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Ministry of Health Malaysia

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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TRAINING MANUAL

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Advanced Life Support
Training Manual

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9 7 8 9 6 7 2 6 9 2 1 0 2

Table of CONTENTS

Foreword

Chapter 1-11

Table Of CONTENTS

Appendix

Foreword

Foreword

by Director-General of Health Ministry of Health Malaysia

Tan Sri Dato' Seri Dr. Noor Hisham bin Abdullah
Director-General of Health
Ministry of Health Malaysia

The world has been facing unprecedented challenges in battling COVID-19 for the past two years. We are presently still in the midst of facing possibly the greatest challenges of our career. During these troubled times, up to date resuscitation skills and knowledge are vital. Now more than ever, resuscitation training of healthcare workers must prevail not only to obtain the best outcomes for our patients, but also to ensure the safety of those performing these live saving acts.

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The International Liaison Committee on Resuscitation Training (ILCOR) in their five yearly updates, has come up with several new recommendations on resuscitation practices. The National Committee on Resuscitation Training (NCORT) has reviewed and adopted these recommendations into this latest edition of the Advanced Life Support Training Manual.

I sincerely applaud the efforts of the Advanced Life Support Subcommittee of NCORT in coming up with this update. I believe this manual will be an invaluable reference to healthcare workers at all levels of care for the years to come.

Thank you.

Foreword

by Deputy Director-General of Health (Medical) Ministry of Health Malaysia

Dato' Dr. Asmayani binti Khalib
Deputy Director-General of Health (Medical)
Ministry of Health Malaysia

Resuscitation skills are essential for all healthcare staff involved in the care of patients with potentially life-threatening conditions. These life saving measures play an essential role in improving the chances of survival in patients who develop unexpected sudden cardiac arrest. During this ongoing pandemic, numerous recordings of healthcare workers performing CPR have surfaced on social media, increasing the community's awareness of resuscitation. All healthcare staff should therefore grab this opportunity to better equip themselves with these core resuscitation skills in order to better prepare themselves to care for their patients.

Congratulations to the Advanced Life Support (ALS) subcommittee for their continued efforts in ensuring that ALS training in Malaysia is ongoing, accessible, and always kept up to date.

Thank you.

All healthcare staff should therefore grab this opportunity to better equip themselves with these core resuscitation skills in order to better prepare themselves to care for their patients.

CHAPTER 1
Course Overview

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Course Overview

The Advanced Life Support (ALS) course aims to coach vital resuscitation skills to medical personnel especially those working in acute and critical care areas. This course extends beyond the basic ABCs of resuscitation and intends to equip participants with the skills and knowledge to perform as a vital member of the resuscitation team.

Strong Basic Life Support (BLS) skills are the foundation of ALS therefore participants are expected to have passed the BLS Course before enrolling for this course.

The ALS course focuses on developing skills as an individual and as part of a resuscitation team. You are required to fully read the ALS provider training manual before the course. Lectures are brief and not intended to fully encompass all of the learning material.

This ALS course entails active participant immersion in a series of simulations and scenarios with the objective of enhancing the participant's skills in treating patients with unstable arrhythmias or patients with cardiac arrest. These simulations are designed to reinforce the important core concepts of:

- Basic Life Support (BLS)
- Advanced Life Support (ALS)
- Effective resuscitation team dynamics

Course Objectives

Upon completion of this course, participants should be able to:

- Treat and stabilise patients with unstable bradyarrhythmias or tachyarrhythmias.
- Manage cardiac arrest until there is return of spontaneous circulation (ROSC), transfer of care or until termination of resuscitation.
- Demonstrate effective communication as team member or as team leader and recognize the impact of team dynamics on the overall performance of the resuscitation team.

COVID-19 pandemic precautions

To minimise risks to all participants and instructors during the ongoing COVID-19 pandemic, the Advanced Life Support course must be conducted in a two day blended approach involving online training and assessment on Day 1 and in person training and assessment on Day 2.

The proposed ALS course schedule is as follows:

Day 1

0730 – 0800 hrs	Registration
0800 – 0830 hrs	Course overview
0830 – 0900 hrs	Lecture – Airway Management
0900 – 0930 hrs	Lecture – Drugs
0930 – 1030 hrs	Lecture – Algorithm
1030 – 1100 hrs	Tea Break
1100 – 1130 hrs	Lecture - Put it all together
11.30 – 1200 hrs	Lecture – Post cardiac arrest care
1200h – 1230 hrs	Lecture – Ethics in resuscitation
1230 – 1300 hrs	Lecture – Resuscitation during the COVID-19 pandemic
1300 – 1400 hrs	Lunch
1400 – 1530 hrs	Theory exam (MCQ/ECG)

Day 2

0800 – 1200 hrs	Practical training - Airway & Megacode
1200 – 1300 hrs	Lunch
1300 – 1630 hrs	Exam - Airway & Megacode

Participants should remain with the same instructor throughout the duration of the practical training and exam. The following instructor : participant ratios should be adhered to during this pandemic:

- 4 separate megacode stations with an instructor : participant ratio of 1:3 or 1:4
- 4 separate airway stations with an instructor : participant ratio of 1:3 or 1:4

The ALS course may be allowed to return to a pre COVID-19 course format when deemed safe to do so. This will allow for these changes to be implemented:

- Full two day in person course following the same suggested schedule
- Rotation of participants through one airway & three megacode stations
- Instructor : participant ratio of about 1:7 or 1:8 at every station

CHAPTER 2

The Systematic Approach

CHAPTER 2

The Systematic Approach:
BLS Primary Survey & ALS Secondary 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 opening the airway
- Check breathing before starting chest compressions
- Attach an AED, then analyse for a shockable rhythm before delivering a shock

Remember:
- Assess...then perform approciate action.

Table 1: BLS Primary Survey

Assess	Action
***D**anger* • Are there blood spills, sharps, electric wires? • Is the scene dangerous?	Wear PPE (gloves, apron, mask, face shield/goggles) if available Make sure you, the victim and bystanders are safe.
***R**esponsiveness* Is the patient responsive?	Tap shoulders and Say 'Hello! Hello! Are you OK?'
***S**hout for help*	'Emergency! Emergency! Ask for an AED, call ambulance 999 or bring emergency trolley & defibrillator if available
***A**irway* • Is the airway open?	Open the airway using non-invasive techniques (head tilt-chin lift; jaw thrust if trauma is suspected)
***B**reathing* • 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)
***C**irculation* • 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 Pulse check should be done simultaneously with breathing assessment
***D**efibrillation* • Is there a shockable rhythm? • Check with a manual defibrillator 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
- Frequent or inapprociate 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) insertion.

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: 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/jaw-thrust, oropharyngeal airway (OPA) or nasopharyngeal airway (NPA) Use advanced airways if needed (e.g. SGA or ETT)

<table>
<tr><th>Assess</th><th>Action</th></tr>
<tr><td>

Breathing

- Are oxygenation and ventilation adequate?
- Is an advanced airway indicated?
- Is proper placement of airway device confirmed?
- Is ETT secured and placement reconfirmed frequently?
- Are exhaled CO_2 and SPO_2 monitored?

</td><td>

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-valve 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.

Early endotracheal intubation should be considered if the COVID-19 status of the patient is not known.

Once advanced airway device is used:

- Confirm proper placement by:
- Clinical criteria (colour, chest rise, auscultation)
- Capnometry or capnography
- Secure the device to prevent dislodgment
- No more cyclical CPR:
    - perform continuous chest compressions at a rate of 100-120/min and
    - ventilation at a rate of 10 breaths/minute
- Continue exhaled CO_2 measurement

</td></tr>
</table>

Assess	Action
Circulation	
• What is 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, give fluids if needed. Attach ECG leads and monitor for arrhythmias or cardiac arrest rhythms (VF, pVT, asystole and PEA) Give appropriate drugs to manage rhythm (e.g. amiodarone, lignocaine, atropine, magnesium) and blood pressure (adrenaline) Other inotropes or vasopressors to be considered after ROSC is achieved. (dopamine, noradrenaline, adrenaline)
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 (definitive care). Look for 5Hs and 5Ts causes • 5Hs: Hypoxia, Hydrogen ion, Hypothermia, Hypovolemia, Hypo/ hyperkalaemia • 5Ts: Tamponade (cardiac), Tension pneumothorax, Thrombosis (pulmonary or coronary), Toxins.

CHAPTER 3
Team Dynamics

CHAPTER 3

Team Dynamics

Roles

Team Leader

Organizes the group, monitors individual performance of team members, be able to perform all necessary clinical skills, direct and back up team members, model excellent team behaviour, trains and coaches, facilitates understanding and focuses on comprehensive care and able to provide critique of group performance after resuscitation effort.

Team Member

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

Team Dynamics and Communication

Closed Loop Communication

Clear communication between team leaders and team members is essential. When communicating with team members, the leader should use closed loop communication. The leader gives clear order or assignment and then confirm that the message is heard. The team member verbally repeats the order to confirm that the order or assignment is 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 is 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 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, team leader or member may need to intervene if an action is about to occur at an inappropriate time. For example, 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. In actual fact the adrenaline should be repeated every 3 to 5 minutes. All suggestions for a different intervention or action should be done tactfully and professionally by the team leader or member. Again, in all settings, we must be professional and gracious when providing constructive feedback.

Re-evaluation and Summarising

An essential role of the team leader is monitoring and re-evaluation 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.

Team debriefing

A team debriefing could be done, led by the team leader after the resuscitation has been completed and the patient has been admitted to a critical care ward to discuss pertinent issues that occurred during the resuscitation and reinforce teaching points among members.

CHAPTER 4

Airway Management & Ventilation

CHAPTER 4

Airway Management & Ventilation

Highlights of 2020 Resuscitation Guidelines on Airway Management

- During the early phase of CPR, a rescuer should start with a basic airway intervention and gradually step up according to the skills of the rescuer in managing the victim's airway
- Only those who are competent and familiar with the technique should attempt endotracheal intubation (to achieve → 95% of success within 2 attempts)
- Chest compression should not be interrupted for → 5 seconds during endotracheal intubation
- Endotracheal intubation using video laryngoscope is encouraged according to rescuer experience especially during COVID-19 era
- Waveform capnography should be used to confirm correct endotracheal tube placement.
- When supplementary oxygen is available, use the maximal feasible inspired oxygen concentration during CPR
- Do not use End Tidal CO^{2} as a sole indicator to prognosticate resuscitation outcome
- If oxygen leakage occurs while using supraglottic airway devices resulting in inadequate ventilation, pause compression and change back to using 30:2 compression: ventilation ratio

Overview of Airway Management

Maintaining oxygenation during CPR and peri-arrest period is important. As an integral part of oxygenation, a patent airway is paramount to facilitate adequate ventilation to improve oxygenation and sufficient elimination of carbon dioxide.

Airway management during resuscitation depends on patient factors, the phase of resuscitation (during CPR or after ROSC) and the skill of the rescuers. A variety of modalities of airway management e.g. bag valve mask (BVM), supraglottic airway devices (SGAs) and endotracheal tube (ETT) are considered during resuscitation as a part of stepwise approach to airway management. Ultimately endotracheal intubation is needed for post resuscitation care if the victim remains unconscious after ROSC.

Oxygen during CPR

1. Use the maximal feasible inspired oxygen concentration if available during CPR.

2. After ROSC, titrate the inspired oxygen concentration to achieve the SpO_2 in the range of 94 – 98% or arterial partial pressure of oxygen 75 – 100 mmHg.

Adjuncts for Airway Management and Ventilation

1. There are various modalities for managing the airway during resuscitation depending mainly on the skill and the familiarity of the rescuer. Options include bag mask ventilation (BMV), supraglottic airway devices (SGAs) and endotracheal intubation.

2. There is inadequate evidence to show the difference in survival or favorable neurological outcome with the use of bag mask devices (BMV), supraglottic airway devices (SGAs) and endotracheal tube (ETT). Either BMV or an advanced airway (SGAs, ETT) may be used for oxygenation and ventilation during CPR.

3. Once an advanced airway has successfully been inserted, there is no more cyclical CPR (30:2). The ventilation rate should be 10 breaths per minutes (1 breath every 6 seconds) and chest compression should be 100-120 per minute. Deliver ventilation over 1 second to achieve a visible chest rise.

4. Cricoid pressure during CPR is not recommended as it can impair ventilation and may cause airway obstruction.

Oxygen Delivering Devices

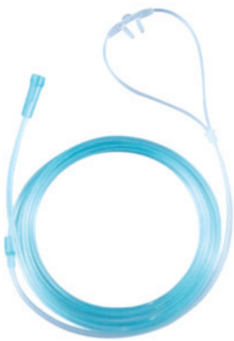
Patients in respiratory distress often require oxygen therapy. There are various oxygen delivering devices that can deliver supplemental oxygen concentration from 21% - 100%.

Table 1. Delivery of Supplemental Oxygen: Flow Rates and Percentages of Oxygen Delivered

Device	Flow Rates (L/min)	Delivered Oxygen (%) - approximate
Nasal Cannula	1 2 3 4 5 6	21 - 24 25 - 28 29 - 32 33 - 36 37 - 40 41 - 44
Simple Face Mask	6 - 10	35 – 60
Venturi Mask	4 - 8 10 - 12	24 - 40 40 – 50
Mask with O_2 Reservoir Rebreathing Non-rebreathing	10 - 15 10 - 15	70 - 80 95 - 100

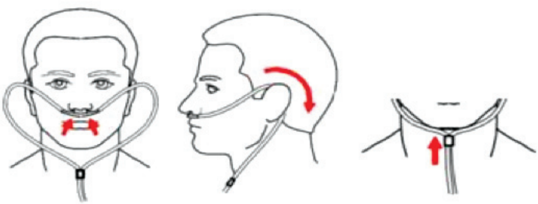
Nasal Cannula

- 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



Nasal Cannula

Correct Placement of Nasal Cannula



Nasal Cannula insertion steps

Simple Face Mask

- Made from silicone rubber or transparent plastic
- Various size, from pediatric to big adult
- Fits loosely on the face, which allows room air to be inhaled, if needed
- O_2 concentration depends on:
  - O_2 supply flow rate
  - Patient inspiratory flow rate
  - Pattern of ventilation
  - Tight fit of the mask

- Supplies 35% to 60% oxygen with flow rates of 6 to 10L/ minute
- Does not supply oxygen > 60%

Simple Face Mask

Venturi Mask

- Based on Bernoulli's principle
  - O_2 passes 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.

Venturi Mask

- Gives desired concentration of oxygen to patient (24% to 60%)
- Ideally used for patient with Chronic Obstructive Pulmonary Disease (COPD)

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:

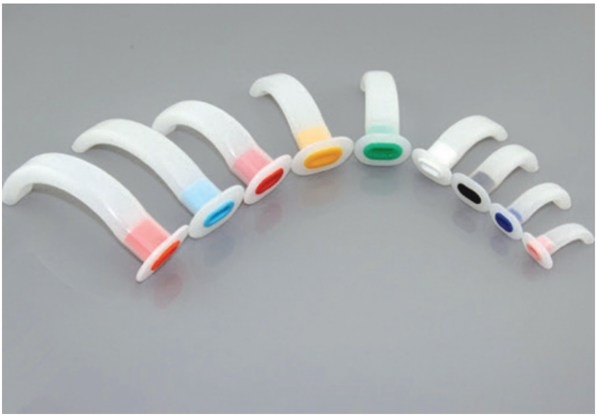
Rebreathing system	Non-rebreathing system
• No valve and so gas exhaled in the initial phase of expiration returns to the reservoir bag	• Presence of a one-way valve that prevents any exhaled gas from returning to the reservoir bag
• Provides up to 70% to 80% O_2 with flow rates of 10-15 L/minute	• Provides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

Non Rebreathing Mask

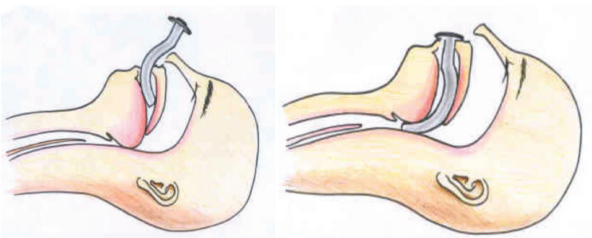
Non-invasive Airway Devices

Oropharyngeal Airway

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



Variety of orophraryngeal airway sizes



Placement of Oropharyngeal Airway

Nasopharyngeal Airway

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

Nasophryngeal Airway

Placement of Nasopharyngeal Airway

Manual Assist Ventilation

In unconscious or semi-conscious victims, the healthcare provider should open the airway by head tilt-chin lift or jaw thrust (if suspected cervical injury). An oropharyngeal or nasopharyngeal airway may be used to prevent the tongue from occluding the airway.

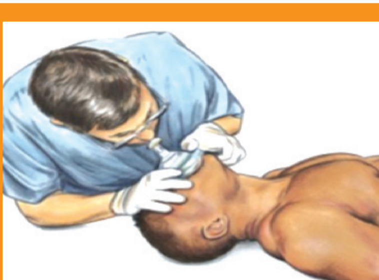
Head tilt – Chin lift or "Sniffing Position"

Jaw Thrust (Suspected C-Spine injury)

Mouth to Mask Ventilation (Pocket Resuscitation Mask)

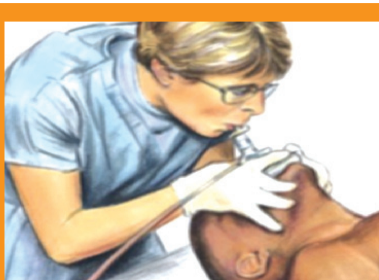
- Pocket resuscitation mask is a one-way valve mask
- Advantages:
  - Eliminates direct contact
  - Oxygenates well if O_2 attached
  - Easier to perform than bag-mask ventilation
  - Best for small-handed rescuers

- Two ways of carrying out mouth to mask ventilation depending on whether there are 1 or 2 rescuers
- Not recommended during the COVID-19 pandemic



1-Rescuer Technique

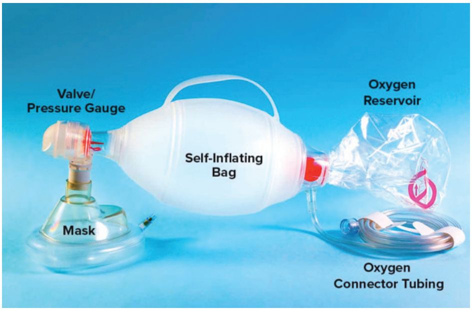
- Performed from sides
- Rescuer slides over for chest compressions
- Fingers-head tilt-chin lift



2-Rescuer Technique

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

Bag-mask Ventilation



- The bag-mask device consists of a self-inflating bag with a non-rebreathing valve
  - Can be used with a face mask or an advanced airway e.g. Supraglottic airway devices (SGAs) or endotracheal tube (ETT)
  - Provides positive pressure ventilation
  - Cannot be used to allow spontaneous breathing

- Adequate ventilation can be ensured when there is a visible chest rise (5-6 ml/kg)
- Overventilation may result in gastric inflation with complications such as regurgitation and aspiration.
- The bag mask device is held with an EC clamps technique using either 1 hand or 2 hands.

2 Hand (E-C Clamp Technique)

1 Hand (E-C Clamp Technique)

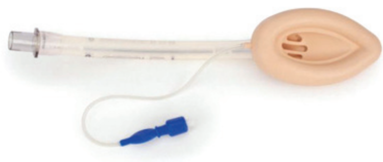
Advanced Airway Devices

Supraglottic Airway Devices (SGAs)

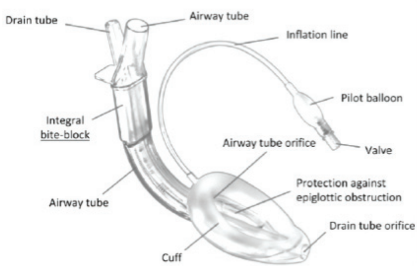
SGAs are devices designed to maintain an open airway and facilitate ventilation. Insertion of a supraglottic airway device does not require visualization of vocal cords, therefore can be done with minimal chest compression interruptions.

Laryngeal Mask Airway

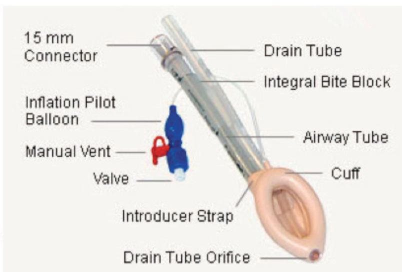
- An advanced airway device that is considered an acceptable alternative to the ETT
- Technically easier to insert with minimal interruption to chest compression
- Ventilating a patient via LMA does not protect against gastric aspiration
- Composed of a cylindrical tube with a cuff and connected to an inflatable pilot balloon



Classic LMA



Supreme LMA



Proseal LMA

Recommended Size Guidelines for LMA in adults

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 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)	30ml
Size 5	>70 kg (large adult)	40ml

- STOP inflating ONCE no more air leak from mouth

Insertion of LMA

Before inserting an LMA, the following items must 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 selections – 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 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

---

Step 4: Lubrication of LMA cuff/mask

- Use a water-soluble lubricant to lubricate
- Only lubricate LMA cuff/mask just prior to insertion
- Lubricate back of LMA cuff/mask thoroughly
- Avoid excessive lubricants on interior 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 pull the lower jaw downwards
  - Visualize the posterior oral cavity
  - Ensure that LMA is not folding in the cavity as it is inserted

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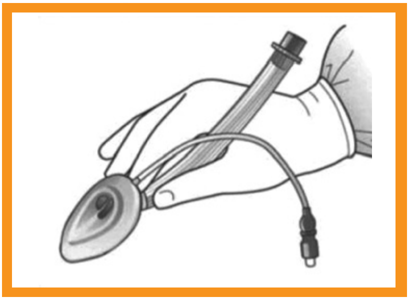
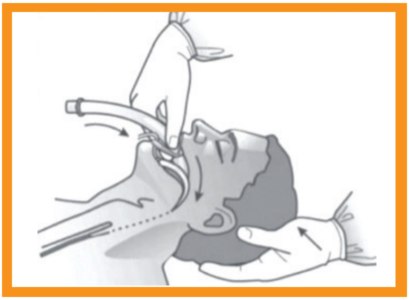
Below are a series of diagrams showing the insertion of LMA:



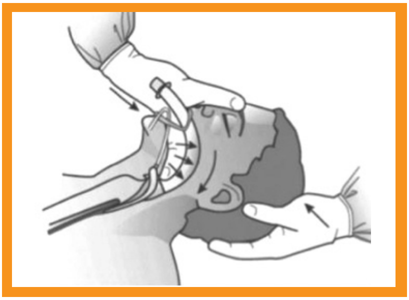
1 | Method for holding the LMA for standard insertion technique

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

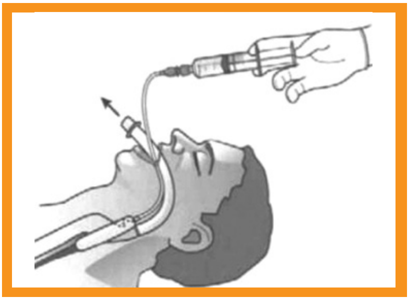


4 | The index finger pushes LMA in a cranial direction following the contours of the hard and soft palates



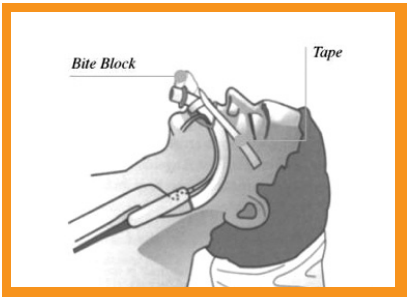
5 | Maintaining pressure with finger on LMA in the cranial direction, advance LMA until definite resistance is felt at the base of the hypopharynx: note flexion of the wrist

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



7 | 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



8 | 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 and no air leaks from mouth

COMPLICATIONS OF SGAs

1. Aspiration (in patient with full stomach)
2. Laryngospasm
3. Bronchospasm
4. Airway trauma
5. Inadequate ventilation due to gas leakage

Endotracheal Tube (ETT)

Endotracheal intubation is the gold standard for airway management 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 protects the airway against aspiration. Endotracheal intubation should only be performed by trained personnel.

Laryngoscope

- Consists of a handle (which contains a battery power source) and a blade
- 2 types of blades: Macintosh blade (curved) for adults, Miller blade (straight) for newborn and infants
- Before using the laryngoscope, ensure that the light on the blade is in good working order

Endotracheal Tube

Choosing The Correct Size ETT

Age	Internal Diameter (mm)	Length at lip for Oral ETT
Adult Male	7.5-8.0	20-22 cm
Adult Female	7.0-7.5	18-20 cm

Preparation for Endotracheal Intubation

The equipment needed for intubation may be remembered as mnemonic **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/Younker), Syringe, Stylet

- Adequate oxygen source
  - wall or cylinder
  - if oxygen source is from oxygen cylinder, check O_2 pressure
- Enough helping hands
- Equipment to confirm correct placement of ETT i.e. Stethoscope, CO_2 detector devices
- Resuscitation and intubation drugs available and ready

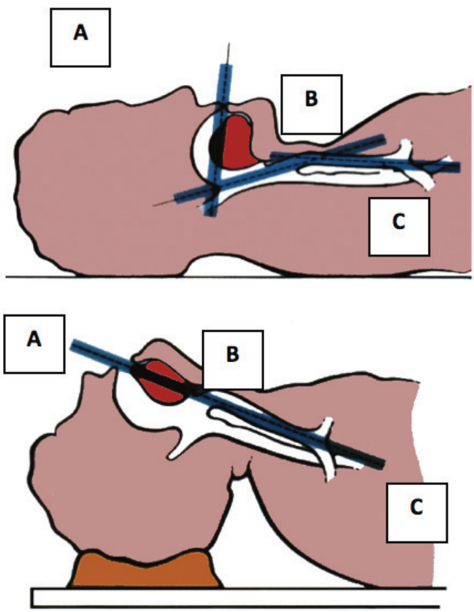
The Technique of Endotracheal Intubation

The following steps are necessary for successful endotracheal intubation:

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

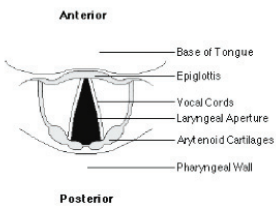
Step 2: Preoxygenation

- 100% O_2 for 3 minutes or with 4 vital capacity breaths (maximal inspiration)

Step 3: Laryngoscopy and insertion of ETT

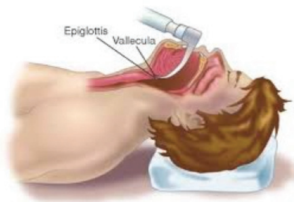
3A : Laryngoscopy

- Hold the laryngoscope in the left hand
- Enter at the right side of the mouth and push the tongue towards the left
- Move the laryngoscope blade towards the midline and advance to the base of the tongue
- Advance the laryngoscope blade to the vallecula
- Lift upward and forward to bring up the larynx and vocal cords into view. Do not use teeth as a fulcrum or a lever



Laryngoscopic View

Hand Position



Macintosh laryngoscope blade position

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 2.5 cm further into the trachea
- Inflate the ETT with enough air to occlude the airway to achieve an adequate seal
- Ideally a cuff manometer should be used to obtain a cuff pressure of 20 – 30 cm H_2O

Important point to note: Endotracheal intubation attempts should not interrupt chest compression for more than 5 seconds

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Step 4A: Correct placement of ETT can be suggested by:

- Observing colour of patient
- Visualizing chest rise and presence of vapour in the ETT during ventilation
- 5 points auscultation for breath sounds (auscultate epigastrium, anterior chest at bilateral mid-clavicular lines and thorax at bilateral mid-axillary lines)

Step 4B: Confirmation of ETT placement is by:

- End-tidal CO_2 with capnography
- CO_2 detector device

Step 5: Secure ETT with tape

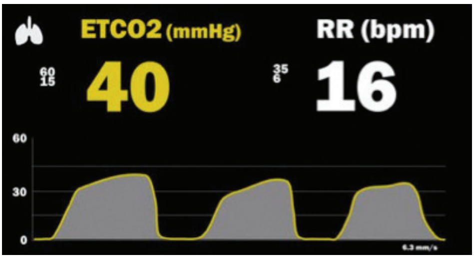
Step 6: Ventilate with a tidal volume of 6-8 ml/kg at a rate of 10 breaths per minute

Waveform Capnography

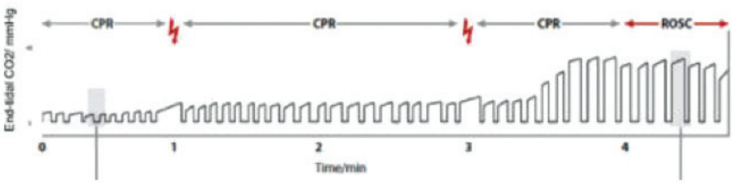
Continuous waveform capnography is recommended as the most reliable method of confirming and monitoring correct placement of the endotracheal tube (ETT).

End-tidal CO_2 during resuscitation:

- Confirms ETT placement
- Correlates with cardiac output
- Assesses adequacy of ventilation
- Indicates quality of CPR
- Signifies ROSC
- Carries prognostic value for survival during resuscitation



Waveform Capnography.
Normal range (approximately 35 to 45 mmHg)



- Waveform Capnography during resuscitation. Abrupt rise indicates return of spontaneous circulation.
- Use $EtCO_2$ as a guide for monitoring the quality of chest compressions

Complications of Endotracheal Intubation

During Intubation	Hypoxia, 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 into bronchus
	Obstruction from kinking, secretions or over-inflation of cuff
	Disconnection from breathing circuit
	Accidental extubation/ETT dislodgement
	Lip ulcer in prolonged oral intubation
	Infection
After Extubation	Sore throat
	Hoarseness
Long term	Subglottic stenosis
	Vocal cord granuloma
	Laryngeal granuloma

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 -120 mmHg (adults)

Complications of Tracheobronchial Suctioning

- Sudden severe hypoxia during the application of negative pressure in the trachea (due to decrease in functional residual capacity)
- Cardiac arrest if severe hypoxia
- Increase in blood 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 the 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 the duration of suctioning to 10-15 seconds. If desaturation or arrhythmias occur, immediately discontinue suctioning and manually bag patient with O_2
Step 6	Prior to repeating the procedure, the patient should be ventilated with 100% O_2 for about 30 seconds

CHAPTER 5
ALS Core ECG Rhythms & Recognition

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ALS Core ECG Rhythms & Recognition

Recognising different types of ECG changes is important during resuscitation. This chapter illustrates not only normal sinus rhythm but also include the different types of arrhythmias that may be seen in patients requiring resuscitation.

1. Normal sinus rhythm

Defining Criteria	
Rate	60 - 100
QRS Complex	Normal and Narrow (< 100ms wide)
Rhythm	Regular, Sinus rhythm P wave is followed by a QRS complex
P wave	P interval is constant (P-R interval < 0.2 sec). Normal P wave morphology and axis (upright in I and II, inverted in aVR)

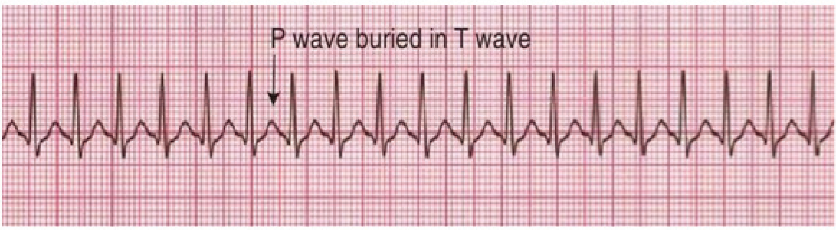
2. Sinus arrhythmia

Defining Criteria	
Rate	Varies
QRS Complex	Normal
Rhythm	Sinus or irregular
P wave	Normal

3. Sinus tachycardia

Defining Criteria	
Rate	> 100 per minute
QRS Complex	Normal
Rhythm	Sinus, regular
P wave	P for every QRS complex P waves may be hidden within each preceding T wave at higher rate.

4. Supraventricular tachycardia

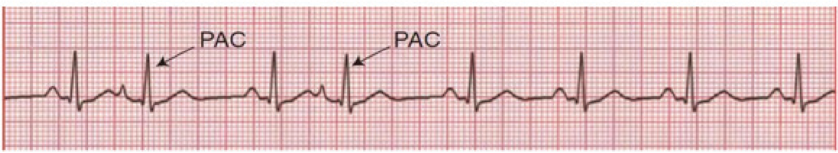


Defining Criteria	
Rate	Atrial rate 120 to 150 per minute or >150bpm
QRS Complex	Normal and Narrow
Rhythm	Regular
P wave	Seldom seen due to rapid rate because p wave "hidden" in preceding T waves

5. Sinus bradycardia

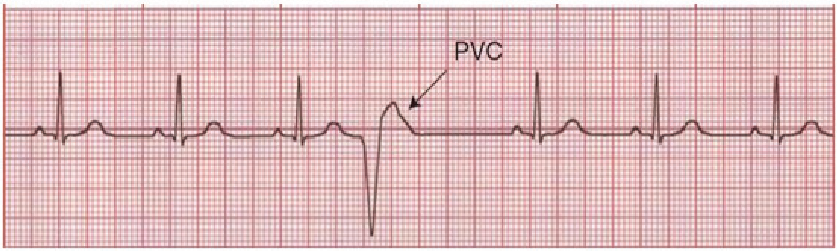
Defining Criteria	
Rate	<60 per minute
QRS Complex	Normal
Rhythm	Regular Sinus
P wave	Normal, every P wave followed by QRS complex

6. Premature atrial complexes



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

7. Premature Ventricular Complexes (PVCs)

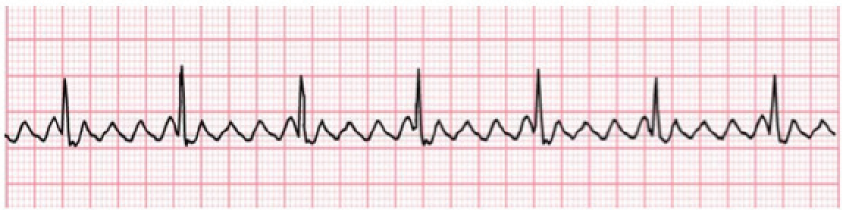


Defining Criteria	
Rate	Sinus rate with presence of ventricular ectopic
QRS Complex	Normal QRS complex with presence of single broad QRS complex (≥ 120 ms) with abnormal morphology
Rhythm	Regular with extra beats, pause beat
P wave	Present before normal QRS complex

8. Atrial fibrillation

Defining Criteria	
Rate	Variable ventricular rate
QRS Complex	Present, usually < 120 ms Absent isoelectric baseline
Rhythm	Irregular
P wave	No P waves. Chaotic atrial fibrillatory waves Fibrillatory waves may mimic P waves leading to misdiagnosis

9. Atrial flutter



Defining Criteria	
Rate	Atrial rate **250** 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

10. 1st degree heart block

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

11. Second-Degree AV Block Mobitz 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 occur from cycle to cycle, then one P is not followed by QRS complex- "dropped beat"

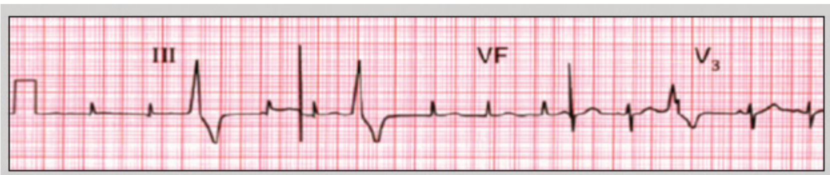
12. Second-Degree AV Block Mobitz Type II

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

13. 3rd degree heart block

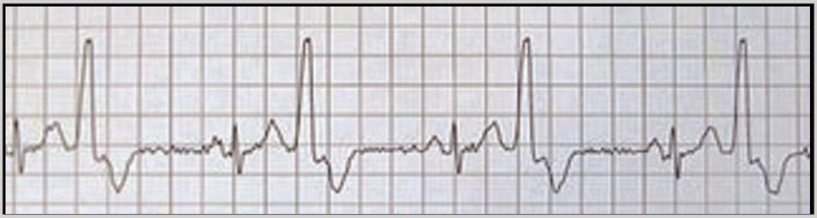
Defining Criteria	
Rate	Atrial rate 60 to 100 per minute, dissociated from ventricle rate. Ventricle rate depend on rate of ventricle escape beats
QRS Complex	Complete absence of AV conduction – *none* of the supraventricular impulses are conducted to the ventricles. Narrow implies high block relative to AV node Wide implies low block relative to AV node
Rhythm	Atrial and ventricular rate regular but independently "dissociated"
P wave	Normal

14. Multifocal Ventricular 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

15. Ventricular bigeminy

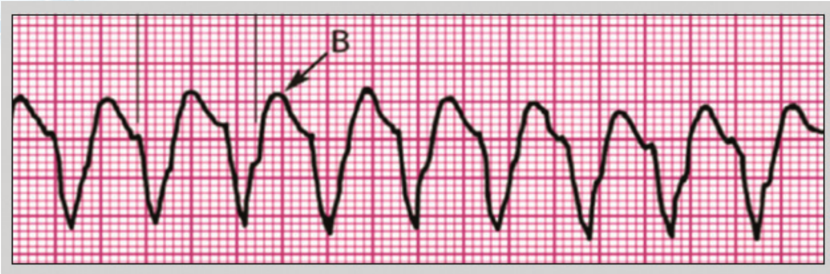


Defining Criteria	
Rate	Sinus rate with presence of ventricular ectopic.
QRS Complex	Normal QRS complexes with alternating broad QRS complexes
Rhythm	Sinus rate with alternating ventricular rate
P wave	Present before normal QRS complex

16. Couplets

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

17. Monomorphic VT

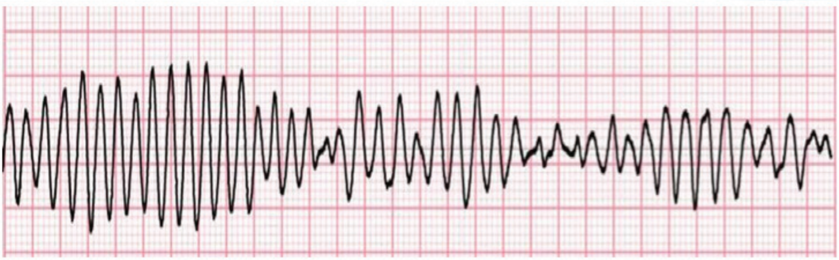


Defining Criteria	
Rate	>100per minute, typically 120 to 250 per minute
QRS Complex	Wide and bizarre, PVC like complexes >0.12 second
Rhythm	Regular ventricular rate
P wave	Seldom seen but present
Escape Beat	Occasional chance capture of a conducted P wave I. Capture Beat - QRS morphology looks like a normal QRS complex II. Fusion Beat - "Hybrid " QRS complex, fusion of a normal QRS morphology and the ventricular morphology from the VT
Nonsustained VT	Last < 30 seconds

18. Polymorphic VT

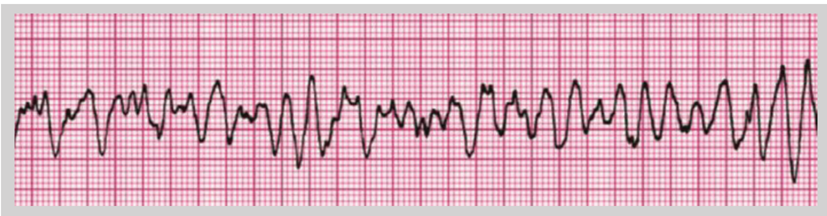
Defining Criteria	
Rate	150 to 250 per minute
QRS Complex	Display classic spindle-node pattern
Rhythm	Irregular ventricular rhythm
P wave	Non-existent

19. Torsades De Pointes



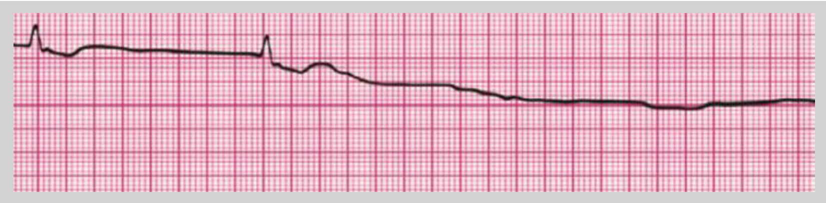
Defining Criteria	
Rate	150 to 250 per minute
QRS Complex	QRS showed continually changing of axis (hence 'turning of point')
QT Interval	Prolonged
Rhythm	Irregular ventricular rhythm.
P Wave	Non-existent

20. Ventricular fibrillation



Defining Criteria	
Rate	150 to 500 per minute
QRS Complex	Chaotic irregular deflections of varying amplitude. No identifiable P waves, QRS complexes, or T waves
Rhythm	Indeterminate
Amplitude	Can be described as fine (peak to trough 2 to < 5mm), medium (5 to < 10 mm), coarse (10 to < 15 mm) or very coarse (> 15 mm)

21. Asystole



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

CHAPTER 6
Defibrillation and Electrical Therapy

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Defibrillation and Electrical Therapy

- Defibrillation is indicated in approximately 20% of cardiac arrests
- Defibrillation is a vital component of CPR as it has the potential to terminate Ventricular Fibrillation (VF)/ pulseless Ventricular Tachycardia (pVT) and achieve ROSC
- Knowledge of how to use a defibrillator (manual or Automated External Defibrillators (AEDs) is key for rescuers performing Advanced Life Support (ALS)
- In order to minimise interruptions to chest compressions when using a manual defibrillator, rescuers should aim to take less than 5 seconds to recognise a shockable cardiac arrest rhythm and make the decision to give a shock

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
- Indicated only for VF or pVT where a single shock is given followed immediately by chest compression without any pulse check or rhythm reanalysis after a shock
- Shock success typically defined as the termination of VF within 5 seconds after the shock. Shock success using this definition does not equal to resuscitation outcome

The Importance of Early Defibrillation

Early defibrillation is crucial to survival from sudden cardiac arrest (SCA) due to the following:

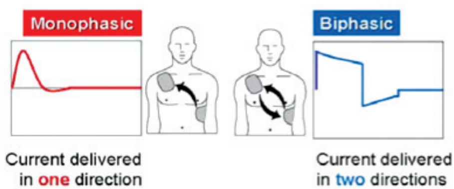
- Most frequent initial collapsed rhythm in out-of-hospital cardiac arrest (OHCA) is VF
- Defibrillation is the mainstay of therapy to terminate VF
- The probability of successful defibrillation diminishes rapidly over time
- VF tends to deteriorate to asystole over time

Defibrillation should be done without delay when a defibrillator machine is immediately available. Routine delivery of 2 minutes CPR before rhythm analysis and shock for an unwitnessed VF is not recommended.

Defibrillators

- Modern defibrillators are classified according to 2 types of waveforms: **monophasic** and **biphasic**
- Energy levels vary by type of device and manufacturer
- Biphasic defibrillators have greater efficacy in terminating atrial and ventricular tachyarrhythmias.
- Biphasic defibrillators are more commonly used nowadays

Figure 1: Monophasic & biphasic defibrillator waveforms



Monophasic Waveform Defibrillators

- Current delivery of one polarity (i.e., direction of current flow)
- Categorized by the rate at which the current pulse decreases to zero

Biphasic Waveform Defibrillators

- Equivalent or higher efficacy for termination of VF when compared with monophasic waveforms.
- There are two main types of biphasic waveform:
  - **Biphasic Truncated Exponential (BTE)** and
  - **Rectilinear Biphasic (RLB)**

Defibrillation energy levels and number of shocks

There is absence of clear evidence regarding optimal initial and subsequent energy levels for shock. Any initial **energy level ranging from 120 – 360 J** is acceptable, followed by fixed or escalating energy up to the maximum output of the defibrillator.

There remains no evidence to support either a **fixed or escalating energy protocol.** Both strategies are acceptable; however, if the first shock is not successful and the defibrillator is capable of delivering shocks of higher energy, it is reasonable to increase the energy for subsequent shocks.

A single shock strategy is reasonable in preference to stacked shocks for defibrillation in the setting of unmonitored cardiac arrest.

In the setting of **monitored cardiac arrest** with defibrillator available immediately (during cardiac catheterisation or high-dependency areas), **use of up to three-stacked shocks may be considered.**

Preparing the Patient

Electrode/Paddle Size

- A larger pad/paddle size (within the limits of 8 - 12 cm in diameter) lowers transthoracic impedance
- Defibrillators with self-adhesive pads have largely replaced defibrillation paddles in clinical practice

Electric/Paddle force

- 8kg force in adult

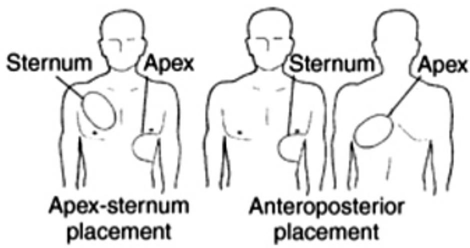
Transthoracic Impedance

- Use gel pads and 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

- **Anterolateral (sternal-apical)** is the position of choice.
    - The right (sternal) pad is placed to the right of the sternum, below the clavicle
    - The apical pad is placed in the left mid-axillary line, approximately level with the V6 ECG electrode
- Also consider an alternate pad position when the patient is in the **prone position (bi-axillary)**
- Anterior-left infrascapular, and anterior-right infrascapular electrode placements are comparably effective
- Ensure that the paddle and gel or pads are in full contact with the skin

Figure 2: Placement options for defibrillation paddles or electrodes



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 (ICD)**
  - Pad placement to avoid implantable medical devices
  - **Place the pad** away from the device **(at least 8 cm)** or use an alternative pad position (anterior-lateral, anterior-posterior)

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**, taking off any **oxygen mask or nasal cannula and place them at least 1 m away** from the patient's chest. **Ventilator circuits should remain attached**
- Use self-adhesive defibrillation pads
- Ensure good pad–chest-wall contact
- If manual paddles are used, gel pads are preferable to electrode plates and gels because the plates 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 team members are in contact with patient or resuscitation trolley prior to defibrillator discharge

Safety Measures During Defibrillation

- 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
- Remove the oxygen delivery device if in use
- When pressing the shock button, the defibrillator operator should face the patient, not the machine
- A clear and firm warning should be given before delivering a shock (e.g., "Clear shocking")
- Everyone must stand clear of patient
- The entire sequence should take less than 5 seconds

Table 1: Steps when performing defibrillation

1	**Attach ECG leads to patient's chest**
2	**Turn defibrillator on – select leads**
3	**Analyse the rhythm* Shockable?**
4	**Apply gel pad to patient's chest**
5	**Select energy level**
6	**Apply paddles to chest**
7	**Charge the paddles**
8	**Ensure safety measures as above**
9	**Check monitor again**
10	**Discharge shock and return the paddles to the machine**
11	**Resume CPR**

** A quick rhythm check may also be performed using the paddle mode*

- Pre shock pause should be no more than 5 seconds. Even a 5 – 10 second delay will reduce the chance of survival. Use of adhesive pad is encouraged to reduce delay

- Continue giving high quality chest compression for 2 minutes after delivery of shock to improve coronary perfusion pressure and cerebral perfusion. Check the pulse and rhythm only after completing 2 minutes of CPR

Synchronized Cardioversion

- A shock delivery that is timed to occur with the R wave of the electrocardiogram rather than with the T wave

- 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 and Monomorphic VT with pulse

- Conscious patients require anaesthesia or sedation, before attempting synchronised cardioversion

Table 2: Recommended Energy Level for Synchronized Cardioversion (ERC Guidelines)

Waveform	Biphasic energy	Monophasic energy
Narrow regular (SVT, Atrial Flutter)	70 – 120 J	100 J
Narrow irregular (Atrial Fibrillation)	120 – 150 J	200 J
Broad complex tachycardia (VT)	120 – 150 J	200 J
Monomorphic VT	120 – 150 J	200 J

Atrial Fibrillation

- An initial synchronised shock at maximum defibrillator output rather than an escalating approach is a reasonable strategy based on current data

Atrial Flutter and Paroxysmal Supraventricular Tachycardia

- Give an initial shock of 70 -120 J
- Give subsequent shocks using stepwise increase in energy

Ventricular Fibrillation (VF)

- CPR and defibrillation are the mainstay treatment for VF
- Defibrillation as soon as the defibrillator machine is available
- Use of adrenaline after the 2nd shock
- Use of antiarrhythmic after the 3rd shock

  ** For further details refer to the VF algorithm*

Recurrent ventricular fibrillation (refibrillation)

- Recurrence of fibrillation is usually defined as '**recurrence of VF during a documented cardiac arrest episode**, occurring after initial termination of VF while the patient remains under the care of the same providers

- **Consider escalating the shock energy** after a failed shock

Refractory ventricular fibrillation

- Refractory VF is defined as **fibrillation that persists after three or more shocks** and occurs in approximately 20% of patients who present in VF

- **Consider escalating the shock energy** or using an **alternative defibrillation pad position** (e.g., anterior-posterior)

Patient with witnessed and monitored VF

- In areas where the **self-adhesive pads are already attached to the patient** e.g., invasive catheterization laboratory, coronary care unit, critical care unit

- **3 quick and successive (stacked) shocks** are recommended

- Chest compression is unlikely to improve the already very high chance of ROSC when defibrillation occurs early in the electrical phase, immediately after onset of VF

Dual/Double Sequential Defibrillation (DSD)

- Involves the use of 2 defibrillators to deliver 2 overlapping shocks or 2 rapid sequential shocks to treat refractory VF
- However, the latest guidelines do not recommend the routine use of DSD

Ventricular Tachycardia (VT)

- **If pulseless VT (pVT)**
  - Treat as VF
- **Unstable Polymorphic (Irregular) VT**
  - Treat as VF using defibrillation doses
  - Polymorphic VT that occurs in the setting of QT prolongation in sinus rhythm is considered as Torsades de Pointes
    - Prompt defibrillation is indicated in patients with hemodynamically unstable Torsades de Pointes
    - In the conscious patient with recurrent episodes of Torsades de Pointes, IV magnesium sulfate (initial dose of 1 to 2 grams IV over 15 minutes, may be followed by an infusion) is first-line therapy
- **Unstable Monomorphic (Regular) VT with a Pulse**
  - Treat with biphasic waveform cardioversion (synchronized) at 120 J - 150 J or monophasic waveform cardioversion at 200 J
  - If the initial shock fails, increase the dose in a stepwise fashion

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

CHAPTER 7

Drugs in Resuscitation

CHAPTER 7
Drugs in Resuscitation

Highlights of 2020 Resuscitation Guidelines on Drugs in Resuscitation

- The use of adrenaline is highly recommended during CPR
- In non-shockable cardiac arrest, adrenaline is to be administered as soon as feasible
- For shockable rhythm, adrenaline should be administered after initial two defibrillation attempts have failed
- Vasopressin is not recommended to replace adrenaline or to be used together with adrenaline during CPR
- Intravenous (IV) is the preferred route of drug administration. Intra-osseus (IO) maybe considered if attempts at IV is not successful or feasible

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 (PSVT) 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 re-entry involving AV node or sinus node
- May be considered for narrow complex re-entry 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 20 mL saline flush
- If unsuccessful, this can be followed with 12 mg 1- 2 minutes later
- If still unsuccessful, followed with 18 mg 1- 2 minutes later

Side-effect and Precautions

- Transient unpleasant side effects, in particular nausea, flushing, and chest discomfort
- Caution if need to be given in asthmatic patient
- 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
- The initial dose should be reduced to 3 mg in patients taking dipyridamole or carbamazepine

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 and survival to discharge, although no difference in survival at 3 months (systematic review and meta-analysis)
- Better outcome when administered early
- 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

- V/IO: 1mg (1 ml 1:1000) administered every 3 - 5 minutes followed by 20ml flush
- Administer as soon as feasible in non-shockable rhythm
- Administer after second defibrillation in shockable rhythm
- If IV/IO is difficult to establish, adrenaline can be given through ETT at dose of 2 - 2.5 mg
- For Symptomatic Bradycardia (2nd degree Heart Block Type 2 and 3rd degree Heart Block), infusion at 2 - 10 µg/minute, titrated to response

For Anaphylactic Shock

- IM : adult or children → 12 years give 0.5 mg as initial dose (0.5 ml of 1:1000)
- IV: titrate 50-100 µg (0.5 - 1 ml) according to response (use 10 ml 1:10000)

Side-effect and Precautions

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

Aminophylline

Introduction

- Adenosine receptor antagonist and phosphodiesterase inhibitor
- Stimulate cardiac muscle → tachycardia and increase cardiac contractility
- Relaxes smooth muscle → bronchodilator

Indications

- Alternative drug for severe symptomatic bradycardia not responding to atropine
- Safely used in inferior MI patients, post-cardiac transplant patients and acute spinal injury patients
- Also used to treat acute exacerbation of bronchial asthma (not discussed here)

Dose and Administration

- 100 – 200 mg IV slow injection

Side-effect and Precautions

- Stimulate CNS causing difficulty to sedate
- Can precipitate arrhythmia
- Diuresis due to increase in anti-diuretic hormone (CNS stimulation)
- Increase gastric acid secretion with increased risk of aspiration

Amiodarone

Introduction

- An antiarrhythmic with complex pharmacokinetics and pharmacodynamics properties.
- Act on sodium, potassium and calcium channels.
- Poses alpha and beta-adrenergic blocking properties
- A membrane-stabilising anti-arrhythmic drug that increases the duration of the action potential and refractory period in atrial and ventricular myocardium
- 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 VF/pVT (persistent after at least 3 shock and adrenaline)
- Unstable tachyarrhythmias (failed 3x cardioversion)
- Stable tachyarrhythmias

Dose and Administration

- Refractory VF/pVT : IV/IO 300 mg bolus (dilute in 20 mL Dextrose 5% solution) after 3rd defibrillation
- Can repeat after the 5th defibrillation : 150 mg
- Unstable tachyarrhythmias; 300 mg IV over 10 - 20 minutes
- Stable tachyarrhythmias; 300 mg IV over 20 - 60 minutes
- Maintenance infusion; 900 mg IV over 24h (if needed)

Side-effect 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 → 2.2 g are associated with hypotension)

Atropine

Introduction

- An anticholinergic agent
- Antagonises the action of the parasympathetic neurotransmitter acetylcholine (Ach) at muscarinic receptors. Therefore, it blocks the effect of vagus nerve on both the Sino-Atrial (SA) node and the Atrio-Ventricular (AV) node, increasing sinus automaticity and facilitating AV node conduction

Indications

- First line drug for symptomatic bradycardia
- Organophosphate poisoning

Dose and Administration

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

Side-effect and Precautions

- 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

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

- Hyperkalaemia
- Hypocalcaemia
- Overdose of calcium channel blocker
- Hypermagnesaemia

Dose and Administration

- The initial dose of 10 ml 10% calcium chloride (6.8 mmol calcium) may be repeated if necessary
- Administer calcium chloride via a central line if possible

Side-effect 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

Dobutamine

Introduction

- Used as a positive inotropic drug of choice in the post-resuscitation period
- It has beta-agonist activity which causes vasodilatation and increase in heart rate especially direct stimulation of beta-1 receptors

Indications

- In hypotension with poor output state
- With presence of pulmonary oedema where hypotension prevents the use of other vasopressors

Dose and Administration

- 5 – 20 μg/kg/min as continuous infusion

Side-effect and Precautions

- May worsen hypotension especially during the start of treatment
- Can increase the risk of arrhythmia, including fatal arrhythmias

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 alpha and beta receptors
- 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

Dose and Administration

- Usual infusion rate is 5-20 µg/kg/minute and dose titrated according to response

Side-effect and Precautions

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

Lignocaine

Introduction

- Act as a sodium channel blocker

Indications

- Alternative to amiodarone in refractory VF/pVT
- Stable Monomorphic VT with preserved ventricular function

Dose and Administration

- Refractory VF/pVT: 1 - 1.5 mg/kg IV or IO
- May give additional dose 0.5 -0.75 mg/kg
- Maximum dose 3 mg/kg

Side-effect and Precautions

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

Magnesium

Introduction

- An electrolyte important for maintaining membrane stability
- Hypomagnesaemia can cause myocardial hyperexcitability especially in the presence of hypokalaemia or digoxin
- Insufficient evidence to recommend for or against its routine use in cardiac arrest

Indications

- Torsade de pointes

Dose and Administration

- 1 - 2 g diluted in 10 ml D5% to be given over 15 minutes.

Side-effect and Precautions

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

Noradrenaline

Introduction

- Strong beta-1 & alpha-1 adrenergic effects and moderate beta-2 adrenergic effects

Indications

- Used for hypotension in post resuscitation period
- Cardiogenic shock

Dose and Administration

- 0.05- 1 µg/kg/min as continuous infusion

Side-effect and Precautions

- Cause tissue necrosis if extravasation occurs
- Do not administer sodium bicarbonate through same IV line containing noradrenaline
- Beta effects and increased afterload may increase myocardial work and oxygen consumption
- Very high dose can lead to peripheral limb ischaemia

Sodium Bicarbonate

Introduction

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

Indications

- Known preexisting hyperkalemia
- Known preexisting bicarbonate responsive acidosis e.g.: aspirin overdose, diabetic ketoacidosis, tricyclic antidepressant or cocaine
- Prolonged resuscitation for more than 15 minutes
- Upon ROSC after long arrest interval with documented metabolic acidosis
- Not useful nor effective in hypercarbic acidosis e.g: cardiac arrest of CPR

Dose and Administration

- 1 mEq/kg bolus

Side-effect and Precautions

- May cause tissue necrosis if extravasation occurs
- Do not administer together with IV line used for vasopressor or calcium

Verapamil

Introduction

- A calcium channel blocking agent that slows conduction and increases refractoriness in the AV node
- The action may terminate re-entrant arrhythmias and control the ventricular response rate in the atrium

Indications

- Narrow complex paroxysmal SVT (unconverted by vagal manouvers or adenosine)
- Arrhythmias known with certainty to be of supraventricular origin

Dose and Administration

- 2 – 2.5 mg IV over 2 minutes, repeated doses 5 -10 mg every 15 – 30 minutes to a maximum of 20 mg

Side-effect and Precautions

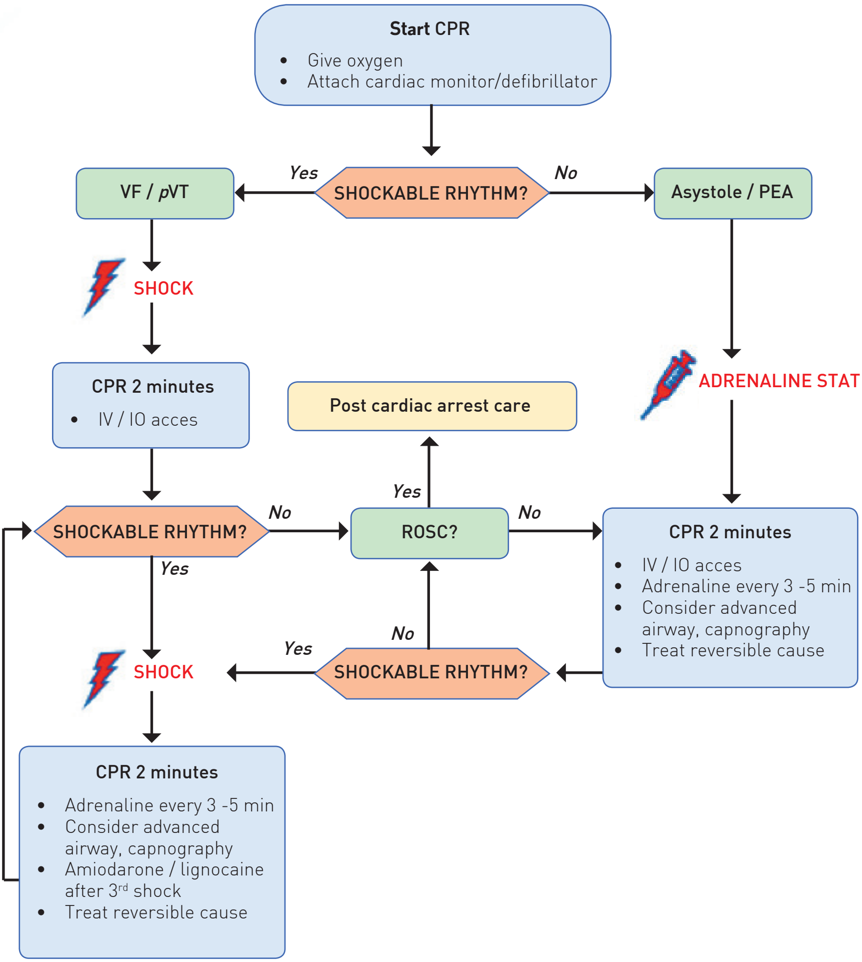
- May cause cardiovascular collapse if given to a patient with ventricular tachycardia
- May decrease myocardial contractility and critically reduce cardiac output in patients with severe LV dysfunction

CHAPTER 8

ALS Algorithms

CHAPTER 8
ALS Algorithms

Cardiac Arrest Algorithm



High Quality CPR	Shock Energy for Defibrillation	Drug therapy	Advanced Airway	Return of Spontaneous Circulation (ROSC)	Reversible Causes
• **Push hard** (at least 5cm) an **fast** (at least 100-120/min) and allow **complete chest recoll** • **Minimise Interuptions** in compression • **Avoid excessive ventilation** • **Change compressor** every 2 min or sooner if fatigued • If no advanced airway, **30:2 compression:** ventilation ratio **Quantitative** • **waveform capnography** - If ETC02 is low or decreasing, reassess CPR quality	**Biphasic** Manufacturer recommendation (eg initial dose of 120-200J); if unknown use maximum available. Second and subsequent doses should be equivalent, and higher doses may be considered **Monophasic** 360J	**Adrenaline** 1 mg IV/IO every 3-5 minutes **Amiodarone** First dose 300mg IV/IO bolus Second dose 150mg Or **Lignocaine** First dose 1-1.5mg/kg IV/IO Second dose 0.5-0.75mg/kg	• Endotracheal intubation or supraglottic advanced airway • Waveform capnography or capnometry to confirm an monitor ETT placement • Once advanced airway in place, **give 1 breath every 6 seconds** (10 breaths/ minutes) with continuous chest compressions	• Pulse present an blood pressure **recordable** • Abrupt and sustained increase in ETCO2 • Spontaneous arterial pressure waves with intra-arterial monitoring	**5H** • Hypovolemia • Hypoxia • Hydrogen ion (acidosis) • Hypo/ hyperkalaemia • Hypothermia **5T** • Tension - pneumothorax • Tamponade, cardiac • Toxins • Thrombosis, pulmonary • Thrombosis, coronary

Adult Tachycardia With A Pulse Algorithm

Assess with ABCDE approach

Heart rate usually > 150/min if tachyarrhythmia

↓

Identify and treat underlying cause

- Maintain patent airway, assist breathing if necessary
- Cardiac monitoring to identify rhythm, blood pressure monitoring & pulse oximetry
- Oxygen (if SPO2 < 94%)
- IV access
- 12-lead ECG if available

↓

Persistent tachyarrhythmia causing:

- Hypotension
- Acutely altered mental status
- Sign of shock
- Ischaemic chest discomfort
- Acute heart failure

Yes →

UNSTABLE

SYNCHRONISED CARDIOVERSION

Consider sedation if patient conscious

↑

If refractory (up to 3 attemps) consider

- Underlying cause
- Addition of anti-arrhythmic drug (Amiodarone)
- Deliver the 4[th] synchronized carioversion
- If arrhythmia persists, seeks expert help

No ↓

STABLE

MEDICATION OR MANEUVER

Narrow QRS (<0.12s)

Regular

Probable SVT

- **Vagal maneuvers**

If vagal maneuver ineffective:

- **Adenosine**
- **Beta blockers** or **calcium channel blockers**

Seek expert help if unresolved (probable Atrial Flutter)

Irregular

Probable Atrial Fibrillation

- Control rate **with beta blocker** or **calcium channel blocker**
- Consider **digoxin** or **amiodarone** if evidence of heart failure
- **Anticoagulate** if duration > 48 hours

Broad QRS (>0.12s)

Regular

Probable Momomorphic VT

- **Lignocaine**
- **Amiodarone**

Irregular

AF with bundle branch block

- **Treat as narrow complex**

Polymorphic VT

- **Treat as VF using** defibrillation doses

Torsades de Pointes

- **Immediate defibrillation** if unstable
- **Magnesium** to prevent recurrence

<table>
<tr><th>DRUGS</th><th>CARDIOVERSION</th></tr>
<tr>
<td>
Adenosine
6mg rapid IV push followed with NS flush; 2nd dose 12mg if required; 3rd dose 18mg if required

Amiodarone
300 mg IV infusion over 10-20 minutes if unstable; over 60 minutes if stable
Consider IV infusion 900mg over 24 hours if needed

Lignocaine
1 - 1.5mg/kg IV bolus. 2nd dose 0.5 - 0.75mg/kg if required

Magnesium
1 to 2 grams IV over 15 minutes, may be followed by an infusion
</td>
<td>
Synchronized cardioversion:
Refer to your device's spesific recommended energy level to maximize first shock success

Recommended energy level:
<table>
<tr><th>Waveform</th><th>Biphasic energy</th><th>Monophasic energy</th></tr>
<tr><td>Narrow regular (SVT, atrial flutters)</td><td>70 - 120J</td><td>100J</td></tr>
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<tr><td>Monomorphic VT</td><td>120 - 150J</td><td>200J</td></tr>
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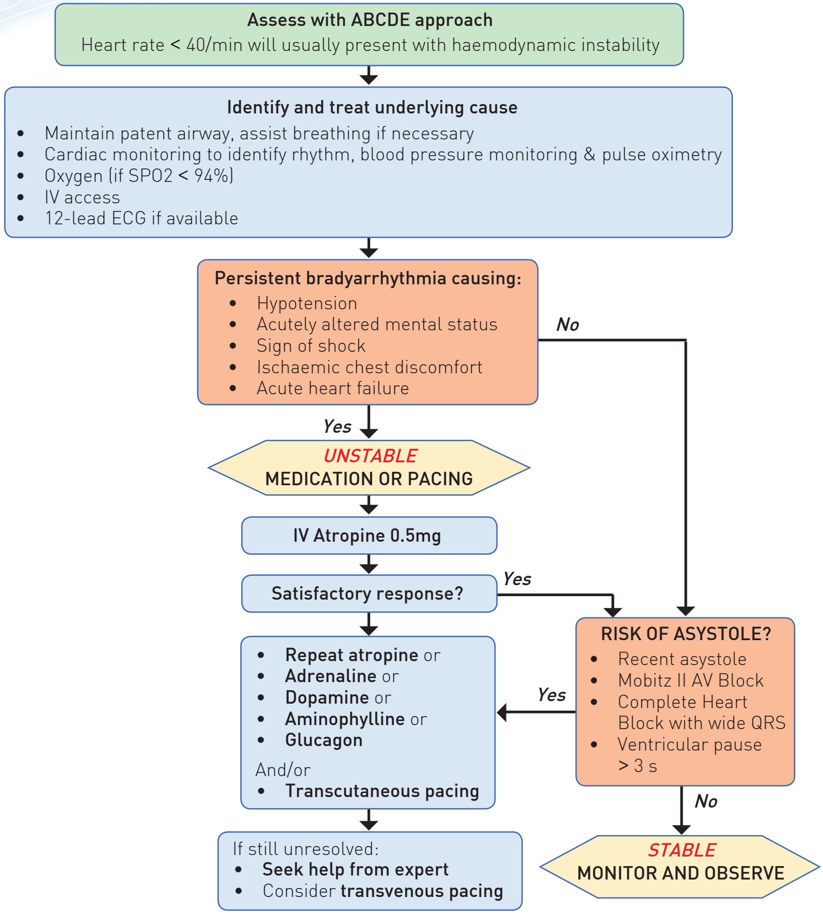
Adult Bradycadia Algorithm



DRUGS	CARDIOVERSION
Atropine First dose 0.5mg IV bolus. Repeat every 3 - 5 minutes. Maximum 3 mg **Dopamine** 5 - 20ug/kg/min IV infusion titrate to patient response. Taper slowly **Adrenaline** 2- 10ug/min IV infusion titrate to patient response	**Aminophylline** If beta blocker overdose, spinal cord injury or post heart transplant recipient 100 - 200mg IV slow injection **Glucagon** If calcium channel blocker or beta blocker overdose 50ug/kg IV loading followed by 1-15mg/ hour infusion titrated to patient response

CHAPTER 9

Resuscitation in Special Circumstances

CHAPTER 9
Resuscitation in Special Circumstances

SPECIAL CAUSES, SPECIAL SETTINGS AND SPECIAL PATIENTS

5Hs & 5Ts

5Hs	5Ts
Hypoxia	Tension pneumothorax
H+ ion (acidosis)	Tamponade (cardiac)
Hypo/ Hyperkalemia and other electrolytes disorders	Thrombosis (coronary)
Hypothermia	Thrombosis (pulmonary)
Hypovolemia	Toxins (poisoning)

Hypoxia

Survival after an asphyxia-induced cardiac arrest is rare and survivors often have severe neurological impairment. Thus, during CPR early effective ventilation of supplementary oxygen is essential. Those who are unconscious but have not progressed to a cardiac arrest are much more likely to make a good neurological recovery. Administer 100% oxygen until oxygen levels can be reliably measured especially at prehospital setting.

Electrolyte imbalances

A high degree of clinical suspicion and aggressive treatment can prevent cardiac arrest from electrolytes abnormalities especially from life-threatening hyperkalemia. Early recognition and prompt treatment must be done immediately and follow standard guidelines for management of hyperkalemia. Other electrolytes disorders are also important to be managed correctly to minimize complications leading to cardiac arrest namely hypercalcemia, hypocalcemia, hypermagnesemia and hypomagnesaemia.

Acidosis

Acidosis is common in cardiac arrest patients. IV sodium bicarbonate (1-2 mmol/kg) can be considered in presence of severe acidosis.

Hypothermia

Hypothermic patients without signs of cardiac instability (systolic blood pressure → 90 mm Hg, absence of ventricular arrhythmias or core temperature → 28° C) can be rewarmed externally using minimally invasive techniques (e.g. with warm forced air and warm intravenous fluid). Patients with signs of cardiac instability should be transferred directly to a centre capable of extracorporeal life support (ECLS). For hypothermic cardiac arrest patients, CPR should be continued during transfer.

Hypovolaemia

Hypovolaemia is a potentially treatable cause of cardiac arrest that usually results from a reduced intravascular volume (i.e. haemorrhage), but relative hypovolaemia may also occur in patients with severe vasodilation (e.g. anaphylaxis, sepsis). Early recognition and immediate treatment with intramuscular adrenaline remain the mainstay of emergency treatment for anaphylaxis. Intravenous adrenaline should only be used by those experienced in the use and titration of vasopressors in their normal clinical practice (e.g. anesthetists, emergency physicians, intensive care doctors)

Trauma

The mortality from traumatic cardiac arrest (TCA) is very high. Success from resuscitation is time sensitive. The reversible causes in TCA are not the same as cardiac arrest in medical situations. The most common cause of death is haemorrhage. It is recognised that most survivors do not have hypovolaemia, but instead have other reversible causes (hypoxia, tension pneumothorax, cardiac tamponade). Reversible causes should receive immediate and concurrent treatment. Chest compressions should not delay the treatment of reversible causes. Principles of damage control resuscitation in trauma including hypotensive resuscitation, haemostatic resuscitation and damage-control surgery. Cardiac arrest of non-traumatic origin leading to a secondary traumatic event should be recognised and treated with standard algorithms. If available, point of care ultrasound can be used to assist diagnosis, target treatment and assess response.

Tension pneumothorax

Diagnosis of tension pneumothorax in a patient with cardiac arrest or haemodynamic instability must be based on clinical examination. During CPR, presentation is not always classical, but when it is suspected in the presence of cardiac arrest or severe hypotension, chest decompression should be carried out immediately before radiographic confirmation.

Coronary thrombosis

There is limited evidence for recommending the routine transport of patients with continuing CPR after out-of-hospital cardiac arrest (OHCA) of suspected cardiac origin. Transport may be beneficial in selected patients where there is immediate hospital access to the catheterisation laboratory and an infrastructure providing pre-hospital and in-hospital teams experienced in mechanical or haemodynamic support and percutaneous coronary intervention (PCI) with ongoing CPR.

Pulmonary thrombosis

In suspected pulmonary embolism (PE), follow the ABCDE approach (Airway, Breathing, Circulation, Disability, Exposure) and existing guidelines for PE. Recommendations for administration of thrombolytic drugs when pulmonary embolism is the suspected cause of cardiac arrest remain unchanged. Consider continuing CPR for 60 to 90 minutes after thrombolytic drugs are administered. Routine use of surgical embolectomy or mechanical thrombectomy is however not recommended. Consider these methods when there is a known diagnosis of pulmonary embolism.

Toxins

Ensure personal safety and do not use mouth-to mouth resuscitation in suspected poisoning cases. Routine use of gastric lavage for gastrointestinal decontamination in poisoning is no longer recommended. The preferred method of gastrointestinal decontamination in patients with intact or protected airway is activated charcoal especially if given within 1 hour from the time of ingestion. Reduced emphasis is placed on hyberbaric oxygen therapy in carbon monoxide poisoning. For up-to-date guidance in severe or uncommon poisonings, seek advice from a poison centre.

Cardiac arrest associated with concomitant diseases

Anaphylaxis

Anaphylactic shock can occur with or without skin rash. Diagnosis is considered in presence of airway swelling, wheezing and/or hypotension. Once the diagnosis is made immediately call for help and remove patient from the triggering agent if possible. Lie the patient down. Pregnant patients can be put on the left lateral position. Begin ABCDE algorithm (Airway, Breathing, Circulation, Disability, Exposure) to assess the patient. Administer IM injection of adrenaline 1:1000 0.5 ml (0.5 mg) preferably over the mid-lateral thigh as soon as possible. This can be repeated every 5-10 minutes. Administer oxygen, IV crystalloids and monitor for response.

Asthma

Patients most at risk include those with:

- Previous history of intubation due to asthma;
- Beta-2 agonists dependence;
- Poor compliance with medication;
- Food allergy in a patient with asthma.

The main causes of cardiac arrest in asthma patient are:

- Hypoxaemia
- Severe bronchospasm
- Mucous plugging leading to asphyxia
- Cardiac arrhythmias due to hypoxia, electrolyte abnormalities or asthma medication (e.g. beta-adrenergic agonists, aminophylline).
- Tension pneumothorax
- Development of auto-PEEP in mechanically ventilated patient due to reduction in venous return.

Treatment of cardiac arrest in asthmatic patient

- Follow standard BLS guidelines
- Start Advanced Life Support
- Consider early intubation due to significant risk of gastric inflation and hypoventilation of the lungs when attempting to ventilate a severe asthmatic
- Minimise development of air trapping during CPR with respiratory rates of 8 – 10 breaths per minute
- If dynamic hyperinflation of the lungs is suspected during CPR, compression of the chest while disconnecting endotracheal tube may relieve air trapping (advise precautions for suspected or confirmed COVID-19 patient)

Patients with ventricular assist devices (VADs)

Full training in the procedures for equipment failure and the cardiac arrest situation associated with ventricular assist devices (VADs) is recommended. External chest compression may be particularly useful to decompress a non-functional right ventricle in cardiac arrests that might be the cause of the loss of cardiac output. Few implantable left ventricular assist devices (LVAD) in the market currently such as a HeartMate (Thoratec, Pleasanton, CA, USA) or HeartWare (HeartWare, Framingham, MA, USA).

Management of cardiac arrest in patient with VADs are; start ALS algorithm; check the rhythm; perform defibrillation for shockable rhythms (VF/pVT)

Because it is possible for a patient to have asystole or VF, but still have adequate cerebral blood flow due to adequate and continued pump flow. If the patient is conscious and responding then you will have more time in which to resolve this arrhythmia and external chest compressions will not be needed.

Obesity

The World Health Organization (WHO) uses body mass index (BMI; weight in kg divided by height in m^2) to define obesity in adults as:

- Overweight (25.0–29.9 kgm^{-2})
- Obesity class 1 (30.0–34.9 kgm^{-2})
- Obesity class 2 (35.0-39.9 $kg\ m^{-2}$)
- Obesity class 3 (≥40 $kg\ m^{-2}$)

No changes to sequence of actions are recommended in resuscitation of obese patients. CPR may be challenging because of physical and physiological factors related to obesity: patient access and transportation, patient assessment, difficult IV access, airway management, quality of chest compressions, the efficacy of vasoactive drugs, and the efficacy of defibrillation because none of these measures are standardised to a patient's BMI or weight. Higher inspiration pressures are needed for positive pressure ventilation due to increased intra-abdominal pressure.

Cardiac arrest associated with pregnancy

Key principles during resuscitation from cardiac arrest in pregnancy (2020)

- Oxygenation and airway management should be prioritised during maternal resuscitation
- Fetal monitoring should not be undertaken during cardiac arrest in pregnancy
- During targeted temperature management of a pregnant patient, it is recommended that the fetus be continuously monitored for bradycardia as a potential complication and obstetric and neonatal consultation should be sought
- Delivery of the fetus by perimortem caesarean delivery for female in cardiac arrest in the second half of pregnancy

The main causes of cardiac arrest are haemorrhage, embolism (thromboembolic and amniotic fluid), hypertensive disorders of pregnancy, abortion and genital tract sepsis account for most deaths directly associated with pregnancy, and pre-existing medical conditions for those indirectly related to pregnancy.

During cardiac arrest, gravid uterus (from 20th weeks onwards) results in compromised venous return and cardiac output which limits the effectiveness of chest compressions.

The recommendations are as follow:

- Place the patient in the left lateral position or manually and gently displace the uterus to the left
- Give oxygen, guided by pulse oximetry to correct any hypoxaemia
- Give a fluid bolus if there is hypotension or evidence of hypovolaemia
- Immediately re-evaluate the need for any drugs being given
- Activate Code Red. Obstetric and neonatal specialists should be involved early in the resuscitation
- Identify and treat the underlying cause, e.g., rapid recognition and treatment of sepsis, including early intravenous antibiotics

Key steps for BLS in a pregnant patient

- Call for expert help early (including an obstetrician and a neonatologist)
- Start BLS according to standard guidelines
- Ensure high-quality chest compressions with minimal interruptions
- The hand position for chest compressions may need to be slightly higher on the sternum for patients with advanced pregnancy e.g. third trimester
- Manually displace the uterus to the left to reduce IVC compression
- Add left lateral tilt if this is feasible and ensure the chest remains supported on a firm surface (e.g., in the operating room) – the optimal angle of tilt is unknown. Aim for between 15 and 30^0.
- Start preparing for emergency Caesarean section
- Early tracheal intubation will however make ventilation of the lungs easier in the presence of increased intra-abdominal pressure

At gestational age of more than 20 weeks, perimortem caesarean delivery will enable successful resuscitation of the mother. Discussion with the O&G team should be done regarding the need for a perimortem caesarean delivery as soon as a pregnant woman goes into cardiac arrest. If there is no return of spontaneous circulation in 5 minutes, immediate perimortem caesarean delivery should be performed.

Follow standard post resuscitation guidelines. Targeted temperature management (TTM) in early pregnancy together with continuous fetal heart monitoring can be used.

CHAPTER 10

Post Cardiac Arrest Care

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Post Cardiac Arrest Care

A successful resuscitation leading to return of spontaneous circulation or ROSC marks the beginning of a crucial period that will affect the overall outcome of a cardiac arrest victim.

This period of post cardiac arrest or post resuscitation entails measures that are taken ideally in a critical care area to allow close monitoring of organ function and provision of necessary organ support.

It is well known that post cardiac arrest syndrome which constitute hypoxic-ischemic brain injury, myocardial dysfunction, systemic reperfusion response and persistence of precipitating pathology, may led to catastrophic outcome if allowed to continue during this period. The severity of this syndrome depends largely on the cause and duration of cardiac arrest.

The 2021 ILCOR/ERC guidelines emphasise on the provision of post cardiac arrest care in a timely manner to ensure better neurological outcome and recovery. In general, the post cardiac arrest care period can be divided into 3 timelines i.e., immediate, stabilisation & optimisation and finally prognostication & recovery.

Table 1: Stages of post cardiac arrest care

1. IMMEDIATE	2. STABILIZATION & OPTIMIZATION	3. PROGNOSIS & RECOVERY
• Oxygenation & ventilation • Hemodynamic support • Optimal sedation • Temperature control • Early PCI for STEMI	• Normocapnia • Avoid Hyperoxaemia • Targeted Temperature Management (TTM) • Diagnose & treat seizures • Normoglycemic control	• Timing & multimodal approach • Recovery and long-term outcome

Immediate post cardiac care

Important components of care immediately after ROSC:

- **Oxygenation and ventilation**
  a. Avoid hyperoxemia: SpO_2 between 94 – 98%
  b. Normocapnia: $PaCO_2$ 35-45 mmHg
  c. Lung protective strategies: TV 6-8 ml/kg and plateau pressure < 30 cmH_20

- **Hemodynamic support and organ perfusion**
  a. SBP > 90mmHg or MAP > 65 mmHg
  b. Higher MAP in patient with underlying hypertension
  c. Adequate fluid resuscitation
  d. Early vasopressors or inotropes

- **Optimal sedation**
  a. Use short acting opioids and sedatives
  b. Analgesia based sedatives
  c. Consider neuromuscular blocking agents to control shivering

- **Constant temperature control**
  a. Maintain constant temperature between 32 – 36 degrees celsius for at least 24 hours
  b. Achieve temperature control as soon as possible
  c. Measure core temperature

- **PCI/angiography and CT scan to diagnose and treat ongoing pathologies**
  a. Immediate / early PCI and angiography for STEMI
  b. Delayed PCI for suspected NSTEMI
  c. CT brain or CTPA (if stable for transport) to exclude stroke or pulmonary embolism

Stabilisation and optimisation period in the critical care area

During this period of post resuscitation care, the patient should be cared for in a critical care area where organ support, monitoring and specific interventions are instituted to ensure the best outcome. These interventions include:

- **Targeted temperature management (TTM)**
  a. Constant temperature control 32-36 degrees celsius for 24h
  b. Use active cooling devices
  c. Aim to achieve targeted temperature as soon as possible
  d. Avoid and treat fever

- **Seizure recognition and early treatment**
  a. Seizure increases $CMRO_2$ which worsens neurological outcome
  b. Observe and look out for seizures
  c. Treat seizure promptly
  d. Electroencephalography (EEG)
  - to diagnose non-clinical seizure
  - assess response to treatment

- **Normoxia and normocapnia**
  a. increase in intracranial pressure (ICP) causes secondary brain injury and leads to worse outcome
  b. maintain PaO_2 > 60 mmHg
  c. $PaCO_2$ 35-45 mmHg
  d. avoid hyperoxemia: accept SpO_2 94% to 98%, reduce fiO_2 accordingly

- **Normoglycemia**
  a. Hypoglycemia and hyperglycemia lead to poorer neurological outcome
  b. Target blood glucose level 8 - 10 mmol/L
  c. Start IV insulin infusion
  d. Regular blood glucose monitoring

- **Avoid Hypotension**
  a. MAP < 65 mmHg is associated with poorer functional outcomes
  b. Aim for higher MAP for patients with hypertension
  c. Lactate and organ perfusion as markers e.g. urine output
  d. Ensure adequate fluid loading for fluid responders
  e. Start vasoactive or inotropic agents early
  f. Bedside ECHO to evaluate response and hemodynamic assessment

- **General intensive care interventions**
  a. Venous Thrombo-Embolism (VTE) prophylaxis
  b. Stress ulcer prophylaxis
  c. Early enteral nutrition: consider trophic feeding
  d. Short acting analgesia and sedatives
  e. Avoid routine use of neuromuscular blocking agents
  f. Avoid routine use of prophylactic antibiotics

- **Delay prognostication until after 72 hours following normothermia**
  a. Provide ample time before prognostication
  b. Longer time may be necessary in patients where TTM is instituted, in those with renal impairment or on neuromuscular blockade

Neuroprognostication

Almost 2/3 of deaths in the intensive care unit following cardiac arrest resulted from withdrawal of life sustaining therapy (WLST) due to severe Hypoxic Ischemic Encephalopathy (HIE). Therefore, accurate neuro-prognostication is important either to avoid inappropriate WLST or continuation of futile treatment when the likelihood of good recovery is remote. The Cerebral Performance Categories (CPC) is widely used as outcome measure for post cardiac arrest and CPC score of 1 to 2 are regarded as good neurological outcome.

- Clinical neurological assessment most important
- Exclude confounders
  i. Sedatives
  ii. Neuromuscular blockade
  iii. Hypothermia

iv. Severe hypotension
v. Sepsis
vi. Metabolic derangements
vii. Respiratory derangements

- Multimodal approach
  In a comatose patient with M ≤ 3 at ≥72 hours from ROSC, in the absence of confounders, poor outcome is likely when ≥ 2 of following are present:
  a. No pupillary & corneal reflexes at ≥ 72 hours
  b. Bilaterally absent N20 SSEP wave at ≥ 24 hours
  c. Highly malignant EEG at > 24 hours
  d. Neuron-specific enolase (NSE) > 60 μg/L at 48 hours and/or 72 hours
  e. Status myoclonus ≤ 72 hours
  f. Diffuse & extensive anoxic injury on brain CT/MRI

- Organ donation should be considered in those with brainstem death and is done in accordance to the national clinical practice guidelines on tissue and organ donation.

Recovery and long-term outcome

Survivors of cardiac arrest who recovered with good neurological recovery frequently experience emotional problems, fatigue, cognitive impairment and reduced physical functions. Critical illness-associated weakness is also common and may lead to longer ICU and hospital lengths of stay. In order to improve quality of life and function that will enhance their recovery process, healthcare providers need to consider implementing these recommendations:

a. Physical and non-physical impairment assessments prior to hospital or even ICU discharge for necessary rehabilitation and support needs to be planned

b. Follow-up of patient progress within 3 months to assess for:
   - cognitive impairment
   - emotional problems and fatigue
   - provide information and support both survivors and caregivers

CHAPTER 11

Ethical Issues In Cardiopulmonary Resuscitation

CHAPTER 11
Ethical Issues In Cardiopulmonary Resuscitation

Ethics of resuscitation and end of life issues

Cardiopulmonary resuscitation (CPR) is performed with the aim to preserve life and to achieve acceptable quality of life. CPR practice, like any other medical therapies, continue to evolve, as such, the ethical considerations inevitably should evolve as well. The process of resuscitation may carry risk of causing suffering and prolonging the process of dying, and it is not an appropriate goal of medicine to prolong life at all costs. The decision to not initiate and withhold CPR, are influenced by ethical, legal, religious and cultural background of the community. In the absence of an advanced medical planning or directives, CPR responders are expected to act in the best interest of the victim until a clear direction of care or prognosis can be established, following discussion with his/her next of kin. An ALS provider should be familiar with the relevant legal aspects in ethical issues in resuscitation.

Beneficience

Life sustaining therapy including CPR should be done in the best benefit of the victim. However, a balance between risk and benefit when attempting CPR should be considered. Withholding CPR should be considered if the risk for proceeding with CPR outweighs its benefit.

Non-maleficience

CPR should not be attempted in those whom it will not succeed, where no benefit is likely but there is obvious risk of harm.

Autonomy

A person with decision making capacity should be allowed to make informed decisions pertaining to their health and resuscitation options. An advanced medical plan or directive, once established should be respected in uplifting his rights to medical autonomy.

Justice

This implies to our duty in distributing care equally within the society. If CPR is provided, it should be available to all who shall benefit from it.

As modern medicine continues to evolve alongside technologies that can sustain and prolong life, it is imperative that the ethical basis of resuscitation should evolve as well. New resuscitation techniques and strategies like extracorporeal CPR requires new approaches in dealing with decision to discontinue support. Health care providers will inevitably face difficulties to decide on the direction of resuscitation without a good understanding of such therapy, its appropriate use, limitations, implications and likely benefits.

A shift from doctor-centered (beneficence) to patient-centered (autonomy) care in resuscitation and end of life decisions have been emphasised in the 2015 guidelines. Greater importance has been given to respecting patient's wishes for CPR as part of medical therapy. As such healthcare providers are responsible to equip themselves with sound knowledge in resuscitation, communication and ethical issues pertaining to it, in making end of life decisions.

Termination of resuscitation

- For out of hospital cardiac arrest, upon arrival to hospital, termination of resuscitation can be considered if **ALL** of the following are present:

    - Unwitnessed cardiac arrest
    - No initial bystander CPR was performed
    - No return of spontaneous circulation before transport
    - No shock was delivered before transport

- If the initial identified collapse rhythm is asystole, CPR can be terminated when there is no return of spontaneous circulation after 20 – 25 minutes (when performed by a highly trained resuscitation team) and all possible reversible causes have been excluded.

Cardiopulmonary resuscitation during the COVID-19 pandemic

Safety First, Do No Harm and "No Emergency during Pandemic"

- Healthcare workers (HCWs) involved in resuscitation are at highest risk of contracting the disease due to the interventions involved during CPR and the highly contagious nature of SARS-CoV-2 virus.
- CPR is an aerosol-generating procedure (AGP) as it involves interventions in close contact with the patient particularly during chest compression and airway management including bag-valve mask ventilation, tracheal intubation and suction.
- Rescuers and HCWs involved in resuscitation need to be familiar with donning and doffing of Personal Protective Equipment (PPE) for airborne-precaution in order to minimise the risk of disease transmission.
- Donning PPE may lead to a brief delay to initiate CPR, but safety of HCWs remains as first priority and should not be compromised.
- Unprotected CPR should be avoided.

Advanced medical planning and communication barriers

- Discussion on advanced medical planning including withholding CPR should be communicated early especially in cases where the predicted outcome is expected to be poor in the event of a cardiac arrest.
- Barriers in communication exist leading to difficulty in establishing an advanced medical plan.
- Establishing Do Not Attempt CPR (DNACPR) early during the course of care helps to prevent misunderstanding, confusion and fear amongst HCWs and next of kin.

Ethical decision making

- The basic principles of ethics in medical treatment including CPR remain applicable and valid although challenging during the current pandemic situation as knowledge gaps exist with scarcity of guidelines or criteria to withhold or withdraw resuscitation.
- Equal access to healthcare and high quality resuscitation for both COVID-19 and non-COVID-19 while ensuring safety of HCWs are fundamental considerations during the current pandemic.

Key Messages of Ethical Considerations of CPR during COVID-19 Pandemic

1. Safety of rescuers and team members is the first priority.
2. Do not perform CPR if rescuers are not adequately protected with airborne precaution PPE.
3. HCWs need to be familiar with correct donning and doffing of PPE.
4. Establish advanced medical plan early. Communicate and document plan clearly.
5. New approaches are needed to overcome the barriers to effective communication.
6. Ethics in resuscitation remain valid and should be applied when deciding the goals of care.

APPENDIX

Checklist

Skill Station Competency Checklist

NAME:	DATE:

Skill Station Competency Checklist **Airway Management**	√ if done correctly
1. Adult endotracheal intubation - Correctly assembles the apparatus required for intubation and knows the complications of intubation.	
2. Laryngeal mask insertion - Correctly inserts LMA and ventilates adequately.	
3. Ventilation using pocket mask - Able to ventilate desirable tidal volume on mannikin using 1-Rescuer Technique and 2-Rescuer Technique.	
4. Endotracheal suctioning - Knows the pressure, catheter size, complications and sterile technique of suctioning.	
5. Bag-valve mask ventilation - Checks the bag-valve mask device and ventilates to desirable tidal volume on a mannikin.	
6. Identify the following devices and know their advantages and disadvantages: - Nasal prong - Simple face mask - Venturi mask - Rebreathing high flow mask and non-rebreathing high flow mask - Oropharyngeal airway and nasopharyngeal airway	
7. Other skills: - Apply nasal prong - Perform jaw thrust - Identify anatomy for cricothyroid puncture	

TEST RESULT	Indicate **P**ass or **N**eeds **R**emediation	P	NR
Instructor signature affirms that skills test was done according to NCORT ALS guidelines Save this sheet with course record		Instructor Signature: Instructor Name:	
Repeat Megacode: **Pass / Fail** Instructor Signature: Instructor Name:			

NAME:		DATE:

No.	Skill Station Competency Checklist **BLS Primary Survey and Interventions**	√ if done correctly
1	Assesses **D**anger	
2	Establishes un**R**esponsiveness	
3	**S**houts for help: Activates Emergency Medical Services (EMS) and gets AED/ defibrillator or directs 2nd rescuer to activate EMS and get the AED/defibrillator	
4	Checks and opens the **A**irway (head tilt-chin lift; or jaw thrust without head extension if trauma is suspected)	
5	Checks for absent or abnormal **B**reathing (Assesses for absence of breathing almost simultaneously while opening the airway in less than 10 seconds *Checks carotid pulse (during COVID pandemic, pulse check is warranted for HCW)* - Pulse present *(proceed to Step 10)* - No pulse present *(proceed to ALS non-shockable rhythm algorithm)*	
6	While waiting for AED/defibrillator, starts 30 Chest compressions immediately if no breathing or abnormal breathing; followed by 2 rescue breaths	
7	Attaches AED/**D**efibrillator as soon as it is available - AED advices **no shock required**; or defibrillator shows either **organised rhythm** or **non-shockable rhythm** *(proceed to Step 8)* - AED advices **shock required**; or defibrillator shows **shockable rhythm** *(proceed to ALS shockable rhythm algorithm)*	
8	Immediately resumes CPR with chest compression to ventilation ratio of 30:2	
9	Reassesses patient every 2 minutes (analyses rhythm & checks pulse)	
10	If patient has a pulse but is not breathing - Performs rescue breaths just enough to see chest rise at the correct rate 1 breath every 5 to 6 seconds (10 to 12 breaths/minute)	

NAME:	DATE:

Skill Station Competency Checklist **ALS Megacode**	Comments	√ if done correctly
1. Supervision & leadership - *Able to function well as a team leader and coordinate the resuscitative effort of the entire team*		
2. Proper sequencing - *Follows the steps in the algorithm in the correct sequence and does not miss any vital steps*		
3. Monitoring team members - *Continuously monitors the team's performance to ensure tasks are carried out correctly*		
4. Rhythm diagnosis - *Able to correctly identify the correct cardiac rhythm and take appropriate action immediately*		
5. Defibrillator operation - *Operates defibrillator in the correct mode (defibrillation or cardioversion)* - *Administers shocks safely and at the correct time*		
6. Drugs - *Orders for the right drugs to be given at the correct time and in correct doses*		
7. Patient vital signs and physical examination - *Interprets vital signs correctly. Performs appropriate physical examination and interprets findings correctly*		
8. Ordering and interpretation of lab data - *Asks for appropriate investigations and interprets results correctly*		

TEST RESULT	Indicate **P**ass or **N**eeds **R**emediation	P	NR
Instructor signature affirms that skills test was done according to NCORT ALS guidelines Save this sheet with course record		Instructor potential? Yes / No Instructor Signature: Instructor Name:	

Repeat Megacode: **Pass / Fail**

Instructor Signature:

Instructor Name:

Abbreviations

List of Abbreviations

AED	Automated External Defibrillator
AF	Atrial Fibrillation
ALS	Advanced Life Support
AVNRT	Atrio-Ventricular Nodal Reentry Tachycardia
BVM	Bag-valve mask
CA	Cardiac arrest
cm	Centimeter
CO_2	Carbon Dioxide
CPR	Cardiopulmonary Resuscitation
CNS	Central Nervous System
CVS	Cardiovascular System
D5%	Dextrose 5%
DNACPR	Do not attempt CPR
DNR	Do No Resuscitate
DSD	Dual/Double Sequential Defibrillation
ECG	Electrocardiogram
EEG	Electroencephalography
$ETCO_2$	End Tidal Carbon Dioxide
ETT	Endotracheal Tube
FiO_2	fraction of inspired oxygen
hr	Hour
H_20	Water
IO	Intraosseous
IV	Intravenous
J	Joule
kg	Kilogram
LMA	Laryngeal Mask Airway
LV	Left Ventricle
mEq	Miliequivalent
min	Minute
mg	Miligram
$MgSO_4$	Magnesium Sulphate
MI	Myocardial Infarction
ml	Mililiter
mm	Millimetre
mmol	Milimol
NS	Normal Saline
OHCA	Out Of Hospital Cardiac Arrest
O_2	Oxygen
PAC	Premature Atrial Complex
PSVT	Paroxysmal Supraventricular Tachycardia
PVC	Premature Ventricular Complex
*p*VT	Pulseless Ventricular Tachycardia
ROSC	Return Of Spontaneous Circulation
SA	Sino-Atrial
SCA	Sudden Cardiac Arrest
SGA	Supraglottic Airway
SpO_2	Oxygen Saturation
SVT	Supraventricular Tachycardia
TTM	Targeted temperature management
VF	Ventricular Fibrillation
VTE	Venous thromboembolism
WLST	Withdrawal of life saving therapy
µg	Microgram

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