MOH/P/PAK/229.12 (HB)

Advanced Life Support

training manual

This guideline was developed by:
The ALS Subcommittee,
National Committee on Resuscitation Training
Ministry of Health Malaysia

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Foreword

by

Director General of Health Malaysia

Dato' Sri Dr Hasan Abdul Rahman
Director General
of Health Malaysia

The 1st Basic Cardiac Life Support and Advanced Cardiac Life Support Course were held in Kuala Lumpur General Hospital in 1986. It was jointly organised by the Ministry of Health, Malaysian Society of Anaesthesiologists and National Heart Association in collaboration with the American Heart Association.

Since then, a number of changes have been made to both courses to cater to local needs. The Basic Cardiac Life Support Course was renamed Basic Life Support Course and shortened to one day. Similarly the Advanced Cardiac Life Support Course was renamed Advanced Life Support Course and reduced to two days.

However, material for the Advanced Cardiac Life Support Course was taken totally from the American Heart Association. With the formation of the Advanced Life Support Subcommittee under the umbrella of National Committee on Resuscitation Training, the Advanced Life Support Training Manual was compiled. I congratulate the Subcommittee for producing the training manual.

I hope the participants of the Advanced Cardiac Support Course will find the manual useful and comprehensive.

Thank you.

Chapter 1-10

chapter 1

Course Overview

The Advanced Life Support Course aims to train doctors and healthcare providers working in critical care areas in the resuscitation of patients beyond the ABC of resuscitation.

The course emphasizes on enhancing your skills in the treatment of arrest patients through active participation in a series of simulated cardiopulmonary cases. These simulations are designed to reinforce important concepts, including

- The Basic Life Support (BLS) Primary Survey
- The Advanced Life Support (ALS) Secondary Survey
- The ALS algorithms
- Effective resuscitation team dynamics

Course Objectives

Upon completion of this course, you should be able to

- Manage cardiac arrest until return of spontaneous circulation (ROSC), termination of resuscitation, or transfer of care
- Demonstrate effective communication as a member or leader of a resuscitation team and recognize the impact of team dynamics on overall team performance

Course Description

The course concentrates on skills both individually and as part of a team. Lectures are short and few. Therefore you are expected to have read the ALS provider training manual before the course. In addition, strong BLS skills are the foundation of ALS. You must have passed the 1-rescuer BLS/ Automated External Defibrillator (AED) course before enrolment into the ALS course. The course programme is as follows:

Day 1

0730 - 0800h	Registration
0800 - 0810h	Course overview
0810 - 0840h	Lecture - Airway Management
0840 - 0910h	Lecture - Algorithm
0910 - 0940h	Lecture - Drugs
0945 - 1000h	Tea Break
1000 - 1215h	Skill stations: Airway, Defibrillation and ECG recognition + drugs with each station lasting 45 minutes
1215 - 1300h	'Put it all together'
1300 - 1400h	Lunch
1400 - 1700h	Megacode practice

Day 2

0815 - 0830h	Lecture - Ethics in resuscitation
0830 - 0930h	Theory test
0930 - 1300h	Megacode practice
1400 - 1700h	Test on Airway and Megacode

chapter 2

The Systematic Approach:

The BLS Primary Survey and
The ALS Secondary Survey

The BLS Primary Survey

The BLS goal is to support or restore effective oxygenation, ventilation, and circulation until ROSC or until ALS interventions can be initiated. Performance of the actions in the BLS Primary Survey substantially improves a patient's chance of survival and a good (or better) neurologic outcome.

Before conducting the BLS Primary Survey, you should assess ***D***anger, check patient ***R***esponsiveness, ***S***hout for help (activate emergency medical system and get an AED).

The BLS Primary Survey is an ***ABCD*** approach using a series of sequential assessments. Each assessment is followed by appropriate action(s) if needed. As you assess each step (the patient's airway, breathing, circulation, and determine if defibrillation is needed), you stop and perform an action, if necessary, before proceeding to the next assessment step. Assessment is a key component in this approach. For example:

- Check for responsiveness before shouting for help and open the airway
- Check breathing before starting chest compressions
- Attach an AED, then analyze for a shockable rhythm before delivering a shock

> ***Remember:***
> assess...then perform appropriate action.

Table 1 below shows an overview of BLS Primary Survey. DRS is included before ABCD for completeness.

Assess	Action
Danger - Are there blood spills, sharps, electric wires? - Is the scene dangerous?	Wear PPE (gloves, apron, mask) if available Make sure you, the victim and bystanders are safe
Responsiveness - Is the patient responsive?	Tap shoulders and Say 'Hello! Hello! Are you OK?'
Shout for help	'Emergency! Emergency! Call ambulance 999 or bring emergency trolley & defibrillator if available

Assess	Action
Airway - Is the airway open?	Open the airway using non invasive techniques (head tilt-chin lift; jaw thrust without head extension if trauma is suspected)
Breathing - Is the patient breathing and are respirations adequate?	Look for normal breathing in not more than 10s (almost simultaneously when performing head tilt chin lift)
Circulation - Is the patient breathing and are respirations adequate?	Perform high-quality CPR if not breathing or abnormal breathing (gasps) is seen until an AED arrives
Defibrillation - Is there a shockable rhythm? Check with a manual defibrillation or use an AED	Provide shocks as indicated Follow each shock immediately with CPR, beginning with chest compressions

NB. Make every effort to minimize interruptions in chest compressions. Limit interruptions in chest compressions to no longer than 10s

Avoid:

- Prolonged rhythm analysis
- Taking too long to give breaths to the patient
- Frequent or inappropriate pulse checks
- Unnecessarily moving the patient

The ALS Secondary Survey

The ALS Secondary Survey is conducted after the BLS Primary Survey when more advanced management techniques are needed.

Advanced airway interventions may include the laryngeal mask airway (LMA), or endotracheal tube (ETT).

Advanced circulatory interventions may include drugs to control heart rhythm and support blood pressure.

An important component of this survey is the differential diagnosis, where identification and treatment of the underlying causes may be critical to patient outcome.

In the ALS Secondary Survey, you continue to assess and perform an action as appropriate until transfer to the next level of care. Many times assessments and actions in ALS will be performed ***simultaneously*** by team members.

Table 2: The ALS Secondary Survey

Assess	Action
Airway - Is the airway patent? - Is an advanced airway indicated?	- Maintain airway patency in unconscious patients by use of head tilt-chin lift, orophyaryngeal airway (OPA) or nasopharyngeal airway (NPA) - Use advanced airways if needed (e.g. LMA or ETT)
Breathing - Are oxygenation and ventilation adequate? - Is an advanced airway indicated? - Is proper placement of airway device confirmed? - Is tube secure and placement reconfirmed requently? - Are exhaled CO_2 and oxyhemoglobin saturation monitored?	- Give supplementary oxygen - Assess the adequacy of oxygenation and ventilation by • Clinical criteria (colour, chest rise, auscultation) • Oxygen saturation • Capnometry or capnography The benefit of advanced airway placement is weighed against the adverse effects of interrupting chest compressions. If bag-mask ventilation is adequate, insertion of an advanced airway may be deferred until the patient fails to respond to initial CPR and defibrillation or until ROSC. If advanced airway devices are used: - Confirm proper integration of CPR and ventilation - Confirm proper placement of advanced airway devices by • Clinical criteria (colour, chest rise, auscultation) • Capnometry or capnography - Secure the device to prevent dislodgment - Continue exhaled CO_2 measurement
Circulation - What was the initial cardiac rhythm? - What is the current cardiac rhythm? - Have you established access for drug and fluid? Does the patient need volume (fluid) for resuscitation? - Are medications needed for rhythm or blood pressure?	- Obtain IV / IO access - Attach ECG leads and monitor for arrhythmias or cardiac arrest rhythms (eg VF, pulseless VT, asystole, and PEA) - Give appropriate drugs to manage rhythm (e.g. amiodarone, lidocaine, atropine, magnesium) and blood pressure (e.g. adrenaline, vasopressin, and dopamine) - Give IV / IO fluids if needed
Differential Diagnosis - Why did this patient develop cardiac arrest? - Why is the patient still in arrest? - Can we identify a reversible cause of this arrest?	• Search for, find and treat reversible causes (i.e. definitive care). Look for 5H and 5T causes. • 5H: Hypoxia, Hydrogen ion, Hypothermia, Hypovolemia, Hypo/hyperkalemia. • 5T: Tamponade (cardiac), Tension pneumothorax, Thrombosis (pulmonary or coronary), Toxins

chapter 3

Team Dynamics

Roles

Team Leader

Organizes the group, monitors individual performance of team members, backs up team members, models excellent team behavior, trains and coaches, facilitates understanding and focuses on comprehensive patient care.

Team Member

Must be proficient to perform skills within their scope of practice. They are clear about their role assignment, prepared to fulfill the role responsibilities, well practiced in resuscitation skills, knowledgeable about the algorithms and committed to success.

Team Dynamics and Communication

Closed Loop Communication

When communicating with team members, the leader should use closed loop communication. The leader gives an order or assignment and then confirms that the message was heard. The team member confirms that the order or assignment was heard and informs the leader when the task is complete.

Clear Messages

All messages and orders should be delivered in a calm and direct manner without yelling or shouting. The team leader should speak clearly while the team members should question an order if they are unsure what was said.

Clear Roles and Responsibilities

Every member of the team should know his/her role and responsibilities. To avoid inefficiencies, the team leader should clearly delegate tasks. A team member should not accept assignments above his/her level of expertise.

Knowing One's Limitations

Every member of the team should know his/her imitations and capabilities and the team leader should be aware of them. A new skill should not be attempted during the arrest, instead call for expert help at an early stage.

Knowledge Sharing

A critical component of effective team performance is information sharing. The team leader can ask for suggestions when the resuscitation efforts seem to be ineffective.

Constructive Intervention

During a code, a team leader or member may need to intervene if an action is about to occur at an inappropriate time. The person recording the event may suggest that adrenaline be given as the next drug because it has been 5 minutes since the last dose. All suggestions for a different intervention or action should be done tactfully.

Reevaluation and Summarizing

An essential role of the team leader is monitoring and reevaluation of the status of the patient, interventions that have been done and assessment findings.

Mutual Respect

The best teams are composed of members who share a mutual respect for each other and work together in a collegial, supportive manner. All team members should leave their egos at the door.

chapter 4 Airway Management

Overview of Airway Management

The support of ventilation and oxygenation during CPR and the peri-arrest period are still important. The purpose of ventilation during CPR is to maintain adequate oxygenation and sufficient elimination of carbon dioxide. Airway obstruction by the tongue or any other foreign body must be excluded before the purpose of ventilation can be achieved.

It is also important to note that both systemic and pulmonary circulation are reduced markedly during cardiac arrest so that the normal ventilation perfusion relationships can be maintained with minute ventilation which is much lower than normal. Empirical use of 100% oxygen during resuscitation from cardiac arrest is reasonable.

Oxygen Delivering Devices

Oxygen administration is always appropriate for patient in acute distress. Various devices are used to deliver supplementary oxygen.

Table 3: Delivery of Supplementary Oxygen

Device	Flow Rates	Delivered Oxygen (%) -approximate
Nasal cannula	1L/minute 2L/minute 3L/minute 4L/minute 5L/minute 6L/minute	24 28 32 36 40 44
Simple face mask	6-10L/minute	35-60
Venturi mask (Device specific)	4-12L/minute	24-60
Mask with O_2 Reservoir • Rebreathing • Non-rebreathing	 10-15L/minute 10-15L/minute	 70-80 95-100

Nasal Cannula

- Consists of 2 prongs
- Every 1L/minute increase in O_2 flow rate → increase in FiO_2 by 4%
- Usually 1-6L/minute O_2 given
- Do not use more than 6L/minute O_2 as this does not increase oxygenation much, yet dries up nasal passages and is uncomfortable to patient
- O_2 concentration depends on:
  - O_2 supply flow rate
  - Pattern of ventilation
  - Patient inspiratory flow rate

Simple Face Mask

- Made from silicone rubber or transparent plastic
- Various size, from paediatric to big adult
- Adds 100 to 200 ml to the capacity of the O_2 reservoir
- Fits loosely on the face, which allows room air to be inhaled, if needed
- O_2 concentration depends on:
  - O_2 supply flow rate
  - Pattern of ventilation
  - Patient inspiratory flow rate
  - Tight fit of the mask
- Supplies 35% to 60% oxygen with flow rates of 6 to 10L/minute
- Does not supply oxygen > 60%

Venturi Mask

- Based on Bernoullie principle
  - O_2 is passed through a narrowed orifice and this creates a high-velocity stream of gas. This high-velocity jet stream generates a shearing force known as viscous drag that pulls room air into the mask through the entrainment ports on the mask.
- Gives desired concentration of oxygen to patient (24% to 60%)
- Good for patient with chronic obstructive airway disease

Mask with O_2 Reservoir

- The addition of a reservoir bag to a standard face mask increases the capacity of the O_2 reservoir by 600 to 1000 ml. If the reservoir bag is kept inflated, the patient will inhale only the gas contained in the bag.
- There are two types of mask-reservoir bag devices:

Rebreathing system	Non-rebreathing system
• No valve and so gas exhaled in the initial phase of expiration returns to the reservoir bag	• Presence of a one-way valve that prevents any exhaled gas from returning to the reservoir bag
• Provides up to 70% to 80% O_2 with flow rates of 10 - 15L/minute.	• Provides up to 95% to 100% O_2 with flow rates of 10 - 15L/minute.

Non-invasive Airway Devices

Oropharyngeal Airway

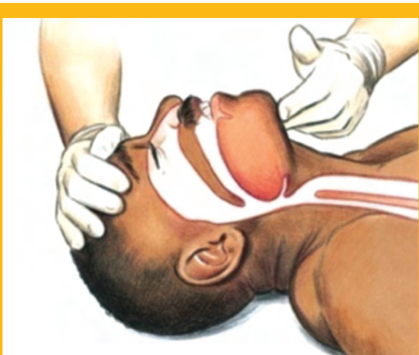
- A semicircular tube to hold the tongue away from the posterior wall of the pharynx
- Used in comatose patient or patient with loss of airway reflex
- May cause laryngospasm in semicomatose patient
- Various sizes (3,4,5)
  - The appropriate size is measured from angle of mouth to angle of jaw

Nasopharyngeal Airway

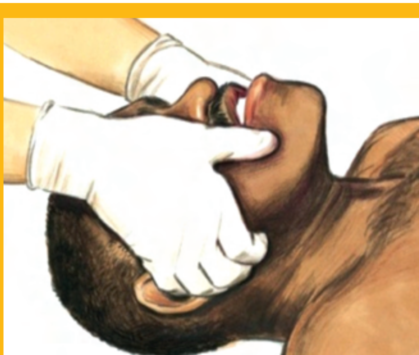
- An uncuffed tube made of soft rubber or plastic
- Used in patient where mouth opening is difficult
- More tolerable by semi-comatose patient
- Used with caution in patient with base of skull fracture or with ENT bleeding
- May cause airway bleeding in up to 30% patients
- Various sizes (size indicates internal diameter)
  - The appropriate size is measured from tip of the nose to tragus of the ear

Manual Assist Ventilation

In an unconscious or semiconscious victim, the healthcare provider should open the victim's airway by head tilt-chin lift or jaw thrust (if suspected cervical injury). Oropharyngeal or nasopharyngeal airways may be used to prevent the tongue from occluding the airway.



Head tilt–chin lift

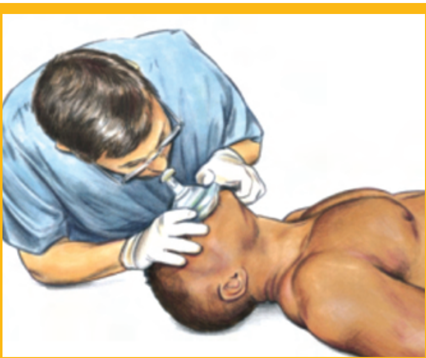


Jaw thrust

Mouth to Mask Ventilation

- The mask is a pocket mask usually with one way valve
- Advantages:
  - Eliminates direct contact
  - Easier to perform than bag-mask ventilation
  - Oxygenates well if O_2 attached
  - Best for small-handed rescuers

- Two ways of carrying out mouth to mask ventilation depending on whether there are 1 or 2 rescuers



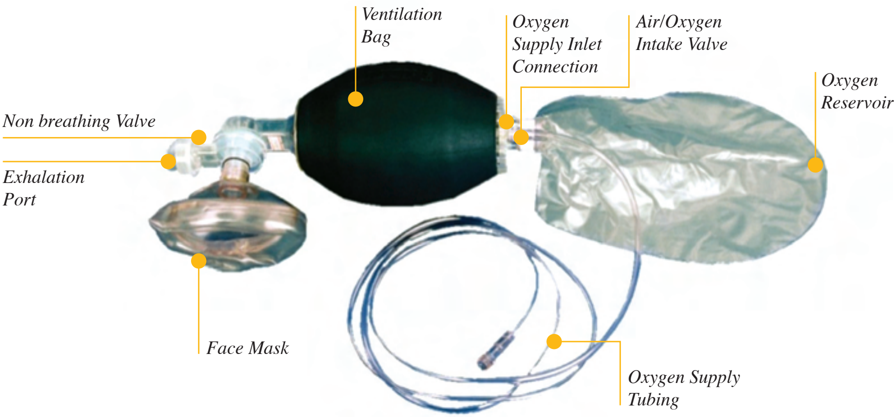
1- Rescuer Technique

- Performed from sides
- Rescuer slides over for chest compressions
- Fingers-head tilt-chin lift

2- Rescuer Technique

- The rescuer chest compression
- The ventilator stands at head end

Bag-mask Ventilation



- The bag-mask device consists of a self-inflating bag and a non-rebreathing valve
    - Can be used with a face mask or an advanced airway eg Laryngeal mask airway (LMA) or endotracheal tube (ETT)
    - Provides positive pressure ventilation
    - Cannot be used to allow spontaneous breathing
- The provider should use an adult (1 to 2 L) bag and deliver just enough volume to produce an obvious chest rise
- Bag-mask ventilation can produce gastric inflation with complications, including regurgitation and aspiration
- Two ways of holding the bag-mask device on the face for adequate ventilation:

One Hand (E-C Clamp Technique)

Two Hand Technique

Advanced Airways

Bag-mask ventilation is not suitable for prolonged periods of ventilation as it also inflates the stomach. Therefore, ALS providers should be trained in the use of an advanced airway (supraglottic airways or ETT).

However, the provider should weigh the need for minimally interrupted chest compressions against the need for insertion of a supraglottic airway or an ETT.

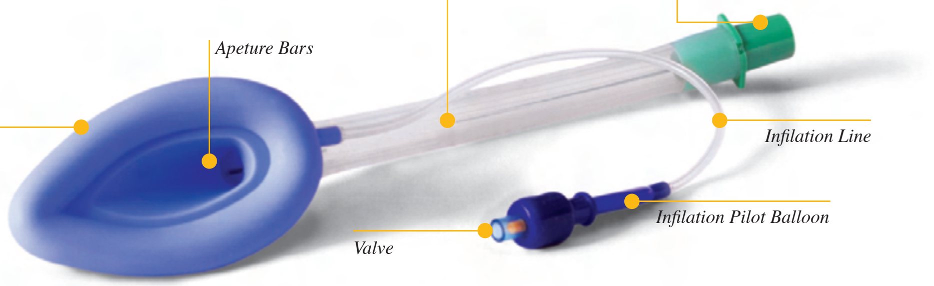
Supraglottic Airways

Supraglottic airways are devices designed to maintain an open airway and facilitate ventilation. Insertion of a supraglottic airway does not require visualization of vocal cord and so it is possible to insert without interrupting chest compression during resuscitation.

A number of supraglottic airways are available:
Laryngeal mask airway (LMA), combitube and laryngeal tube. The LMA provides a more secure and reliable means of ventilation and is widely used in clinical practice.

Laryngeal Mask Airway

- An advanced airway device that is considered an acceptable alternative to the ETT
- Invented by Dr. Archie Brain, a British anaesthetist at London Hospital, Whitechapel in 1981
  - The invention causes a paradigm shift in airway management
- Used in over 100 countries worldwide
- Over 150 million users to date over 15 years
- When compared with the ETT, the LMA provides equivalent ventilation; successful ventilation during CPR has been reported in 72% to 97% of patients
- Technically easier to insert and should allow minimal interruption to chest compression during resuscitation
- Ventilating patient via LMA may still cause gastric aspiration
- Composed of a tube with a cuffed mask-like projection at the end of the tube and connected to a pilot balloon



Versions of LMA

Many different versions of LMA since its invention:

- LMA Classic - original reusable design
- LMA Unique - disposable version for use in emergency and prehospital setting
- LMA Fastrach (Intubating LMA) - as a conduit for intubation
- LMA Flexible - soft tubing and not for use in emergency setting
- LMA Proseal - additional channel for suctioning of gastric contents
- LMA Supreme - similar to Proseal but with built-in bite block
- LMA Ctrach - built-in fiber-optics with a video screen

Recommended Size Guidelines for LMA

The following table shows the Recommended Size Guidelines and the Amount of Air needed to inflate the LMA cuff:

Size of LMA	Weight of patient	Max Air in Cuff Not to Exceed
Size 1	< 5 kg	4 ml
Size 1.5	5 to 10 kg	7 ml
Size 2	10 to 20 kg	10 ml
Size 2.5	20 to 30 kg	14 ml
Size 3	30 to 50 kg or small adult	20 ml
Size 4	50 to 70 kg (adult)	30 ml
Size 5	> 70 kg (large adult)	40 ml

Insertion of LMA

Before any attempt to insert an LMA, the following equipment has to be prepared:

- Personal protective equipment - mask, eye shield/goggle, gloves
- Appropriate size LMA
- Syringe with appropriate volume (10, 20 or 50 ml) for LMA cuff inflation
- Water soluble lubricant
- Ventilation equipment
- Tape or other device(s) to secure LMA
- Stethoscope

The following are the steps necessary for successful insertion of LMA:

Step 1: Size selection - as per Recommended Size Guidelines

Step 2: Examination of LMA

- Inspect surface of LMA for damage, including cuts, tears, or scratches
  - Do not use the LMA if the airway tube is damaged in any way

- Inspect interior of LMA airway tube to ensure that it is free from blockage or loose particles
  - Any particles present in the airway tube should be removed as patient may inhale them after insertion

- Inflate cuff to ensure that it does not leak
- Deflate cuff to ensure that it maintains a vacuum

Step 3: Check inflation and deflation of cuff

- Inflate cuff with the recommended volume of air
- Slowly deflate cuff to form a smooth flat wedge shape which will pass easily around the back of the tongue and behind the epiglottis

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Step 4: Lubrication of LMA Cuff/Mask

- Use a water soluble lubricant to lubricate
- Only lubricate LMA cuff/mask just prior to insertion
- Only lubricate back of LMA cuff/mask thoroughly
- Avoid excessive lubricants on anterior surface or in the bowl of cuff/mask as inhalation of the lubricant following placement may result in coughing or obstruction

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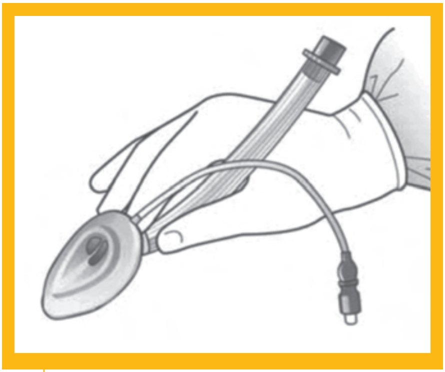
Step 5: Position head for insertion

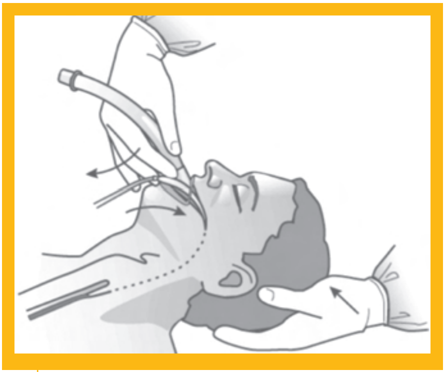
- LMA can be inserted even if the head is in the neutral position as long as the mouth opening is adequate
- Avoid LMA fold over:
  - Assistant pulls the lower jaw downwards
  - Visualize the posterior oral cavity
  - Ensure that LMA is not folding over in the cavity as it is inserted

Below are a series of diagrams showing the insertion of LMA:

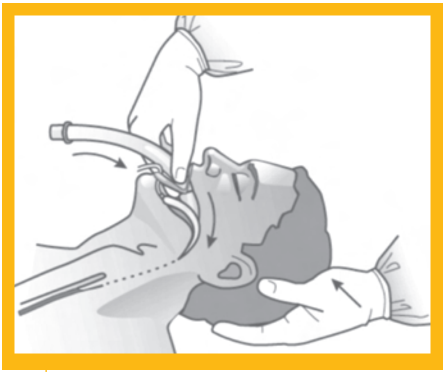


1 Method for holding the LMA for **standard** insertion technique

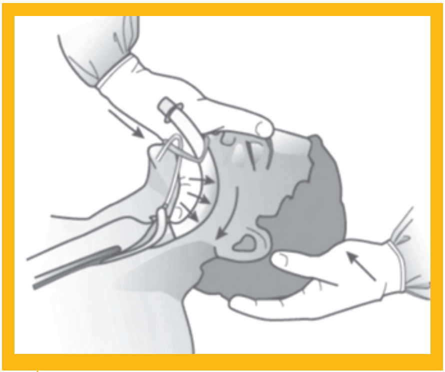
2 With the head tilt and the neck flexed, insert the cuff of LMA into the oral cavity; direction of force goes against the hard palate



3 To facilitate introduction of LMA into the oral cavity, gently press the middle finger down onto the jaw

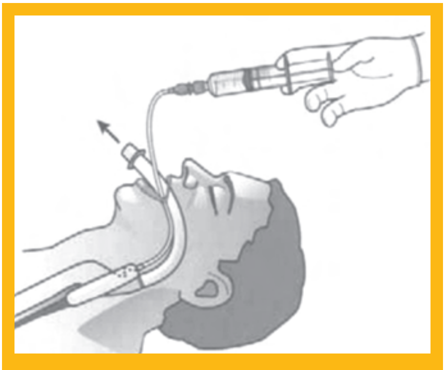


4 The index finger pushes LMA in a cranial direction following the contours of the hard and soft palates



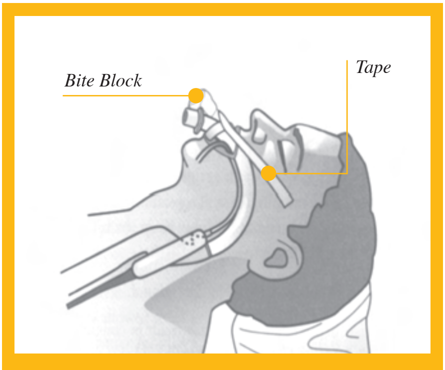
5 Maintaining pressure with finger on LMA in the cranial direction, advance LMA until definite resistance is felt at the base of the hypopharynx: note flexion of the wrist

6 Gently maintain cranial pressure with non-dominant hand while removing index finger



8 To allow LMA to seat optimally, inflate without holding LMA

Inflate cuff with just enough air to obtain a seal - this should correspond to intracuff pressures around 60 cm H_2O; do not over-inflate



9 Tape the bite-block and LMA airway tube downwards against the chin

Finally connect to bag-mask or ventilator and look for chest rise
Confirm equal breath sounds over both lung fields & absence of ventilatory sounds over epigastrium

Final words on LMA

- Test cuff before use
- Don't lubricate anterior side of LMA mask
- Insert only in comatose patient
- Keep cuff inflated until patient awake

Endotracheal Tube (ETT)

The ETT is usually regarded as the "Gold Standard" of airway control while endotracheal intubation is a highly skilful procedure that requires adequate training and ongoing maintenance of skill.

The ETT was once considered the optimal method of managing airway during cardiac arrest. It keeps the airway patent, permits suctioning of airway secretions, enables delivery of a high concentration of oxygen, provides an alternative route for the administration of some drugs, facilitates delivery of a selected tidal volume, and with the use of a cuff, may protect the airway from aspiration.

However, it is now clear that the incidence of complications is **unacceptably high** when intubation is performed by inexperienced providers. Interruption of chest compression significantly reduces chance of ROSC. ALS provider therefore must weigh the risks and benefits of endotracheal intubation during resuscitation against prolonged interruption of chest compression. If endotracheal intubation is deem essential, it should be done by the most experienced personnel and chest compression should not be interrupted for more than 10-20s. Alternatively, if ventilation is adequate with bag-mask or supraglottic devices, endotracheal intubation for cardiac arrest may be delayed until ROSC.

Equipment for Endotracheal Intubation:

The equipment necessary for endotracheal intubation may be remembered as mnemonics **MALES**:

M - Mask (Bag-mask), Magill forceps
A - Airways (Oropharyngeal/Nasopharyngeal Airway)
L - Laryngoscope, LMA, Lubricant gel
E - Endotracheal tubes + Stylet + tape for securing ETT
S - Suction (Catheter/Yaunker), Syringe, Stylet

Laryngoscope

- Consists of handle (which contains a battery power source) and blade
- 2 types of blades: Macintosh blade (curved) for adults Miller blade (straight) for newborn and infants
- Make sure that the light on the blade works and is bright when lit up

Endotracheal Tube

"Typical" modern ETT has the following features:

- Marked with
  - Size with internal diameter in mm; external diameter in smaller lettering
  - Z-79 which denotes that the material has been implantation tested in rabbit muscle for tissue compatibility
  - Distance from the tip of ETT at intervals along ETT's length. Most plastic tubes are longer than is usually required and may be cut to size
  - Other markings which may refer to the manufacturer, the trade name of the type of ETT, and whether it is intended for oral or nasal use
  - A radio-opaque line to aid detection of ETT on chest X-rays
- Curved with a left-facing bevel at the distal. A hole in the wall opposite the bevel (Murphy eye) allows ventilation should the end become obstructed by the tracheal wall or mucus or secretions
- Attached to a ETT connector at the proximal end
- May bear a cuff near the distal end, with a pilot balloon running towards the proximal end. The cuff is of high volume and low pressure type to reduce pressure on the tracheal mucosa

Choosing The Correct Size ETT

Age	Internal Diameter (mm)	Anchor for Oral ETT
Adult Male	8 - 8.5	20 - 22 cm
Adult Female	7 - 7.5	18 - 20 cm
Newborn to 3 months	3	weight (kg) +6
Infants	3 - 3.5	weight (kg) +6
Children >1year If using cuffed ETT	(Age/4) + 4 (Age/4) + 3.5	3 times size of ETT used/ (Age/4)+12

Preparation for Endotracheal Intubation

It is important to get ready before any attempt in intubation:

- Ensure equipment ready and in good order: **MALES**
- Ensure adequate oxygen source
  - wall or cylinder
  - if oxygen source is from oxygen cylinder, check O_2 pressure
- Ensure enough helping hands
- Ensure equipment to monitoring success of placement of ETT ie Stethoscope, End-tidal CO_2 monitor and Pulse oximeter ready and in good order
- Ensure resuscitation and intubation drugs available and ready

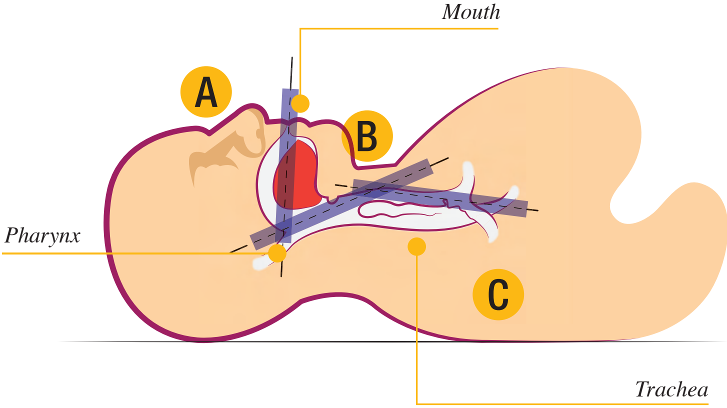
The Technique of Endotracheal Intubation

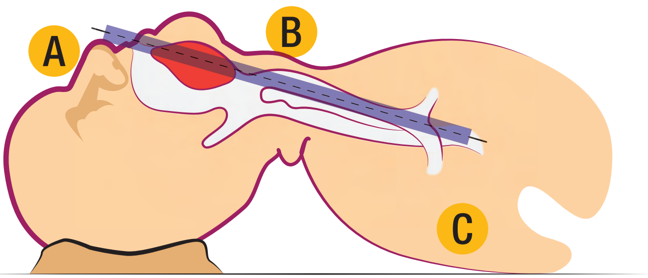
The following are steps necessary for successful endotracheal intubation during cardiac arrest:

Step 1: Position patient in the 'sniffing the morning air' position

- Flexion at lower cervical spine
- Extension at atlanto-occipital joint

To align the axes of upper airway as shown in the diagram below





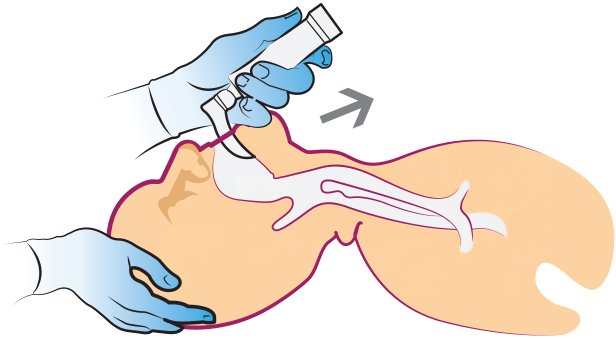
Extend-the-head-on-neck ("look up"): aligns axis A relative to B
Flex-the-neck-on-shoulders ("look down"): aligns axis B relative to C

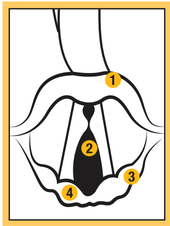
Step 2: Preoxygenation

- 100% O_2 for 3 minutes or with 4 vital capacity breaths

Step 3: Laryngoscopy and insertion of ETT

3A: Laryngoscopy





1 . Vallecula
2 . Vocal cord
3 . Arythenoid Cartilage
4. Glottic Opening

- Use left hand to hold laryngoscope
- Enter at right side of mouth and push tongue towards left side
- Move the laryngoscope blade toward midline and advance to the base of tongue. Advance the blade to the vallecula if the curved blade is used or to just beyond tip of epiglottis if the straight blade is used
- Lift upward and forward to bring the larynx and vocal cords into view as indicated by the arrow in the diagram above. The direction of force necessary to lift the mandible and tongue is 45 degrees. Do not use the teeth as a fulcrum or a lever

3B: Insertion of ETT

- Insert the ETT through the vocal cords. View the proximal end of the cuff at the level of the vocal cords and advance it about 1 to 2.5cm further into the trachea
- Inflate the ETT with enough air to occlude the airway (usually 10 to 20ml)

Important point to note:

Time taken for laryngoscopy and insertion of ETT should not be more than 30 seconds and preferably less than 15 seconds.

Step 4: Confirm correct position of ETT

- Observe colour of patient
- Visualise chest rise with delivery of first manual breath
- Detect vapour in ETT
- 5 points auscultation for breath sounds (auscultate epigastrium, anterior chest at bilateral mid-clavicular lines and thorax at bilateral mid-axillary lines)
- Detect end-tidal CO_2 with capnography or CO_2 detector device

Step 5: Secure ETT with tape

Step 6: Ventilate with a tidal volume of 6-8 ml/kg (visible chest rise) at a rate of 8-10 breath per minute

Use of Devices to Confirm Correct ETT Placement Via Detection of CO_2 Production

Detection of end-tidal CO_2 during resuscitation:

- Confirms ETT placement; note that $EtCO_2$ detection will not differentiate between tracheal and endobronchial tube placement. Careful auscultation is essential
- Correlates with cardiac index
- Assesses adequacy of ventilation
- Indicates quality of CPR
- Signifies ROSC
- Carries prognostic value for survival post cardiac arrest

There are a number of CO_2 detector devices available:

i) Esophageal detector device
ii) End-tidal CO_2 ($EtCO_2$) detector device
iii) Disposable calorimetric $EtCO_2$ detector
iv) Continuous digital $EtCO_2$ detector device
v) Continuous waveform $EtCO_2$ capnography

Complications of Endotracheal Intubation

During intubation	Hypoxia from the procedure itself, esophageal intubation and/or laryngospasm and bronchospasm
	Hypertension/hypotension, tachycardia/bradycardia and arrhythmias from/parasympathetic/sympathetic response

	Trauma to teeth, lips, tongue, mucosa, vocal cords, trachea
	Vomiting and aspiration
	Arytenoid dislocation → hoarseness
	Spinal cord trauma in cervical spine injury
When ETT in-situ	Migration to bronchus/esophagus
	Obstruction from kinking, secretions or over-inflation of cuff
	Disconnection from breathing circuit
	Accidental extubation/ETT dislodgement
	Lip ulcer in prolonged oral intubation
	Sinusitis or otitis or nasal ulcer in prolonged nasal intubation
	During extubation: Laryngospasm
	Edema of upper airway
	Pulmonary aspiration
After Extubation	Sore throat
	Hoarseness
Long Term	Subglottic stenosis
	Vocal cord granuloma
	Laryngeal granuloma

Ventilation with an Advanced Airway and Chest Compression

When a cardiac arrest patient has an advanced airway in place during CPR, there is no more cyclical CPR (i.e. 30 compression interrupted by pauses for 2 ventilations).

- Chest compressions are delivered at rate of at least 100 per minute
- Ventilations are delivered at 8 to 10 per minute (1 ventilation every 6-8 seconds)
- Ventilator and compressor should switch role every 2 minutes to prevent compressor fatigue and deterioration in the quality of CPR
- Minimize interruptions in chest compressions
- Avoid excessive ventilations (too many breaths or too large a volume). A lower rate and just adequate tidal volume ventilation is recommended to avoid hyperventilation and over-inflation of the lungs.

Tracheobronchial Suctioning

Suction Catheter

- Size (FG) = ETT internal diameter (mm) x 3/2 or outer diameter should not exceed 1/2 to 2/3 ETT internal diameter
- Minimal trauma to mucosa with molded ends and side holes
- Long enough to pass through tip of ETT
- Minimal friction resistance during insertion through ETT
- Sterile and disposable

Suction Pressure

- 100 to-120mmHg (adults)
- 80 to-100mmHg (children)
- 60 to-80 mmHg (infants)

Complications of Tracheobronchial Suctioning:

- Sudden severe hypoxia, secondary to decrease in functional residual capacity during the application of negative pressure in the trachea
- Cardiac arrest if severe hypoxia
- Increase in intra-arterial pressure and tachycardia due to sympathetic response to suction

Technique of Tracheobronchial Suctioning:

Step 1	Always preoxygenate with 100% O_2 for 3-5 minutes to reduce risk of hypoxia and arrhythmias
Step 2	Using sterile technique, the suction catheter is inserted without closing the side opening in the proximal end of the catheter
Step 3	The suction catheter is advanced to the desired location which is approximately at the level of the carina where trachea bifurcates
Step 4	Suction is applied intermittently by closing the side opening while the catheter is withdrawn with a rotating motion
Step 5	Limit duration of suctioning to 10-15 seconds. If arrhythmias occur, immediately discontinue suctioning and manually bag patient with O_2
Step 6	Prior to repeating the procedure, patient should be ventilated with 100% O_2 for about 30 seconds.

Point to note:

In patient with elevated intracranial pressure (e.g. head injury), temporary hyperventilation before and after suctioning may be indicated

chapter 5

Defibrillation and Safety

What is Defibrillation?

- The passage of an electrical current across the myocardium to depolarise a critical mass of myocardium and enable restoration of coordinated electrical activity
- An electrophysiological event that occurs 30-50 ms after shock delivery-the heart is stunned and hopefully the sino-atrial (SA) node will take over
- Aims to restore sinus rhythm
- Typically defined as the termination of ventricular fibrillation (VF) for at least 5 after the shock. Shock success using this definition does not equal to resuscitation outcome
- Only for VF or pulseless ventricular tachycardia (VT) where a single shock is given followed immediately by chest compression without any pulse check or rhythm reanalysis after a shock

The Importance of Early Defibrillation

Early defibrillation is critical to survival from sudden cardiac arrest (SCA) for the following reasons:

1) Most frequent initial rhythm in out-of-hospital witnessed SCA is VF
2) Treatment for VF is defibrillation
3) The probability of successful defibrillation diminishes rapidly over Time
4) VF tends to deteriorate to asystole over time

For every minute that passes between collapse and defibrillation, survival rates from witnessed VF SCA decrease 7% to 10% if no CPR is provided. When bystander CPR is provided, the decrease in survival rates is more gradual and averages 3% to 4% per minute from collapse to defibrillation.

CPR prolongs VF, delays the onset of asystole and extends the window of time during which defibrillation can occur. **Basic CPR alone, however, is unlikely to terminate VF and restore a perfusing rhythm.**

Defibrillators

Modern defibrillators are classified according to 2 types of waveforms: monophasic and biphasic. Monophasic waveform defibrillators were introduced first, but biphasic waveforms are used in almost all Automated External Defibrillators (AEDs) and some manual defibrillators sold today. Energy levels vary by type of device and manufacturer.

Monophasic Waveform Defibrillators

- Deliver current of one polarity (i.e. direction of current flow)
- Categorized by the rate at which the current pulse decreases to zero:
  - Monophasic damped sinusoidal waveform (MDS) current returns to zero gradually
  - Monophasic truncated exponential waveform (MTE) current returns abruptly (truncated) to zero

Biphasic Waveform Defibrillators

- Equivalent or higher efficacy for termination of VF when compared with monophasic waveforms
- Different biphasic waveforms have not been compared with regard to efficacy
- Use the manufacturer's recommended energy dose (120 to 200J). If the manufacturer's recommended dose is not known, defibrillate at 200J, the maximal dose

Preparing The Patient

Electrode/Paddle Size

- Minimum 150 cm^2, 8 to 12 cm in diameter for both handheld paddle electrodes and self-adhesive pad electrodes although defibrillation success may be higher with electrodes 12 cm in diameter rather than with those 8 cm in diameter
- Small electrodes (4.3cm) harmful and may cause myocardial necrosis

Electric/Paddle force

- 8kg in adult
- 5kg in 1-8years when using adult paddles

Transthoracic Impedance

- Use gel pads or electrode paddles or self-adhesive pads to reduce transthoracic impedance. The average adult human impedance is 70 to 80 Ω. When transthoracic impedance is too high, a low-energy shock will not generate sufficient current to achieve defibrillation

Electrode/Paddle Placement

- Can be at antero-lateral, antero-posterior, anterior-left infrascapular and anterior-right infrascapular locations on the chest/back. All these 4 positions are equally effective. For ease of placement and education, anterolateral is a reasonable default electrode placement.
- Ensure that the paddle and gel or pads are in full contact with the skin
- Special considerations:

Breasts
- Place lateral pads/paddles under breast tissue
- Move pendulous breasts gently out of the way

Wet Chest
- Briskly wipe the chest dry before attaching electrode pads and attempting defibrillation

Hirsutism
- Shave hirsute males prior to application of pads
- Remove excess chest hair by briskly removing an electrode pad (which will remove some hair) or by rapidly shaving the chest in that area

Automated Implanted Cardioverter Defibrillator
- Avoid placing the pads or paddles over the device as there is a potential for pacemaker or ICD to malfunction after defibrillation when the pads are in close proximity to the device
- Use antero-posterior and antero-lateral locations

Presence of Transdermal Medication Patch (eg patch containing nitroglycerin, nicotine,analgesics, hormone replacement, anti-hypertensives)
- Do not place electrodes over transdermal medication patch which may block delivery of energy from the electrode pad to the heart and may cause small burns to the skin
- Remove medication patch and wipe the area before attaching the electrode pad if defibrillation is needed

Safety Issues

Fire

- Ignited by sparks from poorly applied defibrillator paddles in the presence of an oxygen-enriched atmosphere
- Avoid defibrillation in an oxygen-enriched atmosphere
- Use self-adhesive defibrillation pads
- Ensure good pad–chest-wall contact
- If manual paddles are used, gel pads are preferable to electrode pastes and gels because the pastes and gels can spread between the 2 paddles, creating the potential for a spark

Accidental Electrocution

- Charge paddles after being placed on patient's chest rather than prior to being taken out from the defibrillator
- Ensure that none of the rescuer team members is in contact with patient/victim/resuscitation trolley prior to defibrillator discharge

Safety and Clearing The Patient

- Always announce that a shock is about to be delivered
- Perform a visual check making sure no one is in contact with the patient
- "Clear" the patient and rescuers before each shock

- Make sure that no oxygen is flowing across the patient's chest or openly across the electrode pads
- Carry out the above steps quickly to minimize the time from the last compression to shock delivery

An Example:

"One I Clear"
(Check to make sure you have no contact with the patient, the trolley or other equipment)

"Two, You Clear."
(Check to make sure that no one is touching the patient. "No one" includes providers performing chest compressions, starting IVs, inserting catheters, or performing ventilation and airway maintenance)

"Three, Everybody Clear."
(Perform a visual check to make sure no one has contact with the patient or trolley)

These steps are summarized below:

1	Attach electrodes to patient's chest
2	Turn defibrillator on – select leads
3	Analyse the rhythm? shockable
4	Apply coupling agent or pads to patient's chest
5	Select energy level
6	Apply paddles to chest
7	Charge the paddles
8	The **"Clear"** chant
9	Check monitor again
10	Discharge shock and return the paddles to the machine

Synchronized Cardioversion

- A shock delivery that is timed (synchronized) with the QRS complex
- Avoids shock delivery during the relative refractory portion of the cardiac cycle when a shock could produce VF

Use of Synchronized Cardioversion

- Indicated in a hemodynamically unstable patient (low blood pressure) with a perfusing rhythm (pulse present)
- Recommended in supraventricular tachycardia due to re-entry, atrial fibrillation,atrial flutter, and atrial tachycardia
- Recommended in monomorphic VT with pulses
- Not effective for treatment of junctional tachycardia or multifocal atrial tachycardia

Initial Recommended Energy Level for Synchronized Cardioversion

- Narrow Regular: 50-100J
- Narrow Irregular:120-200 biphasic or 200J monophasic
- Wide Regular:100J
- Wide Irregular: defibrillation (NOT synchronized, 360J monophasic or 120-200J biphasic)

Supraventricular Tachycardias (Re-entry Rhythms)

- *Cardioversion of Adult Atrial Fibrillation:*
  Initial energy dose- biphasic 120 to 200J or monophasic 200J
  If the initial shock fails, increase the dose in a stepwise fashion
- *Cardioversion of Adult Atrial Flutter and Other Supraventricular Tachycardias:*
  Initial energy dose- 50 to 100J often sufficient
  If the initial shock fails, increase the dose in a stepwise fashion

Ventricular Tachycardia (VT)

- **Pulseless VT**
  - Treat as VF

- **Unstable Polymorphic (Irregular) VT With or Without a Pulse**
  - Treat as VF using defibrillation doses)

- **Unstable Monomorphic (Regular) VT With a Pulse**
  - Treat with monophasic or biphasic waveform cardioversion (synchronized) at an initial energy dose of 100J. If the initial shock fails, increase the dose in a stepwise fashion.

Points to know:

Synchronized cardioversion is preferred for treatment of an organized ventricular rhythm. However, for some arrhythmias, the many QRS configurations and irregular rates that comprise polymorphic ventricular tachycardia make it difficult or impossible to reliably synchronize to a QRS complex. If there is any doubt whether monomorphic or polymorphic VT is present in the unstable patient, do not delay shock delivery to perform detailed rhythm analysis-provide high energy unsynchronized shocks (i.e. defibrillation doses, 360J monophasic or 120-200J biphasic).

Pacing

- Not recommended for patients in asystolic cardiac arrest as it is not effective and may delay or interrupt the delivery of chest compressions

It is reasonable for healthcare providers to be prepared to initiate pacing in patients who do not respond to atropine (or second-line drugs if these do not delay definitive management). Immediate pacing might be considered if the patient is severely symptomatic. If the patient does not respond to drugs or transcutaneous pacing, transvenous pacing is probably indicated.

Summary

The recommendations for electrical therapies described in this section are designed to improve survival from SCA and life threatening arrhythmias. Whenever defibrillation is attempted, rescuers must coordinate high-quality CPR with defibrillation to minimize interruptions in chest compressions and to ensure immediate resumption of chest compressions after shock delivery.

chapter 6

ALS Core ECG Rhythms and Recognition

Sinus Tachycardia

Defining Criteria	
Rate	>100 per minute
QRS Complex	Normal and P for every QRS complex
Rhythm	Sinus
P Wave	Present

Atrial Ectopic

Defining Criteria	
Rate	Sinus rate
QRS Complex	Normal and narrow
Rhythm	Regular sinus with atrial ectopic beat
P Wave	Normal P wave with presence of ectopic atrial beat

Atrial Fibrillation

Defining Criteria	
Rate	Wide range of ventricle response
QRS Complex	Present
Rhythm	Irregular
P Wave	Chaotic atrial fibrillatory waves

Atrial Flutter

Defining Criteria	
Rate	Atrial rate 100 to 350 per minute
QRS Complex	Present
Rhythm	Regular Ventricular rhythm often regular Set ratio atrial rhythm e.g. 2 to 1
P Wave	No true P waves Flutter waves in “sawtooth” pattern

Accessory – Mediated Supraventricular Tachycardia

Defining Criteria	
Rate	Atrial rate 120 to 150 per minute
QRS Complex	Normal and Narrow
Rhythm	Regular
P wave	Seldom seen due to rapid rate because p wave "hidden" in preceding T waves

Sinus Bradycardia

Defining Criteria	
Rate	<60 per minute
QRS Complex	Normal
Rhythm	Regular Sinus
P Wave	Normal, every P wave followed by QRS complex

First-Degree AV Block

Defining Criteria	
Rate	Sinus rate
QRS Complex	Normal and Narrow
Rhythm	Regular Sinus
P Wave	Normal, every P wave follow by QRS complex
PR	Prolonged > 0.20 second and fixed

Second-Degree AV Block Morbitz Type I (Wenkebach)

Defining Criteria	
Rate	Sinus rate
QRS Complex	Normal and Narrow
Rhythm	Regular Sinus
P Wave	P wave not followed by QRS complex
PR	Progressive lengthening of PR interval occurs from cycle to cycle, then one P wave is not followed by QRS complex -"dropped beat"

Second-Degree AV Block Morbitz Type II

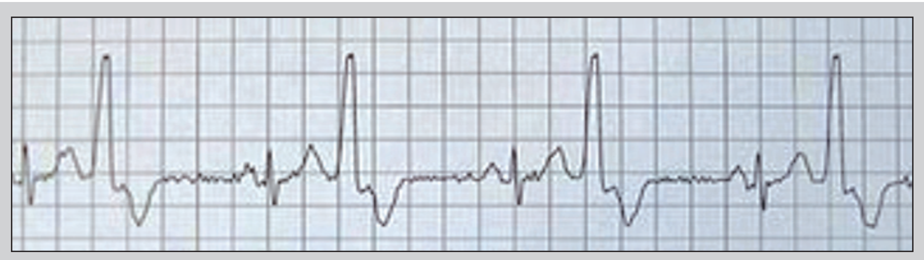
Defining Criteria	
Rate	Usually 60 to 100 per minute
QRS Complex	Normal and Narrow (Wide QRS complex implies low block relative to AV node)
Rhythm	Atrial regular, ventricular irregular
P Wave	Some P wave not followed by QRS complex
PR	Constant and set, no progressive prolongation

Third-Degree AV

Defining Criteria	
Rate	Atrial rate 60 to 100 per minute, dissociated from ventricle rate Ventricle rate depend on rate of ventricle escape beats
QRS Complex	Narrow implies high block relative to AV node Wide implies low block relative to AV node
Rhythm	Atrial and ventricular rate regular but independently “dissociated”
P Wave	Normal

Ventricle Ectopics

Defining Criteria	
Rate	Sinus rate with presence of ventricular ectopics
QRS Complex	Normal QRS complexes with presence of single broad QRS complex
Rhythm	Sinus rate with irregular ventricular rate
P Wave	Present before normal QRS complex

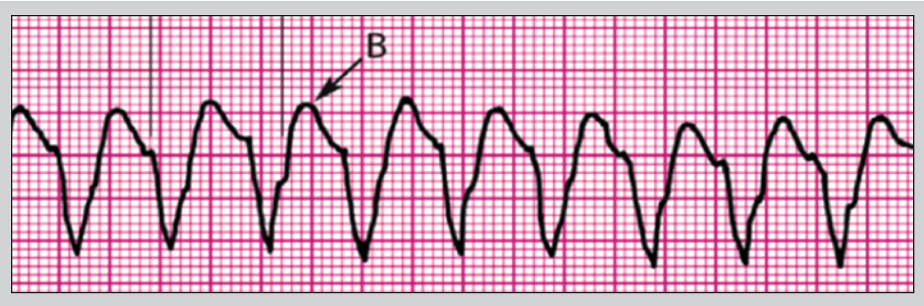


Ventricle Bigeminy

Defining Criteria	
Rate	Sinus rate with presence of ventricular ectopic
QRS Complex	Normal QRS complexes with alternating broad QRS complexes
Rhythm	Sinus rate with alternating ventricular rate
P Wave	Present before normal QRS complex

Couplet

Defining Criteria	
Rate	Sinus rate
QRS Complex	Normal QRS complexes with presence of broad QRS complexes in Couplet
Rhythm	Sinus rate with irregular ventricular rate
P Wave	Present before normal QRS complex

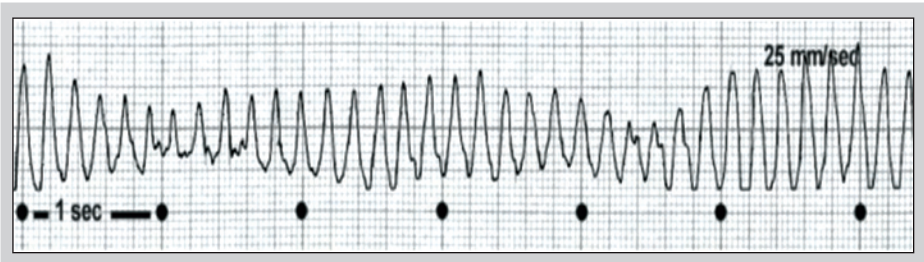


Monomorphic VT

Defining Criteria	
Rate	>100 per minute, typically 120 to 250 per minute
QRS Complex	Wide and bizarre, PVC like complexes >0.12 second
Rhythm	Regular ventricular rate
P Wave	Seldom seen but present
Fusion Beats	Occasional chance capture of a conducted P wave Resulting QRS "hybrid" complex, part normal and part ventricle
Nonsustained VT	Last <30 seconds

Polymorphic VT

Defining Criteria	
Rate	150 to 250 per minute
QRS Complex	Display classic spindle-node pattern
Rhythm	Irregular ventricular rhythm
P Wave	Non-existent

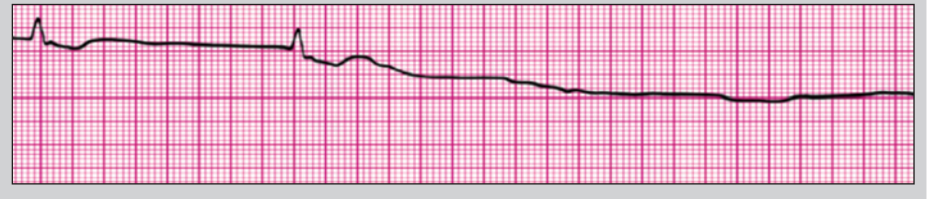


Torsades De Pointes

Defining Criteria	
Rate	150 to 250 per minute
QRS Complex	QRS showed continually changing of axis (hence ‘turning of point’)
QT Interval	Prolonged
Rhythm	Irregular ventricular rhythm
P Wave	Non-existent

Ventricular Fibrillation

Defining Criteria	
Rate	150 to 300 per minute
QRS Complex	Unable to determine; no recognizable P, QRS or T waves
Rhythm	Indeterminate
Amplitude	Can be described as fine (peak to trough 2 to < 5 mm), or medium (5 to < 10 mm) or coarse (10 to <15 mm) or very coarse (> 15 mm)



Asystole

Defining Criteria	
Rate	No ventricle activity
QRS Complex	No deflection seen
Rhythm	No ventricle activity

chapter 7 Drugs in Resuscitation

Adrenaline

Introduction

- Naturally occurring cathecholamines with alpha and beta effects
- Administration in cardiac arrest will cause intense vasoconstriction (alpha adrenergic action) and divert cardiac output to vital organ such as brain and heart
- Can improve ROSC although no difference in survival (Retrospective study)
- Facilitate defibrillation by improving myocardial blood flow during CPR

Indications

- Cardiac arrest: The first drug to be used in cardiac arrest of whatever cause
- Symptomatic bradycardia:
  Can be considered after atropine as an alternative infusion to dopamine
- Severe hypotension
- Anaphylaxis

Dose and Administration

For Cardiac Arrest

- IV/IO: 1mg (10ml of 1:10000 solution), administered every 3-5minutes followed by 20ml flush
- Higher dose: Specific indication only such as beta blocker or calcium channel blocker overdose. Can use up to 0.2mg/kg
- Infusion: Infusion rate of 1μg/min titrated to effects (typically 2-10μg/minute)
- If IV/IO is difficult to establish, adrenaline can be given through ETT at dose of 2-2.5mg

For Profound Bradycardia or Hypotension

- Infusion at 2-10μg/minute, titrated to response

Adverse Effects and Precautions

- Hypertension after resuscitation
- Tachyarrhythmias
- Tissue necrosis if extravasation occurs

Following ROSC, even small doses of adrenaline (50-100μg) may induce tachycardia, myocardial ischaemia, VT and VF. If further dose is required, it must be titrated carefully to achieve an appropriate blood pressure

Atropine

Introduction

- An anticholinergic agent
- Antagonises the action of the parasympathetic neurotransmitter acetylcholine at muscarinic receptors. Therefore, it blocks the effect of the vagus nerve on both the sino-atrial (SA) node and the atrio-ventricular (AV) node, increasing sinus automaticity and facilitating AV node conduction

Dose and Administration

- The recommended dose for bradycardia is 0.5mg IV every 3 to 5 minutes to a max total dose of 3mg
- Doses of atropine sulfate of < 0.5mg may paradoxically result in further slowing of the heart rate
- Atropine administration should not delay external pacing for patients with poor perfusion

Introduction

- First line drug for symptomatic Bradycardia
- Organophosphate poisoning

Dose and Administration

- Use atropine cautiously in the presence of acute coronary ischemia or MI; increased heart rate may worsen ischemia or increase infarction size.
- Will not be effective in infranodal (type II) AV block and new third-degree block with wide QRS complexes

Adenosine

Introduction

- Naturally occurring purine nucleotide
- Slows transmission across AV node but has little effect on other myocardial cells or conduction pathways
- Highly effective for terminating paroxysmal SVT with re-entrant circuits that include AV node (AVNRT)
- In other narrow-complex tachycardias, adenosine will reveal the underlying atrial rhythms by slowing the ventricular response

Indications

- First drug for most form of stable narrow-complex PSVT
- Effective in terminating stable narrow-complex PSVT due to reentry involving AV node or sinus node
- May be considered for narrow-complex reentry tachycardia while preparing for cardioversion

Dose and Administration

- Give 6 mg adenosine as a rapid IV push through a large (e.g. antecubital) vein followed by a 20mL saline flush.
  If unsuccessful, this can be followed with up to two doses each of 12mg every 1-2 minutes

Side Effects and Precautions

- Transient unpleasant side effects, in particular nausea, flushing, and chest discomfort
- Should not be given in patient with asthma
- In WPW syndrome, blockage of conduction across the AV node by adenosine may promote conduction across an accessory pathway
- In supraventricular arrhythmias, this may cause a dangerously rapid ventricular response. It may also precipitate atrial fibrillation associated with a dangerously rapid ventricular response.
- Larger doses may be required for patients with a significant blood level of theophylline, caffeine, or theobromine
- The initial dose should be reduced to 3 mg in patients taking dipyridamole or carbamazepine, those with transplanted hearts, or if given by central venous access

Amiodarone

Introduction

- An antiarrhythmic with complex pharmacokinetics and pharmacodynamics
- Act on sodium, potassium and calcium channels
- Poses alpha and beta-adrenergic blocking properties.

Dose and Administration

- For refractory VF/pulseless VT
  - IV/IO 300mg bolus
  (dilute in 20mL Dextrose 5% solution)
  - Can repeat in 3-5minutes, 150 mg

- A membrane-stabilising anti-arrhythmic drug that increases the duration of the action potential and refractory period in atrial and ventricular myocardium
- A mild negative inotropic action
- Causes peripheral vasodilation through non-competitive alpha blocking effects. Atrioventricular conduction is slowed, and a similar effect is seen with accessory pathways.

Indications

- Refractory pulseless VT/VF (between the third and fourth shock when refractory to defibrillatory shock and vasopressor)
- Stable and unstable tachyarrhythmias

- For unstable tachyarrhythmias where cardioversion fails 3X, 300mg IV over 10-20 minutes
- For stable tachyarrhythmias, 300mg IV over 20-60 minutes
- For Maintenance infusion: 900 mg IV over 24h g

Adverse Effects and Precautions

- Can cause hypotension, bradycardia and heart block
- The adverse hemodynamic effects of the IV formulation of amiodarone are attributed to vasoactive solvents (polysorbate 80 and benzyl alcohol)
- Beware of accumulations with multiple dosing (cumulative doses >2.2g are associated with hypotension)

Calcium

Introduction

- Essential for nerve and muscle activity
- Plays a vital role in the cellular mechanism underlying myocardial contraction
- No data supporting any beneficial action for calcium after cardiac arrest
- Some studies have suggested a possible adverse effect when given routinely during cardiac arrest (all rhythms)

Indications

Only in Pulseless Electrical Activity caused by

- hyperkalaemia
- overdose of calcium
- hypocalcaemia
- channel blocker

Dose and Administration

- The initial dose of 10 ml 10% calcium chloride (6.8 mmol Ca^{2+}) may be repeated if necessary

Side Effects and Precautions

- Calcium can slow heart rate and precipitate arrhythmias
- In cardiac arrest, calcium may be given by rapid intravenous injection
- In the presence of a spontaneous circulation give it slowly
- Do not give calcium solutions and sodium bicarbonate simultaneously via the same route

Lignocaine

Introduction

- Act as a calcium channel blocker

Indications

- Alternative to amiodarone in cardiac arrest from VT/VF
- Stable monomorphic VT with preserved ventricular function

Dose and Administration

- Cardiac arrest from VT/VF Initial dose: 1-1.5mg/kg IV or IO
- For refractory VF: may give additional dose 0.5-0.75mg/kg and repeat 5-10 minutes up to 3 times or maximal dose of 3mg/kg

Side Effects and Precautions

- In overdose it can cause slurred speech, altered consciousness, muscle twitching and seizure
- It also can cause hypotension, bradycardia, heart block and asytole

Dopamine

Introduction

- A chemical precursor of noradrenaline that stimulates both alpha and beta adrenergic receptors
- In addition, there are receptors specific for dopamine (DA1, DA2 dopaminergic receptors)
- Stimulates the heart through both alpa and betareceptors
- Both a potent adrenergic receptor agonist and a strong peripheral dopamine receptor agonist. These effects are dose dependent.

Indications

- Second-line drug for symptomatic bradycardia
- Use for hypotension (systolic BP < 70 to 100 mm Hg) with signs and symptoms of shock

Dose and Administration

- Usual infusion rate is 2-20μg/kg/minute and dose titrated according to response

Side Effects and Precautions

- Can cause tachycardia, hypertension
- Can precipitate arrhythmias
- May cause excessive systemic and splanchnic vasoconstriction for higher dose (10-20μg/kg/minute)
- Correct hypovolemia with volume replacement before starting on dopamine
- Use with caution in cardiogenic shock with accompanying CHF

Magnesium

Introduction

- An electrolye important for maintaining membrane stability
- Hypomagnesemia can cause myocardial hyperexcitability especially in the presence of hypokalemia or digoxin
- Given for hypomagnesemia and Torsades de pointes
- Insufficient evidence to recommend for or against its routine use in cardiac arrest

Indications

- Recommended in cardiac arrest only if Torsades de pointes or if hypomagnesemia is present
- Life threatening ventricular arrhythmias due to digitalis toxicity

Dose and Administration

- Cardiac arrest due to Torsades de pointes or hypomagnesemia:
  1-2g diluted in 10 mL D5% to be given over 5-20 minute
- Torsades de pointes with pulse or AMI with hypomagnesemia:
  Loading dose of 1-2g mixed with 50 mL D5% over 5-60 minute, followed with 0.5 to 1g/hour (titrate to control Torsades)

Side Effects and Precautions

- Occasional fall in blood pressure with rapid administration
- Use with caution if renal failure is present

Vasopressin

Introduction

- A non-adrenergic peripheral vasoconstrictor
- Causes coronary and renal vasoconstriction
- No difference in outcome (ROSC, survival to discharge or neurological outcome) with vasopressin (40 units IV) versus adrenaline 1 mg as a first line vasopressor in cardiac arrest (three RCT and meta-analysis of the trials)

Indications

- As an alternative pressor to adrenaline in the treatment of refractory VF or pulseless VT
- Maybe useful as alternative to adrenaline in PEA and asystole

Dose and Administration

- For cardiac arrest
  40 units IV/IO may replace 1st or 2nd dose of Adrenaline

Adverse Effects and Precautions

- Potent peripheral vasoconstrictor. It may precipitate cardiac ischaemia and angina

Sodium Bicarbonate

Introduction

- A strong alkaline agent with high sodium and bicarbonate load
- Not recommended for routine use in cardiac arrest

Indications

- Known prexisting hyperkalemia
- Known preexisting bicarbonate responsive acidosis e.g. : aspirin overdose, diabetic ketoacidosis, tricyclic antidepressant or cocaine
- Prolonged resuscitation with effective ventilation. Upon return of spontaneous circulation after long arrest interval
- Not useful nor effective in hypercarbic acidosis (e.g. cardiac arrest or CPR) without tracheal intubation

Dose and Administration

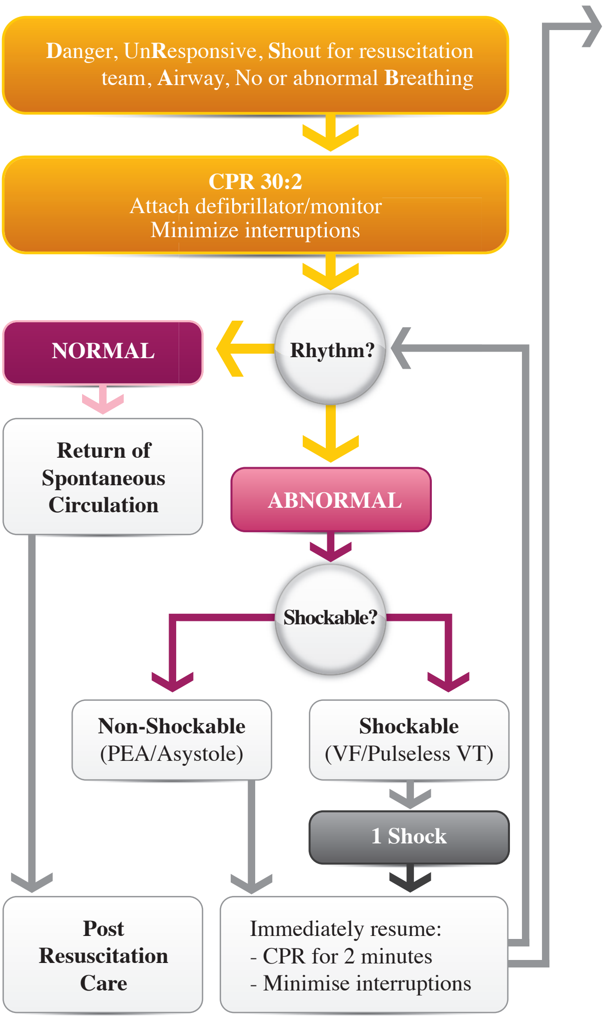
- 1 mEq/kg IV bolus

Adverse Effects and Precautions

- May cause tissue necrosis if extravasation occurs
- Do not administer with same IV line used for vasopressors
- Avoid use with IV line used for IV Calcium

chapter 8 ALS Algorithms

BLS Adult Algorithm



During CPR

- Push hard and fast (at least 100/minute)
- Allow complete chest recoil after each compression
- Minimize interruptions
- 1 cycle CPR 30:2 (2 minute)
- Avoid hyperventilation
- Secure airway and confirm placement
- Rotate compressor every 2 minutes with rhythm check
- Search and treat for reversible causes -5H and 5T

  Hydrogen ion
  Hypoxia
  Hypothermia
  Hypovolemia
  Hypo/hyperkalemia
  Tamponade, cardiac
  Tension pneumothorax
  Thrombosis, Pulmonary
  Thrombosis, Coronary
  Toxins

- Vascular access (IV/IO)
- Give adrenaline every 3-5 minute

ALS Adult Cardiac Arrest

Pulseless Arrest
- BLS algorithm: DRS ABC
- Attach monitor/defibrillator when available

Shockable Rhythm?

Not Shockable
(Asystole/PEA)

Start CPR immediately for 2 minute When IV/IO available,

- Give Adrenaline 1mg IV/IO, repeat every 3-5minutes OR
- Give 1 dose of Vasopressin 40U IV/IO to replace 1st or 2nd dose of Adrenaline

Shockable Rhythm?

Give 2 minutes of CPR

Asystole/PEA algorithm

During CPR

- Push hard and fast (at least 100/minute)
- Allow complete chest recoil after each compression
- Minimize interruptions
- 1 cycle: CPR 30:2 (2 minutes)
- Avoid hyperventilation
- Secure airway and confirm placement
- Rotate compressor every 2 minutes with rhythm check Search and treat for reversible causes*

Shockable
(Pulseless VT/VF)

Give 1 shock

- Manual biphasic: device specific (120-200J)
- AED: device specific
- Monophasic 360J

Resume CPR immediately

Give 2 minutes of CPR

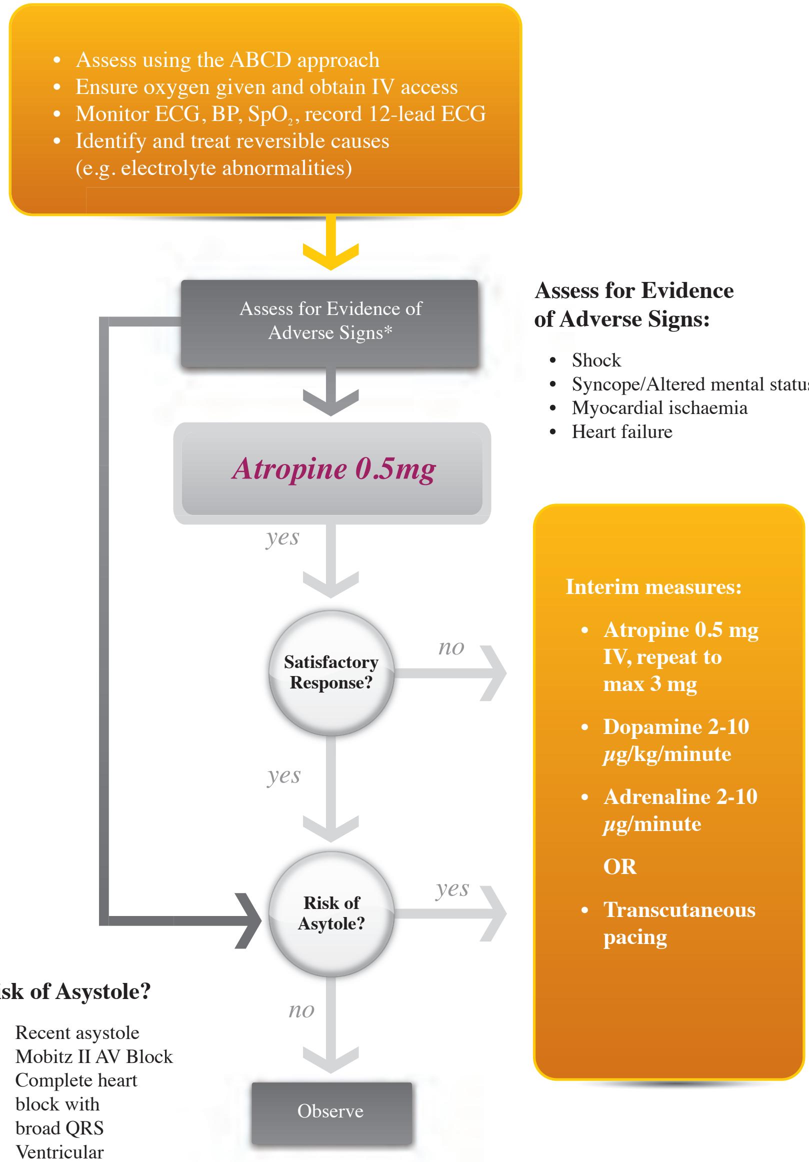
Continue CPR while defibrillator is charging
If shockable rhythm, give 1 shock
Resume CPR immediately after shock
When IV/IO available, during CPR (before or after the shock)

- Give Adrenaline 1mg IV/IO, repeat every 3-5 minutes, OR
- Give 1 dose of vasopressor 40U IV/IO to replace 1st or 2nd dose of Adrenaline

Continue CPR while defibrillator is charging
If shockable, give 1 shock
Resume CPR immediately after shock
Consider anti-arrhythmics: during CPR,

- Give Amiodarone 300 mg IV/IO, 150 mg second dose
  Consider magnesium 1-2g IV/IO loading dose
  for Torsades de pointes

Bradycardia (with pulse) Algorithm



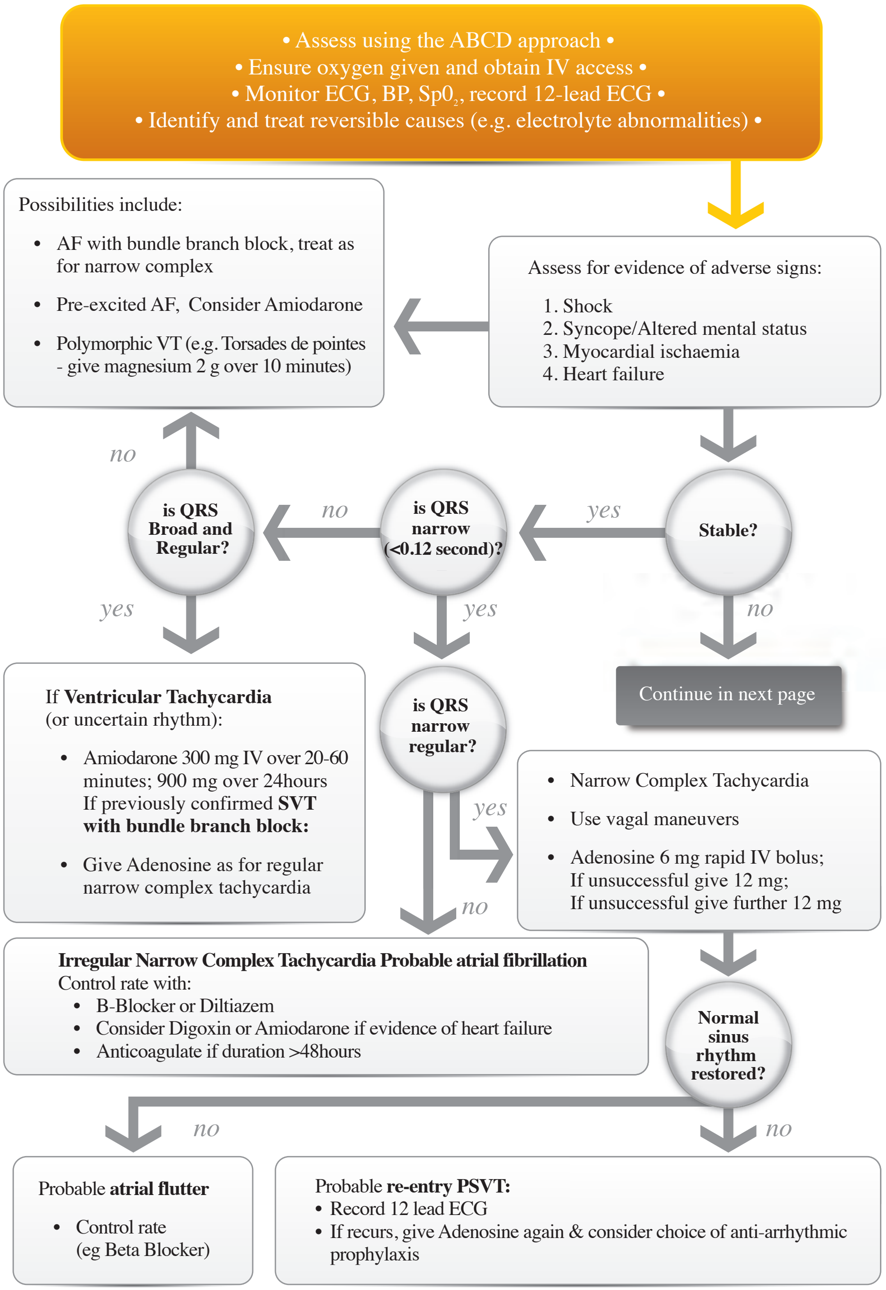
Assess for Evidence of Adverse Signs:

- Shock
- Syncope/Altered mental status
- Myocardial ischaemia
- Heart failure

Risk of Asystole?

- Recent asystole
- Mobitz II AV Block
- Complete heart block with broad QRS
- Ventricular pause > 3s

Tachycardia Algorithm with Pulse



- Assess using the ABCD approach
- Ensure oxygen given and obtain IV access
- Monitor ECG, BP, SpO_2, record 12-lead ECG
- Identify and treat reversible causes (e.g. electrolyte abnormalities)

↓

Assess for evidence of adverse signs:

1. Shock
2. Syncope/Altered mental status
3. Myocardial ischaemia
4. Heart failure

↓

Stable?

↓ *no*

Synchronised DC Shock*
Up to 3 attempts

↓

- Amiodarone 300 mg IV over 10-20 minutes
- Repeat shock
- Followed by Amiodarone 900 mg over 24hours

chapter 9

Post Resuscitation Care

Post Resuscitation Care

Post resuscitation care starts when there is return of spontaneous circulation (ROSC). The chances of achieving ROSC are greatly enhanced when:

- The arrest is witnessed
- The underlying arrhythmia is VF or pulseless VT
- Successful defibrillation is achieved in 2-3 minutes and not longer than 8 minutes
- High quality CPR started and continued

It emphasises the following measures to improve neurological outcome:

- Avoid hyperoxaemia after ROSC; titrate oxygen to SaO_2 94-96%
- Glucose control to treat hyperglycaemia (>10mmol/L) and avoid hypoglycaemia
- Seizure control
- Maintenance of cerebral perfusion
- Therapeutic hypothermia

A comprehensive post resuscitation treatment protocol for the management of patients after cardiac arrest includes:

1. Airway

- Ensure that the airway is open, oxygenation and perfusion are adequate
- Titrate oxygen to SaO_2 94-96%
- Consider advanced airway support if not instituted
- Position the unintubated patient in the recovery position to prevent aspiration

2. Hemodynamics/Circulation

- Always assess the haemodynamic status of the patient
- Monitor vital signs every 5-15 minutes
- Report patient's progress at intermittent intervals
- Report any deterioration or drastic changes immediately
- When resuscitation is prolonged, hypotension is common following ROSC. Should hypotension persist, dopamine titrated to maintain a systolic blood pressure of 90mmHg is the agent of choice

3. Therapeutic Hypothermia

- Cool patient to 32-340ºC for 12-24 hours.

4. Neurology Status

- Assess patient's ability to respond to verbal or painful stimuli
- Check the motor response to detect any motor deficit
- Check the pupils' size and reaction

5. Drug Infusion

- Consider anti-arrhythmics that have been effective during the resuscitation as infusions
- Use infusion pumps to ensure accurate delivery
- Maintain an accurate record of all fluids given

6. Correct Abnormalities

- Actively search and correct underlying abnormalities which may lead to arrest
- Common abnormalities that may require correction after the arrest include electrolyte imbalances, hypoxaemia and acidosis
- Correct glucose level > 10.0mmol/l and avoid hypoglycaemia

7. Transfer to Intensive Care Unit (ICU) or Coronary Care Unit (CCU)

- Make immediate arrangement to transfer the patient to ICU or CCU if the patient's condition remains critical
- Prior to transfer, ensure the patient's condition is stabilised and patient fit for transfer

8. Documentation of the Resuscitation

- The resuscitation record is an essential component of any resuscitation effort
- It provides documentation of the life support procedures that were performed
- The record allows us to reconstruct the sequence of events with correlation of interventions and responses during the resuscitation
- The record also allows the evaluation of appropriateness of care and facilities
- Such documentation allows the evaluation of appropriateness of care and facilities the prospective collection of data for measuring the outcome and effects of training
- Relatives must always be kept informed

Summary

After a successful resuscitation, it is crucial that the patient's airway, breathing and circulation are secured and stabilized. Haemodynamic and neurological states are closely monitored before and during transfer to ICU or CCU. Relatives must always be kept informed.

chapter 10

Ethical Issues in Cardiopulmonary Resuscitation

Ethical Issues in Cardiopulmonary Resuscitation

Cardiopulmonary resuscitation is carried out to preserve life. However, in most instances, CPR is initiated without considering the fact whether it is done against the wishes of the victim, family members or if an advanced directive exists.

Ethical principles

When caring for those who need CPR, healthcare providers must consider ethical, legal and cultural factors. The decision to initiate or continue resuscitative effort should be guided by knowledge, individual patient or surrogate preferences, local and legal requirements.

There are 5 important aspects of ethical principles that govern the decision for resuscitation:

1) Autonomy:
Right of patient to accept or refuse therapy. Applied to those who has decision-making capacity unless otherwise as declared by a court of law

2) Beneficence:
Benefit provided to patient while balancing risks and benefits

3) Non maleficence:
Doing no harm or further harm

4) Justice:
Equal distribution of limited health resources and if resuscitation is provided it should be available to all who will benefit from it within the available resources

5) Dignity and Honesty:
Patient should be treated with dignity. There must be honesty in revealing information in the best interest of the patient

Advanced directives for DO NOT ATTEMPT RESUSCITATION (DNAR)

This is an important aspect in deciding whether to start or withhold CPR. It is a legal binding document in the United States and can be either verbal or written, based on conversations, written directives, living wills or from a durable power of attorney. It is important to note that the court of law accepts written advanced directives more than recollections of conversations.

Principles of futility

Medical futility occurs when an intervention is unlikely to benefit the patient. It is also defined when an intervention fails to achieve patient's intended quality goals or the physician's physiological goals. Discontinuation of resuscitative efforts or withholding resuscitation should be considered in such situations. However, if the prognosis is in doubt or uncertain, a trial of treatment should be considered until adequate information is gathered to determine the expected clinical course or the likelihood of survival.

Following are instances whereby CPR efforts should be reconsidered:

1) When to stop CPR

- Return of spontaneous circulation
- Exhaustion
- Obvious signs of death
- Decision by the caring physician

2) When not to start CPR

- Presence of an Advanced Directive by the patient or surrogate decision maker
- Valid DNAR by attending physician
- Obvious signs of death
- Injuries incompatible with life

Appendix

Skill Station Competency Checklist
Management of Respiratory Arrest

	☑ *if done correctly*

BLS Primary Survey and Intervention

Assesses **D**anger	
Establishes un**R**esponsiveness	
Shouts for help: Activates Emergency Medical **S**ervice (EMS) and gets AED OR Directs 2nd rescuer to activate EMS and gets the AED	
Checks and opens the **A**irway (head tilt-chin lift or if trauma is suspected, jaw thrust without head extension)	
Checks for absent or abnormal **B**reathing (Assesses for absence of breathing almost simultaneously while opening the airway in less than 10seconds)	
Starts 30 **C**hest compressions almost immediately if no breathing or abnormal breathing to be followed by 2 rescue breaths	
Attaches AED-Organized rhythm present	
Check carotid pulse-Pulse present	
Performs rescue breaths just enough to see chest rise at the correct rate 1 breath every 5 to 6 seconds (10 to 12 breath/minute)	

ALS Secondary Survey Case Skills

Inserts OPA and NPA (student should demonstrate both)	
Performs correct bag-mask ventilation	
Administers oxygen	
Reassesses pulse about every 2 minutes	

Critical Action

Performs Primary ABCD	
Properly inserts OPA or NPA	
Can ventilate with bag-mask	
Gives proper ventilation-rate and volume	
Rechecks pulse and other signs of circulation	

CPR/AED Testing Checklist
VF Treated With CPR and Automated External Defibrillation (1 Rescuer)

Skill Step	*Critical Performance Steps*	☐ *Adult/Child CPR with AED if done correctly*
1	Assesses **D**anger	
2	Checks un**R**esponsiveness	
3	**S**houts for help: someone to activate EMS and get an AED	
4	Opens **A**irway using head tilt-chin lift	
5	Checks for absent or abnormal **B**reathing	
6	Locates CPR hand position Delivers 30 compressions at 100/min Acceptable < 20 seconds for 30 compressions	
7	Gives 2 breaths (1 second each)	

AED Arrives

AED 1	Turns AED on	
AED 2	Selects proper AED pads and places pads correctly	
AED 3	Clears patient to analyze (must be visible and verbal check)	
AED 4	Clears patient to shock/presses shock button (must be visible and verbal check) Maximum time from AED arrival < 90 seconds	

Student Continues CPR

8	Delivers second cycle of compressions at correct hand position, adequate depth and full chest recoil Acceptable <20 seconds for 30 compressions	
9	Gives 2 breaths (1 second each) with visible chest rise	

TEST RESULT	Indicate Pass or Needs Remediation:	P	NR
Instructor signature affirms that skills test were done according to NCORT ALS guidelines Save this sheet with course record.		Instructor Signature: ______________________ Print Inst.Name: ______________________ Date: ______________________	

Megacode Testing Checklist 1/2
Bradycardia • VF/Pulseless VT • Asystole

Critical Performance Steps	☑ *if done correctly*
Team Leader	
Ensures high-quality CPR at all times	
Assigns team members roles	
Bradycardia Management	
Starts oxygen, places monitor, starts IV	
Places monitor leads in proper position	
Recognizes symptomatic bradycardia	
Administers appropriate drug(s) and doses	
Verbalizes the need for transcutaneous pacing	
VF/Pulseless VT Management	
Recognizes VF	
Clears before ANALYZE and SHOCK	
Immediately resumes CPR after shocks	
Appropriate airway management	
Appropriate cycles Drug-Rhythm Check/Shock - CPR	
Administers appropriate drug(s) and doses	
Asystole Management	
Recognizes asystole	
Verbalizes potential reversible causes of Asystole/PEA (H's and T's)	
Administers appropriate drug(s) and doses	
Immediately resumes CPR after rhythm checks	
	STOP THE TEST

TEST RESULT	Indicate Pass or Needs Remediation:	P	NR
Instructor signature affirms that skills test were done according to NCORT ALS guidelines Save this sheet with course record.		Instructor Signature: ____________ Print Inst.Name: ____________ Date: ____________	

Megacode Testing Checklist 3
Tachycardia • VF/ Pulseless VT • PEA

Critical Performance Steps	☑ *if done correctly*
Team Leader	
Ensures high-quality CPR at all times	
Assigns team members roles	
Tachycardia Management	
Starts oxygen, places monitor, starts IV	
Places monitor leads in proper position	
Recognizes unstable tachycardia	
Recognizes symptoms due to tachycardia	
Performs immediate synchronized cardioversion	
VF/Pulseless VT Management	
Recognizes VF	
Clears before ANALYZE and SHOCK	
Immediately resumes CPR after shocks	
Appropriate airway management	
Appropriate cycles Drug-Rhythm Check/Shock - CPR	
Administers appropriate drug(s) and doses	
Asystole Management	
Recognizes asystole	
Verbalizes potential reversible causes of Asystole/PEA (H's and T's)	
Administers appropriate drug(s) and doses	
Immediately resumes CPR after rhythm checks	
	STOP THE TEST

TEST RESULT	Indicate Pass or Needs Remediation:	P	NR
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Megacode Testing Checklist 4
Tachycardia • VF/Pulseless VT • PEA

Critical Performance Steps	☑ *if done correctly*
Team Leader	
Ensures high-quality CPR at all times	
Assigns team members roles	
Bradycardia Management	
Starts oxygen, places monitor, starts IV	
Places monitor leads in proper position	
Recognizes tachycardia (specific diagnosis)	
Recognizes no symptoms due to tachycardia	
Attempts vagal maneuvers	
Gives appropriate initial drug thetapy	
VF/Pulseless VT Management	
Recognizes VF	
Clear before ANALYZE and SHOCK	
Immediately resumes CPR after shocks	
Appropriate airway management	
Appropriate cycles Drug-Rhythm Check/Shock-CPR	
Administers appropriate drug(s) and doses	
Asystole Management	
Recognizes asystole	
Verbalizes potential reversible causes of Asystole/PEA (H's and T's)	
Administers appropriate drug(s) and doses	
Immediately resumes CPR after rhythm checks	
	STOP THE TEST

TEST RESULT	Indicate Pass or Needs Remediation:	P	NR
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(NCORT)

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