period of instability. The distance can be lengthy with the risk of airway, ventilatory or cardiovascular problems. Infusions of vasoactive drugs continue on battery power. Ventilation and oxygen are required. The minimum monitoring needed is ECG, invasive arterial pressure and pulse oximetry with an adequately charged transfer monitor. Changing from volatile anaesthesia to total intravenous anaesthesia (usually propofol) for transfer can lead to inadvertent hypotension or hypertension. The following should be carried with the patient: (1) atropine, (2) a vasoconstrictor, and (3) a bag of fluid.

On arrival to CICU, it is the anaesthetist's responsibility to transfer the patient onto a checked ventilator set up to deliver lung protective ventilation. Correct tube position should be confirmed clinically and with capnography. Palpation of a pulse is sensible while monitoring is transferred and an early blood gas is desirable.

Important handover information to nursing staff includes:

- the operation performed and the intraoperative course
- premorbid conditions
- important medications, for example antiplatelet drugs
- relevant trans-oesophageal pre-/postoperative echocardiography findings
- pre-existing renal function
- intravenous infusions, especially cardiovascular system support
- the presence of pacing wires
- suitability for fast-track pathway/early extubation.

Routine fluid management

Traditionally, cardiac surgical patients were aggressively fluid restricted and diuresed on the CICU following the haemodilution associated with cardiopulmonary bypass (CPB) and fluid received in theatre. After CPB, the systemic inflammatory response syndrome (SIRS) causes capillary leak and vasodilatation. Despite a positive balance, patients may still have intravascular hypovolaemia and fluid therapy should be targeted to optimize cardiac output whilst avoiding fluid overload and its associated problems. Central venous pressure (CVP) trends, pulmonary artery catheter (PAC) measurements and cardiac output (CO) monitoring are used to guide fluid requirement. As with any surgery, fluid administration should then be more conservative in the following days and diuretics may be introduced.

If a patient requires more than 2000 ml of fluid, in the absence of overt bleeding, consideration should be given to other investigations and treatment. Most centres practise a conservative transfusion strategy following the association between blood transfusion and worse outcome. However, in patients with residual cardiac disease, red blood cell transfusion should be used to maintain a haemoglobin concentration 8–10 g/dl[1], rather than the 7 g/dl trigger used for critically ill patients without significant cardiorespiratory disease. Patients may receive autologous blood from the CPB circuit via a cell saver or direct from the pump. The 'pump blood' contains residual heparin which may necessitate the use of further protamine (50–100 mg).

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Maintenance intravenous infusion of crystalloid to balance with drugs and other infusions to a total input of 1 ml/kg/hour is indicated, unless there are reasons to limit the input (e.g. pulmonary oedema, pre-existing end-stage renal failure). Serum K^+ levels should be maintained in the upper normal range of 4.5 −5.5 mmol/litre to avoid arrhythmias. Insulin therapy should be instituted if the blood sugar rises above 10 mmol/litre[2] whilst bearing in mind that this will lower serum potassium levels.

Hypotension

Hypotension on arrival on the CICU is most commonly due to hypovolaemia caused by venous pooling on transfer. There are a number of more serious causes that must be sought and treated if a fluid challenge does not improve matters. A useful test to confirm that hypovolaemia is the cause of hypotension is to raise the patient's legs, which should raise the blood pressure in seconds.

The causes of hypotension immediately after cardiac surgery to be considered are:

- circulatory
  - hypovolaemia
  - massive mediastinal bleeding
  - SIRS response to CPB
- cardiac
  - myocardial ischaemia
  - myocardial dysfunction
  - kinking of a venous graft
  - arrhythmias
  - cardiac tamponade
  - systolic anterior motion of the mitral valve
- respiratory
  - tension pneumothorax
  - overventilation
- pharmacological
  - propofol or glyceryl trinitrate (GTN)
  - inadvertent cessation of inotropes or vasopressors
- technical error
  - incorrect calibration of arterial pressure transducer
  - malposition of arterial pressure transducer.

Hypertension

Hypertension can occur on arrival on the CICU or later on waking. Consideration should be given to the underlying cause of hypertension, rather than merely treating the values. Causes include:

- anaesthetic
  - inadequate sedation/need to extubate
  - ongoing muscle relaxation without anaesthesia
  - pain
- temperature
  - hypothermia
- cardiovascular
  - sympathetic vasoconstriction
  - hypertrophic ventricle, for example secondary to aortic stenosis or hypertension
  - cerebrovascular accident
- pharmacological
  - overdose of vasoconstrictors
- technical error
  - incorrect calibration of arterial pressure transducer
  - malposition of arterial pressure transducer.

A balance is required when selecting a target blood pressure in the immediate postoperative period. This must incorporate the risk of potentially fatal bleeding and the need to maintain adequate organ perfusion, for example a friable aortic suture line might require a maximum systolic pressure of 100 mmHg, but the same patient might be habitually hypertensive and require a pressure closer to 140 mmHg for renal perfusion. A sensible strategy is to keep the pressure low during the first few hours only if it has to be and then to let it rise progressively.

Heart rate, rhythm and pacing

Drugs, cardioplegia and temporary or permanent surgical interruption of conduction pathways mean that sinus bradycardia or heart block requiring pharmacological treatment or pacing is common. A heart rate of 90 is usually optimal because the ventricle is relatively 'stiff' while it recovers from the insult of cross-clamping. Infusions of positively chronotropic drugs such as dopamine, dobutamine, isoprenaline or epinephrine can all be used to increase heart rate during this period, which usually lasts about 24 hours. Temporary pacing wires are placed when there is insufficient response to drugs or when the surgery performed carries a high risk of conduction problems (e.g. aortic, mitral valve replacement).

Consideration should be given intraoperatively to the likely need for pacing in the postoperative period. When used, wires are placed in the epicardium and brought out onto the patient's chest wall with atrial wires on the right and ventricular wires on the left. Pacing can comprise two right atrial wires (AOO or AAI), two right ventricular wires (VVI) or four atrioventricular wires (DDD or DVI) depending on the underlying rhythm. Malfunctioning pacing wires can trigger ventricular tachycardia (VT) or ventricular fibrillation (VF) and should routinely be set in the demand mode to avoid pacing on a T wave. If full recovery of conduction does not occur then a permanent pacemaker will be needed.

Atrial fibrillation (AF) occurs commonly. Fibrillating atria (or ventricles) cannot be paced. Patients with preoperative AF will usual have pacing set to VVI. Ventricluar wires are 'safer' than only atrial wires because atrioventricular conduction blockade or AF will cause atrial pacing to be ineffective. The disadvantage of solely ventricular wires is the loss of the 'atrial kick'. This contributes to ventricular preload and improves stroke volume which can provide 20−30% improvement in cardiac output. Prevention and treatment of atrial fibrillation is covered by current guidance produced by the National Institute for Health and Care Excellence.[4]

Temperature management

Patients frequently arrive on the CICU with core temperatures around 35°C unless both active and passive measures have been taken. Patients at increased risk of hypothermia include those undergoing hypothermic CPB and deep hypothermia with circulatory arrest (DHCA). Active management of hypothermia improves outcome and minimizes adverse effects. Methods such as warmed intravenous fluids or heated humidified ventilation circuits tend only to prevent further hypothermia but do not increase core temperature. Forced-air warming systems reduce the

