Post-operative cardiac arrest

Cardiac arrest occurs in approximately 1-2% of patients following cardiac surgery. The patients are highly monitored and causes are often reversible so survival is far better than for other forms of in-hospital arrest. There are key differences between advanced life support (ALS) and post- operative cardiac resuscitation (POCR) that include the potential need for resternotomy in an attempt to correct any surgical cause for the arrest.

Patients in the ICU are highly monitored and may be ventilated. In the event of suspected cardiac arrest, palpation of a central pulse (carotid/femoral) is mandatory to exclude a monitoring error. In a true cardiac arrest, not only will there be absence of central pulse plus absent pulsatility on the pulse oximetry, arterial and central venous waveforms, there will be absent / low end-tidal carbon dioxide. If cardiac arrest is confirmed then the cardiac arrest protocol should be instigated. This includes summoning senior ICU doctors, nurses, the cardiac surgeons, the arrest trolley and equipment for resternotomy.

If the patient is not intubated, bag/mask ventilation should be instituted prior to attempts at intubation. If the patient is intubated, the position and patency of the endotracheal tube should be confirmed. Positive end expiratory pressure (PEEP) should be removed and the patient ventilated with 100% oxygen at a high flow rate. Switching from the ventilator to manual bagging will have the additional benefit of providing information regarding lung compliance and ventilation delivery. The chest should be auscultated to confirm endotracheal tube position, confirm ventilation and to rule out tension pneumothorax. If external chest compressions are commenced, then end-tidal carbon dioxide should be produced (with a correctly positioned endotracheal tube) and arterial line pulsatility should be observed - ideally systolic BP> 60mmHg and diastolic >25 mmHg.

The patient should be connected as soon as possible to the defibrillator with adhesive defibrillation pads. In contrast to the standard European Resuscitation Council guidelines, before starting external cardiac compressions, certain steps should be followed:

- In the event of ventricular fibrillation (VF)/ pulseless ventricular tachycardia (VT), three stacked attempts at DC cardioversion should take place (ideally within 1 minute) prior to initiation of external chest compressions (ECC) and basic life support (BLS). These are witnessed arrests in a situation where the defibrillator is immediately available and therefore myocardial hypoxia is less likely. Amiodarone 300 mg IV can be given if VF/VT persists but should not delay resternotomy
- If the presenting rhythm is asystole or severe bradycardia, check pacing box output and pacing wire integrity. Attempt epicardial pacing (DDD 90bpm) at maximum amplitude settings.
- Do not delay basic life support for defibrillation or pacing for more than one minute. If these initial interventions are unsuccessful, external cardiac compressions should commence at a rate of 100 per minute, a depth of 5cm, at ratio of 30:2 if not intubated or continuously if intubated and attempt to achieve systolic BP >60 mmHg and diastolic BP>25 mmHg. Failure to achieve this suggests that cardiac tamponade or extreme hypovolaemia are likely and emergency resternotomy should be performed.

If pulseless electrical activity (PEA) is the presenting rhythm, the pacing should be turned off in case it is masking VF.

If an IABP is *in situ*, it should be changed to pressure trigger as the ECG is likely to be highly variable or absent during the arrest. Using the pressure trigger should augment the diastolic pressure in between the 'systolic' pulsations caused by the ECC. It should be set to maximum augmentation at a 1:1 ratio.

Adrenaline should be used very cautiously and titrated to effect using doses of up to 0.1 mg. The rationale for this is the lack of good evidence for improved outcome in general cardiopulmonary resuscitation. Furthermore, there are several case reports of extreme hypertension following the administration of 1mg intravenous adrenaline in cardiac arrest situations in post-operative cardiac patients that led to potentially fatal complications such as bleeding, coronary graft rupture and myocardial ischaemia.

Infusions and syringe drivers should be stopped and checked. Sedative infusions are not required during the cardiac arrest as awareness is extremely unlikely in such a low cardiac output state and may do further harm due to adverse cardiovascular effects. It is possible cardiac arrest may be caused by incorrect administration of medications. Vasodilators should be stopped. Vasopressors or inotropes are unlikely to be of use if adrenaline boluses are being given.

During the arrest, roles should be assigned for the airway and breathing, external cardiac massage, defibrillation, drugs and infusions, team leader, ICU coordinator, cardiothoracic surgeon and scrub nurse.

Re-sternotomy

Re-sternotomy is an integral part of resuscitation after cardiac surgery, once all other reversible causes have been excluded. Once an adequate airway and ventilation have been established, indications are:

- VF/pulseless VT – failure of 3 stacked shocks to restore spontaneous circulation
- Asystole or PEA – when other treatments have failed, but within 5 minutes of cardiac arrest
- Failure to achieve BP >60/25 with external chest compressions

Preparation for re-sternotomy should begin simultaneously with the resuscitation efforts. Re-sternotomy is critical if the initial resuscitative steps are unsuccessful. Sternotomy allows operative access to correct surgical reversible causes such as bleeding and cardiac tamponade. Furthermore, internal cardiac massage is superior to external cardiac massage. In a post-surgery patient, internal cardiac massage is far more desirable than external cardiac massage even if re-sternotomy is unlikely to unveil a reversible cause.

It is vital to call the surgeons and a theatre practitioner, if available, early. It takes time to prepare for sternotomy. The team leader should assign roles:

1. external cardiac massage
2. airway and breathing
3. defibrillation
4. drugs and cardiovascular support
5. ICU coordinator
6. At least one 'runner' to retrieve necessary items

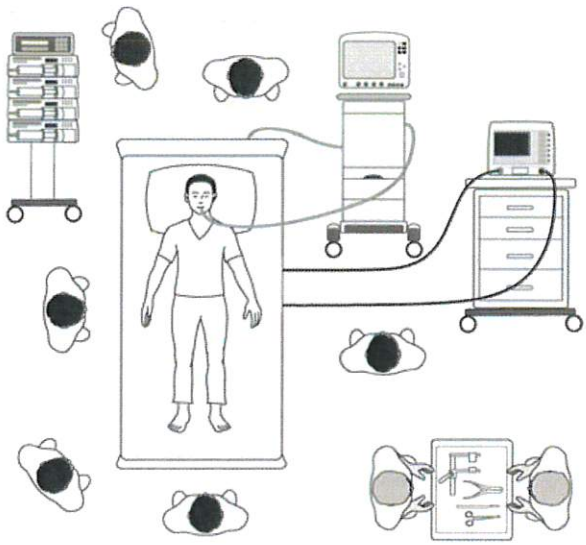

Figure 63. typical arrangement of personnel during a cardiac arrest after cardiac surgery

The unit should have a re-sternotomy trolley and tray with all the necessary equipment to perform re-sternotomy including scalpel, all-in-one drape, a wire cutter, a heavy needle holder and a single piece sternal retractor.

Two or three staff members should put on sterile gown and gloves to prepare the sternotomy set as soon as the cardiac arrest is called. Sterile precautions are limited to gown and gloves to minimise preparation time whilst external cardiac massage continues. Hand washing is not necessary prior to donning sterile gloves.

Once prepared, the person performing external cardiac compression is asked to stand aside. The skin should not be cleansed as it will take minutes to dry and the drape will not stick. The existing sternotomy dressing should be removed and the skin should be relatively clean underneath. An all-in-one drape can then be applied which has a clear adhesive window that will maintain a degree of sterility. A sterile healthcare worker should then recommence chest compressions while further preparing for resternotomy. Once the equipment is ready, cardiac compressions can cease and the re-sternotomy begin.

Summary

- Call the surgeons immediately
- Ensure an adequate airway and ventilation
- Give 3 stacked shocks for VF/VT, pace asystole, turn pacing off in PEA in case it is masking VF
- Do not delay basic life support for defibrillation/pacing for more than 1 minute
- Stop all infusions
- Turn the IABP to pressure trigger, 1:1 and maximum augmentation
- Use adrenaline very cautiously in bolus doses of up to 0.1 mg
- After 3 attempts at defibrillation for VF/VT give 300mg amiodarone and prepare for re-sternotomy
- Re-sternotomy is indicated for ALL presenting rhythms if the initial resuscitation attempts are unsuccessful
- Internal cardiac massage is superior to external cardiac massage