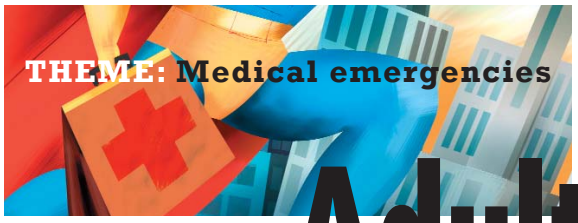

Adult cardiac arrest in general practice

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BACKGROUND Out of hospital cardiac arrest victims contribute significantly to adult mortality figures but are encountered infrequently by most general practitioners and their staff. A number of scientific organisations produce guidelines for the basic and advanced management of cardiac arrest.

OBJECTIVE To review the management principles for basic and advanced adult cardiac life support measures for cardiac arrest.

DISCUSSION General practitioners are required to manage cardiac arrest victims infrequently. The initiation of bystander cardiopulmonary resuscitation and the rapid defibrillation of suitable cardiac rhythms determine a favourable outcome. All staff working at a surgery must be skilled in basic life support. The GP needs an understanding of advanced life support principles.

Sudden cardiac death is a leading cause of death of Australian adults.[1] The most common precipitant of sudden cardiac death is ischaemic heart disease and males are more commonly affected.[2,3] The general practitioner confronts this clinical scenario infrequently but may need to play a leading role in the initial resuscitation. This article will discuss the most common presenting cardiac rhythms in adult cardiac arrest and their treatment algorithms.

Case 1

A 45 year old man presents to your surgery with an hour long history of left sided chest pain. The pain radiates down his left arm and is associated with diaphoresis and dyspnoea. The practice nurse takes the patient directly to the treatment room and applies high flow supplemental oxygen by mask. You attend to the patient within a few minutes of arrival. As the nurse is undertaking a twelve-lead electrocardiogram (ECG) you note the patient suddenly becomes cyanosed and suffers a brief (20 seconds) generalised seizure. The ECG lead II trace is illustrated in Figure 1.

Case 2

A young woman runs into the surgery and yells that someone has collapsed on the footpath outside the pharmacy next door. A doctor is requested to attend the scene. On arrival you find a male in his seventies, cyanosed, unresponsive and with no obvious respiratory effort. He had been observed to suddenly collapse after clutching his chest. There are a number of bystanders looking on.

Case 3

The supervisor of a nursing home has called to ask for you to review an 85 year old female patient. She has marked dementia and significant medical comorbidity. Over the past two weeks she has experienced increased dyspnoea, ankle swelling and has become more breathless. A few minutes before you arrive the patient collapses without a pulse. Cardiopulmonary resuscitation (CPR) is initiated and the local ambulance service called. You arrive at the same time as the ambulance.

Cardiac arrest guidelines

A number of organisations distribute guidelines for the treatment of cardiac arrest. The three primary resources for Australian practitioners are the Australian Resuscitation Council, International Liaison Committee on Resuscitation (ILCOR) and the European Resuscitation Council.[4-7] Each organisation follows similar treatment paths with only subtle differences in the algorithms.

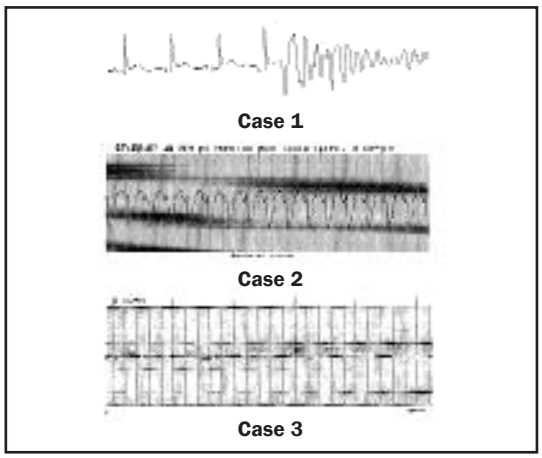

Figure 1. EGCs

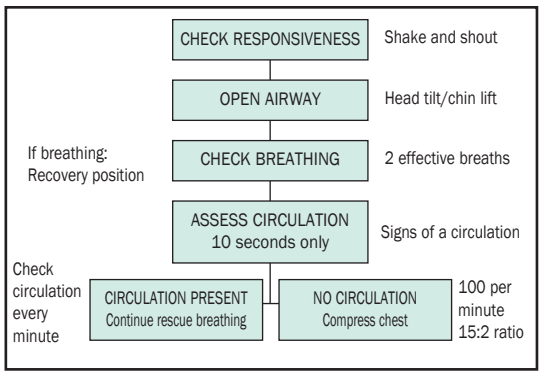

Figure 2. European Resuscitation Council BLS Algorithm[6]

'The chain of survival' concept was developed by Cummins et al in 1991 and adopted by the American Heart Association.[2,14] There are four key factors that are time dependent and when integrated offer the victims of out of hospital cardiac arrest the greatest chance of survival. The four links are:

- early recognition and access to emergency medical services
- early CPR
- early defibrillation, and
- early advanced cardiac life support.[14]

The vast majority of cardiac arrest victims are a result of ischaemic heart disease and the most common presenting rhythm is ventricular fibrillation.[3,9] Defibrillation is the most important intervention in this setting. Basic life support (BLS) measures are also important as they enable an opportunity for correction of other precipitants of cardiac arrest, primarily airway obstruction. Basic life support measures when applied effectively at best provide a significantly reduced cardiac and cerebral perfusion.[10] However, these measures may be associated with the prolongation of the time period for effective cardiac defibrillation.

The European Resuscitation Council (ERC) Basic Life Support algorithm is shown in Figure 2. Initially, safety for the victim and rescuer is assessed. Victim responsiveness is then ascertained. If the patient is not responsive airway patency is quickly examined followed by the pattern of breathing. If breathing is absent or grossly abnormal, the emergency medical services are notified immediately. This may involve sending another bystander for help but if the rescuer is alone they should leave the victim and go for help and then return to initiate further basic life support measures.[6] A defibrillator must be brought to the victim as soon as possible. High flow supplemental oxygen must be delivered as soon as possible.

If the patient has no cardiac output chest compressions are commenced. The rate for adult and paediatric patients is now 100 per minute and the cycle is 15 compressions followed by two breaths. This compression/breath cycle should continue for single and dual operators. If the patient is endotracheally intubated the ratio can be altered but high compression/ventilation ratio is recommended. The basis of this recommendation is that coronary perfusion rises slowly with sequential compressions and this coronary perfusion pressure can dissipate quickly with the break for ventilation.[6] The lower half of the sternum should be compressed to a depth of 4-5 cm.[11] The fracture of ribs may occur during the performance of CPR.

Once basic life support is initiated the treatment follows the advanced life support algorithm. Given the importance of defibrillation in adult cardiac arrest the concept of defibrillation before instigation of basic life support has been proposed.[11]

Advanced life support interventions for victims of cardiac arrest depend on the presenting cardiac rhythm. Those cardiac rhythms which require defibrillation - ventricular fibrillation and pulseless ventricular tachycardia - and those that do not - asystole and pulseless electrical activity are shown in (Figure 3).

The priority is to defibrillate ventricular fibrillation or pulseless ventricular tachycardia if present. The airway should be managed as appropriate for the level of skill of the treating physician. There is no prospective randomised evidence to suggest endotracheal intubation is associated with improved survival to discharge.[5,20] Therefore, insertion of an endotracheal tube is not mandatory but offers the

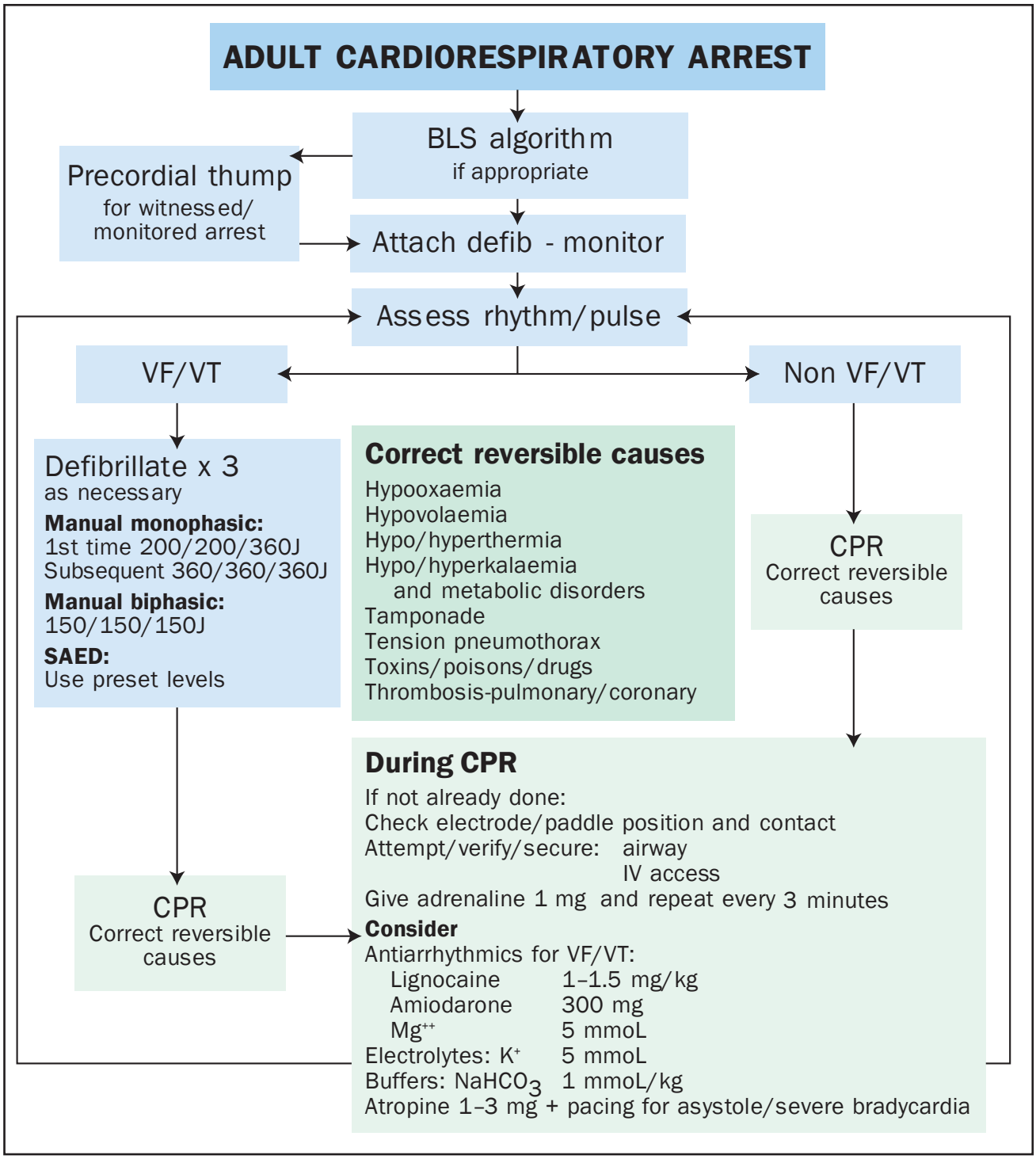

Figure 3. Australian Resuscitation Council ALS Guidelines[4]

advantage of allowing drug delivery before obtaining venous access. With an endotracheal tube in situ the physician may allow another person to hand ventilate the patient while he or she undertakes other resuscitation interventions. An alternative is the laryngeal mask airway but it cannot be used for drug administration. Bag/mask ventilation with simple airway adjuncts is a safe alternative for those operators not skilled in the insertion of an endotracheal tube or laryngeal mask airway.

Although the administration of some medications results in increased survival to hospital, no

drug has been shown in a randomised prospective trial to improve survival to discharge.[5,21] Intravenous cannulation is not a mandatory procedure for the GP but is desirable.

Ventricular fibrillation/pulseless ventricular tachycardia

Once ventricular fibrillation (VF) or ventricular tachycardia (VT) has been identified the goal is to deliver the defibrillating shock as expeditiously as is possible. These rhythms have much higher survival to discharge rates than asystole. Rates approaching 35% have been reported.[10] The ERC recommends up to three consecutive shocks dependent on the success of the preceeding attempt.[7] The initial energy level for the first three shocks is 200 J, 200 J and 360 J respectively for traditional cardiac defibrillators. Subsequent shocks are delivered at 360 J. The energy level delivered is dependent on the type of defibrillator that is utilised. New generation biphasic waveform cardiac defibrillators use lower energy levels.[12] Energy level for these units is 150 J (Figure 3).[4] Traditional (monophasic) defibrillators deliver the energy in a damped sinusoidal or truncated exponential waveform. Biphasic defibrillators as the name suggests deliver their waveform in two directions, with the second phase reversing the direction. The advantages of the biphasic defibrillator are reduced energy requirements allowing smaller, less expensive defibrillators and the potential for reduced cardiac damage from the delivered energy.[22] This potentially translates to a decreased postshock cardiac dysfunction.[12] Biphasic defibrillators have been shown to provide at least equivalent efficacy for defibrillation.[22]

Cardiopulmonary resuscitation continues and the cardiac rhythm is reassessed at one minute intervals. After the initial three shocks adrenaline may be considered. A dose of 1 mg in adults is recommended by the ERC.[7] Adrenaline's proposed positive effect is to maintain coronary artery perfusion by alpha-receptor stimulation rather than as a direct cardiac stimulant. Improved coronary perfusion is thought to be more conducive to effective ventricular defibrillation.[13] Adrenaline alone has not been demonstrated to be associated with improved outcome. The adrenaline may be given endotracheally if intravenous access has not been obtained. The dose in this setting is 2-3 times that of a normal setting.

Anti-arrhythmic agents may be considered should the VF/VT be refractory to the above measures. Lignocaine is available via the PBS doctor's bag prescription and may be given as a bolus dose of 1.0-1.5 mg per kg. Lignocaine has not been demonstrated to improve survival to discharge in the setting of out of hospital cardiac arrest. Amiodarone has been substituted for lignocaine in the ILCOR guidelines.[5] Amiodarone when compared to lignocaine has been demonstrated to show improved survival to hospital rates. Improved hospital discharge survival rates are not statistically significant.[21] Amiodarone needs to be reconstituted with dextrose, ideally in a glass syringe as it adheres to plastic. It is not available in the doctor's bag prescription at present. If preloaded syringes become available at a reasonable cost and improved survival to discharge from hospital rates are proven it may become a viable option.

Despite the vast majority of cardiac arrests occurring as a complication of ischaemic heart disease other causes of arrhythmia should be sought. Examples include magnesium for patients suspected of hypomagnesaemia or sodium bicarbonate for tricyclic antidepressant overdose.

Asystole/pulseless electrical activity

The success rate for resuscitation of patients who present in asystole secondary to a primary cardiac event approaches zero.[3,15] This also includes patients that revert to asystole. In general, profoundly bradycardic pulseless electrical activity rhythms have a similar outcome. Tachycardia or bradycardic pulseless electrical activity should prompt the treating health care provider to quickly assess for the potentially reversible causes (Figure 3). Interventions directed at these reversible causes should be undertaken in parallel with the cardiac arrest algorithms.

Adrenaline at a dose of 1 mg is administered every three minutes of continuous CPR. The patient must be reassessed for vital signs and rhythm change at this time.[7]

Ceasing resuscitation

Terminating resuscitation poses a difficult problem. Most ambulance services in Australia have guidelines for the cessation of resuscitation attempts in out of hospital cardiac arrests. The Queensland Ambulance Service clinical guidelines

Table 1. Queensland Ambulance Service CPR discontinuation criteria (Clinical Practice Manual 2002)

Rapid discontinuation criteria:

- Complete absence of any signs of life (including no respiratory effort), AND
- Flatline asystole on ECG (in at least 2 leads), AND
- A history of at least 10 minutes pulseless and unresponsive with no CPR

In doubt continue CPR

General discontinuation criteria:

Cardiopulmonary resuscitation may be discontinued in cases where there is an inability to restore any signs of life following at least 15 minutes of CPR:

Absent pulses, heart sounds, respiratory effort, AND

Asystole in at least 2 leads of ECG, or a broad complex bradycardia with a rate <10/min

For intensive care paramedics only, a patient in pulseless electrical activity, after 15 minutes of resuscitation and consideration of and treating of any reversible cause

In a patient with severe trauma, after ruling out or treating any reversible conditions such as gross hypovolaemia, tension pneumothorax, etc.

for discontinuation criteria are listed in Table 1.

The decision to transport the patient is often dictated by response to treatment or the circumstances of the cardiac arrest. Victims in public places as opposed to private dwellings are more likely to be transported to hospital regardless of treatment outcome.

Obvious changes indicating irreversible death such as rigor mortis or signs of postmortem lividity dictate immediate cessation of any resuscitation attempts. Patients who present with asystole as the primary rhythm have a uniformly dismal outcome and unless there is a response to advanced life support or extenuating circumstances, (eg. cold water immersion, hypothermia or drug overdose), the author would recommend early termination of resuscitation attempts.

Refractory ventricular arrhythmias without return of spontaneous circulation pose a more difficult scenario to the treating physician. Unless there is return of circulation within 30 minutes of the cardiac arrest it has been the author's experience that the outcome is dismal. This is also supported by ILCOR.[23] Causes other than ischaemic heart disease must be sought and are listed in the advanced life support algorithm (Figure 3). If these conditions exist, prolonged resuscitation beyond 30 minutes may be required while the primary cause is treated. Profound hypothermia may dictate a protracted resuscitation attempt.

Discussion

In Case 1 the patient suffered a cardiac arrest with the initial rhythm being ventricular fibrillation. The patient may initially manifest a brief seizure activity due to initial reduced cerebral perfusion. The physician attempted a precordial thump that was unsuccessful. The precordial thump will generate a small number of joules and this may be enough to cardiovert ventricular tachycardia if that is the rhythm. It is unlikely to be successful more than 30 seconds after cardiac arrest.[7] The receptionist was directed to call the ambulance service. The practice was not equipped with a defibrillator. The doctor and practice nurse commenced BLS measures. The ambulance paramedics arrived within eight minutes and the patient was defibrillated. The patient reverted to sinus rhythm and regained consciousness and was transported uneventfully to hospital. This case emphasises the importance of prompt activation of the emergency medical services and the rapid transport of defibrillator to the scene.

In Case 2 the physician attended the patient. A security guard from the large shopping complex had been trained in the use of an automated external defibrillator (AED). He applied the device and it recommended a shock that was subsequently delivered. The patient remained unresponsive and CPR was commenced. A second shock was recommended and delivered. The patient remained unresponsive and an ambulance paramedic arrived. The rhythm on her monitor was ventricular tachycardia. The doctor cannulated the patient and administered adrenaline. The patient was shocked a third time and then reverted to asystole. The patient was declared deceased on arrival at hospital.

Automated external defibrillators have revolutionised the ability of lay personnel to provide rapid access to defibrillation.[10] These units are small and easy to use. They provide voice prompts after the application of adhesive pads. If a suitable rhythm is detected a defibrillation shock is advised. The whole process usually involves three steps. These units have been placed at many patrolled beaches and shopping centres. To gain the maximum benefit the units must be positioned in areas where significant numbers of high risk patients may be present.[16-18]

In Case 3 the initial rhythm was asystole. Given

the patient's age, significant medical comorbidity and negligible chances of survival the treating physician decided to cease any resuscitation attempts. This decision was discussed with and agreed to by all the attending medical team.

Survival to discharge from hospital figures varies depending on the community and emergency medical system response. Rates from 1.4-23% have been reported.[3] Survival rates to hospital arrival are higher and a figure of 19.1% was reported for Geelong (Australia) during the period 1996-1999.[19] The GP must anticipate a successful result. The airway must be maintained postcardiac arrest and high flow supplemental oxygen continued. Circulatory support may be required but simple posturing of the legs in an elevated position may be all that is necessary. Heart rate and rhythm monitoring must be continued as the recurrence of an arrhythmia may occur. Sedation of an agitated posthypoxia patient may be required but only after adequate oxygenation is ensured. The patient should be transported by ambulance to hospital expeditiously.

Conclusion

Cardiac arrest is an infrequent medical emergency confronting the GP. The survival rates to hospital discharge vary depending on geographical region, emergency medical system, bystander CPR and presenting cardiac rhythm but remain low overall.[3]

General practitioners must be aware of the concept of the 'chain of survival' and its implications. They must be confident to follow a simple treatment algorithm. Staff within the practice will need to take part in any resuscitation and need to be competent in BLS procedures. The Australian Resuscitation Council provides comprehensive treatment guidelines.

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