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1.0 OBJECTIVES

After completing this practical, you should be able to:

- Identify neonates who need resuscitation after birth;
- Prepare the equipments and environment for procedure;
- List the steps of resuscitation;
- Perform the steps of resuscitation procedure correctly and effectively;
- Demonstrate use of bag and mask ventilation on the manikin;
- Perform chest compressions; and
- Record appropriate information about resuscitation procedure.

1.1 INTRODUCTION

This unit discusses the resuscitation of newborn. This practical session will help you to learn how newborns should be resuscitated.

Oxygen is important for every part of the human body. Without oxygen the cells that make up our organs, brain and other body parts will die. During pregnancy baby receives oxygen from his/her mother through the placenta. After the baby is born, the baby starts to use his own lungs to get the oxygen he needs. For most babies this change happens without any problem, but some babies need help to start or continue breathing. The skill of newborn resuscitation gives that help.

The vast majority of newborn babies require no resuscitation except maintenance of temperature and cleaning of airways. However, about 5 – 10% of newborns require some assistance to begin breathing at birth; about 1% need extensive
resuscitation to survive. In India, out of 26 million babies born annually, about 20-25 per cent of neonatal deaths occur as a result of birth asphyxia. The main reason for birth asphyxia and other associated problems is poor management during and immediately after child birth. You being crucial health care provider can contribute significantly in promotion of newborn’s health if you have adequate knowledge and skill in neonatal resuscitation. Hence, this practical will acquaint you with various skills needed to perform Neonatal Resuscitation with competency.

1.2 RESUSCITATION, DEFINITION AND INDICATIONS

**Definition** - Resuscitation involves series of steps taken to ensure the stabilization of newborn to life outside the uterus.

You have already studied resuscitation in your theory course.

Let us review the indications and purposes of neonatal resuscitation.

1.2.1 Indication and Purposes

Conditions predisposing babies to asphyxia and needing resuscitation are given below:

**Mother**: pregnancy induced hypertension, bleeding (placenta previa), prolonged or obstructed labour, fever in labour, post-term pregnancy.

**Umbilical cord**: cord around the baby’s neck, short cord, knot in the cord, prolapsed cord etc.

**During or after birth**: premature baby (before 37 weeks pregnancy), difficult delivery (breech, multiple birth, forceps etc.), congenital or genetic anomalies, meconium in the amniotic fluid, baby has too much fluid in its mouth and throat, emergency LSCS, prolonged labour >24 hrs.

**Purposes of Neonatal Resuscitation**

Purposes of neonatal resuscitation are to:

- Prevent heat loss
- Clear airways by suction
- Establish effective circulation
- Stabilize the newborn and avoid complications e.g. brain damage etc.

1.2.2 Preparation for Newborn Resuscitation

When a newborn needs resuscitation you must start resuscitation at right time and in right way. If things are not prepared properly or if there are delays, it may not be successful. Preparation for newborn resuscitation includes – personnel, equipments and environment.

**Personnel** – preparation for resuscitation requires having skilled persons for performing resuscitation. A team of 3 or more persons with designated role and preferably a separate team should be present for each newborn. Each team should have a leader and team members.
Equipments – a complete set of resuscitation equipment should be available in fully operational condition at the delivery site. The equipments should be checked for functioning in each shift.

Essential resuscitation equipments are discussed below:

Suction equipment
- De lee trap
- Mechanical suction
- Suction catheters, No. 12F, 14 F (oral suction); 5 or 6 F for pre-term and 8F for term baby for E.T. suction
- Feeding tube 6F and 20-ml syringe

Bag and mask equipment
- Neonatal resuscitation bag (250-750 ml) with oxygen reservoir
- Face masks, term (1) and pre-term (0) sizes
- Oxygen with flowmeter and tubing

Intubation equipment
- Laryngoscope with straight blades, No. 1 (term), No. 0 (preterm) and 00 for extremely pre-term baby
- Extra bulbs and batteries for laryngoscope
- Endotracheal tubes: 2.5, 3.0, 3.5, 4.0 mm internal diameter
- Endotracheal tube stylet (optional)

Medications
- Epinephrine
- Normal saline and Ringer’s Lactate
- Sterile water

Miscellaneous
- Watch with seconds hand
- Warm linen, shoulder roll
- Radiant warmer
- Stethoscope
- Adhesive tape
- Syringes 1, 2, 10, 20, 50 ml
- Gauze pieces
- Umbilical catheters 3.5 F, 5F
- Three-way stopcock
- Sterile gloves
1.3 STEPS OF RESUSCITATION PROCEDURE

The steps involved in neonatal resuscitation have been described in depth in Figure 1.1. Approximately 60 seconds (the golden minute) are allotted for completing the initial steps, re-evaluating the condition of the newborn and beginning ventilation and chest compression if required. The decision to progress beyond the initial steps is determined by simultaneous assessment of 2 vital characteristics: respirations (apnea, gasping, or labored or unlabored breathing) and heart rate (whether greater than or less than 100 beats per minute). Assessment of heart rate should be done by intermittently auscultating the precordial pulse. Palpation of the umbilical pulse at stump can provide a rapid estimate of the pulse and is more accurate than palpation at other sites.

A pulse oximeter at the time of delivery can provide continuous assessment of the pulse without interruption of other resuscitation measures, but the device takes 1 to 2 minutes to apply, and it may not function during states of very poor cardiac output or perfusion. Once positive pressure ventilation or supplementary oxygen administration is begun, assessment should consist of simultaneous evaluation of 3 vital characteristics: heart rate, respirations, and the state of oxygenation, the latter optimally determined by a pulse oximeter. The most sensitive indicator of a successful response to each step is an increase in heart rate.

Also keep in mind:

Environment: prevention of heat loss is important for the newborn. Cold stress can increase oxygen consumption and impede effective resuscitation.

Warmth: keeping a newborn baby warm saves the baby’s energy for breathing.

The ways to keep the baby warm:

- **Room**: keep room warm (at least 25°C).
- **Dry the baby**: dry immediately after birth with clean dry sheet and cover newborn by warm dry sheet.

1.3.1 Routine Care

Nearly 90% of newborns are vigorous term babies with no risk factors and clear amniotic fluid. These babies do not need to be separated from their mothers for initial steps of drying and covering with dry linen etc. Warmth is maintained by direct skin to skin contact. Clearing of the airway can be done by wiping the baby’s nose and mouth with sterile cloth. Follow the following steps:

- Note the time of birth

- Receive baby in dry warm linen

- Is baby breathing or crying?

  “YES” or “NO”
If the answer is ‘YES’ follow routine care. The steps of routine care include:

- Dry the baby on mother’s abdomen
- Provide warmth by skin to skin contact
- Cut cord in 1-2 minutes
- Evaluate respiration and heart rate
If the answer is “NO” to the asked question, begin initial steps of resuscitation. 
(refer to Fig. 1.1 & 1.2)

- Cut cord immediately
- Place under radiant warmer and provide initial steps (dry, position, clear airway and tactile stimulus)

**Fig. 1.2: Routine Care and Initial Steps**

### 1.3.2 Initial Steps

For the baby who needs initial steps of resuscitation, the cord of the baby should be cut without delay and baby should be placed under the radiant warmer. In all the deliveries the warmer should be pre-warmed for at least 20 minutes in manual mode (Fig. 1.3).

**Fig. 1.3: Placing the baby under radiant warmer**
Dry

The baby should be immediately dried with dry, pre-warmed towel.

Position

The baby should be positioned on the back with the neck slightly extended in the “sniffing position.” The goal is to move the nose of the baby as far as anterior as possible. Care should be taken to prevent hyper-extension or flexion of the neck, since either may restrict air entry. To attain a correct posture, a rolled piece of cloth/gauze piece (shoulder roll) may be placed under the shoulder of the baby (Figure 1.4 & 1.5).

This is particularly useful when there is a large occiput (back of head) resulting from moulding or edema.

An appropriate position as described facilitates an un-restricted air entry, by bringing the posterior pharynx, larynx and trachea in line. This alignment in the supine position is also the best position for assisted ventilation with mask or the placement of endotracheal tube.

![Shoulder Roll](image)

**Fig. 1.4: Placing shoulder roll**

![Correct and Incorrect positions](image)

**Fig. 1.5: Correct and incorrect positions**

Clear airway

After the baby is positioned well, the presence of secretions may prevent the entry of air into the lungs. Hence, the clearing of the airway if required should
immediately follow once the newborn has been positioned. One should remember that suction should not be done as a routine ritual in all cases.

Method of clearing airway depends upon

- Presence of meconium stained amniotic fluid at the time of delivery.
- The level of activity of the baby (is the baby depressed or vigorous at birth).

**Vigorous baby is defined as baby with strong respiratory efforts, good muscle tone and a heart rate greater than 100bpm.**

### Clearing the airway when amniotic fluid is free of meconium

Secretions of the airway may be removed from the airway by wiping the nose and mouth with a towel or by suctioning with a mucus extractor or suction catheter attached to mechanical suction device. Turning of the head to one side will allow the secretions to collect in the cheek where they can be removed easily.

We should remember that when there are copious secretions, we need to use suction from the wall or from an electric suction machine at a pressure not more than 100mm of Hg.

The mouth is to be suctioned before nose, to ensure that there is nothing for the newborn to aspirate. An easy way to remember the same is that M comes before N in the alphabet.

**Caution: One should be careful while using the catheter. Stimulation of the posterior pharynx during the first few minutes after birth can produce a vagal response, causing severe bradycardia or apnoea.**

### Clearing the airway, when meconium is present and baby is vigorous

In a baby born with meconium stained fluid, who is vigorous (having a normal respiratory effort, good muscle tone, and a heart rate greater than 100 bpm), the airway is cleared simply by use of mucus extractor or large bore suction catheter (12 or 14 F). The steps of clearance are similar to the baby born without meconium stained liquor.

### Clearing the airway, when meconium is present and baby is not vigorous

In a baby born with meconium stained fluid, and non-vigorous, direct suctioning of the trachea soon after delivery is performed before any respiration has occurred. This will reduce the chances of the baby developing meconium aspiration syndrome. The steps to be followed are given below:

1) Insert a laryngoscope and use a 12 F or 14 F suction catheter to clear the mouth and posterior pharynx, so that glottis can be visualized.

2) Insert an endo-tracheal tube into the trachea and attach the endo-tracheal tube to a suction source (a special aspirator device).

3) Apply suction for several seconds when the tube is in trachea and continue as the tube is slowly withdrawn. One can count “one thousand one, one-thousand- two, one-thousand- three and withdraw” (Figure 1.6)

4) Repeat as necessary until little additional meconium is recovered, or until the baby’s heart rate indicates that resuscitation must proceed without delay.
Note: Harmful techniques like squeezing the chest, inserting a finger in the baby's mouth or externally occluding the airway to prevent babies from aspirating meconium are harmful to the baby. Therefore, not recommended.

Tactile stimulation

Drying and suctioning stimulate a baby to breathe. For most of the newborns, these are sufficient to initiate respiration. If the baby does not have vigorous breathing, additional tactile stimulation may be briefly provided.

Stimulation may be useful not only to induce and begin breathing during the initial step of resuscitation but also may be used to stimulate continued breathing after positive pressure ventilation (PPV).

The safe and appropriate methods of providing tactile stimulation are (Figure 1.7):

1) Gently flicking or slapping the soles
2) Gently rubbing the back, trunk and the extremities of the baby.

Any form of stimulation will initiate breathing, if baby is in primary apnoea. Therefore 1 or 2 flicks or slaps to the sole or gently rubbing the back once or twice is sufficient. If baby remains apneic despite tactile stimulation, positive pressure ventilation should be immediately initiated.

Avoid vigorous stimulation like shaking baby or holding baby upside down, slapping in back, squeezing the rib cage, forcing thigh on abdomen or using hot or cold compress as they are very harmful to the baby.
Evaluation

Evaluate the baby to assess if further resuscitation is needed. The entire process of resuscitation should not take more than 30 seconds. This may take more time in case tracheal suctioning is needed in a baby born meconium stained and depressed. Evaluate respiration and heart rate.

- Assess the baby for good respiration, if there are good chest movements or not. The rate and depth of respiration increases after few seconds of tactile stimulation.

  In some babies especially the pre-term, the respiration may be labored. Such breathing should be noted. These babies may require additional respiratory support and monitoring.

- Heart rate: This is done by auscultating the heart or by palpating the umbilical pulsations for 6 seconds. Whatever the number of beats/pulsations, it is multiplied by 10 to obtain the heart rate per minute (e.g. a count of 12 in 6 seconds is a HR of 120/min). The heart rate should be more than 100bpm.

What to do if the heart rate or respiration is abnormal?

On evaluation of breathing and heart rate after initial steps, if baby is apneic or has gasping respiration or heart rate less than 100, one should proceed to provide positive pressure ventilation (PPV).

If baby is breathing well and heart rate is above 100 but respirations are labored or you think that the baby is persistently cyanotic, such baby needs additional respiratory support (especially if pre-term) and tailored optimal oxygen delivery. If the CPAP machine for respiratory support and the blender with pulse oximeter for optimal oxygen delivery are not available, one can consider starting supplemental oxygen and shifting baby immediately to NICU (Figure 1.8).
Free-flow Oxygen

Free flow of oxygen can be provided by:

- Oxygen mask held over the baby’s face
- Flow inflating bag and mask
- Oxygen tubing cupped closely over the baby’s mouth and nose
- T piece resuscitator

If the central cyanosis persists, it would be ideal to attach a pulse oximetry probe to determine if the baby’s oxygenation is in the abnormal range. If the levels are below the saturation targets established for a normal baby during transition and are not increasing, we may have to think of providing supplemental oxygen (**Figure 1.9**).
The normal intra-uterine saturation is 60%, which increases gradually to 90% only by 10 minutes of birth. Because of the normal transition pattern and the possibility of oxygen toxicity, it is best to give oxygen to maintain the saturation of the baby in the acceptable ranges.

The saturation of the baby should be used to decide the duration of oxygen delivery. In case the same is to be given for a longer time then oxygen should be heated and humidified. Avoid flow rates that are more than 5 litres per minute, as this may cause significant convective heat losses.

When central cyanosis improves and the oxygen saturation of the baby are above 85-90%, supplemental oxygen is gradually decreased. If cyanosis or low oxygen saturation (<85%) persists in spite of giving free flow oxygen, the baby may have a significant lung disease and a trial of positive pressure ventilation (PPV) is justified. However, if ventilation is adequate and the baby still remains cyanotic, then a diagnosis of the congenital cyanotic heart disease or persistent pulmonary hypertension of the newborn should be considered.

### 1.3.3 Positive Pressure Ventilation (PPV)

Positive pressure ventilation is indicated if:

- Baby is apneic or gasping or
- Heart rate is less than 100bpm even with breathing, and/or
- Has persistent cyanosis or low oxygen saturation, despite free flow oxygen increased to 100%.

#### Equipments available for PPV in newborns

There are three types of equipments available for providing PPV in the newborns:

1. The self inflating bag
2. The flow inflating bag
3. The T piece resuscitator

#### Bag and Mask Ventilation

- Equipment
- Ventilation

#### Equipment

It is important that you become completely familiar with the specific equipment used where you work.
**Self-inflating bag**

The self-inflating bag is designed to inflate automatically as you release your grip on the bag. It does not require a compressed gas source to fill. You should be able to identify various parts of a self-inflating bag (Fig 1.10).

As the bag re-expands following compression, gas is drawn into the bag through a one-way valve that may be located at either end of the bag depending on the design. This valve is called the air inlet.

Every self-inflating bag has an oxygen inlet, which is usually located near the air inlet. It is a small nipple or projection to which oxygen tubing can be attached with oxygen as needed.

The patient outlet is where gas exits from the bag to the infant and where the mask or ET tube attaches.

In many self-inflating bags, the valve assembly allows gas to flow from the bag through the patient outlet only while bag is being compressed. Since oxygen flow is not continuous, these bags cannot be used to provide free-flow oxygen.

An oxygen reservoir is an appliance that can be placed over the bag’s air inlet. It helps in delivering a high concentration of oxygen to the baby and allows oxygen to be administered in a concentration as high as 90% to 100%.

A resuscitation bag used in neonatal resuscitation has a safety mechanism in the form of a pressure release valve to guard against inadvertent transmission of excess pressure to the baby’s lungs. Pressure release valves on self-inflating bags are generally set to release at 30 to 40 cm H₂O. If pressures greater than 30 to 40 cm H₂O are generated as the bag is compressed, the valve opens, limiting the pressure being transmitted to the lungs of infant. The ideal size of the bag for neonates is 240 to 500 ml capacity.

![Fig. 1.10: Self inflating bag](image)

**The Flow inflating bag**

The flow inflating bag is also called anesthesia bag. It fills only when the source of compressed gas (oxygen, air, or a mix of two) is connected. They usually do not have a fixed safety pop off valve and may be used with/without an attached manometer. PEEP can be provided by adjusting the flow of gas out of the bag through the flow control valve. Large leaks at the face mask, or too low a flow,
will result in collapse of the bag and inability to deliver any positive pressure breath (Fig 1.11).

Fig. 1.11: Flow inflating bag

**T piece resuscitator**

T piece resuscitator is a flow controlled pressure limited ventilator device (Fig 1.12). Piped compressed gas is delivered at one port of T piece. A preset peak inspiratory pressure (PIP), positive end expiratory pressure (PEEP) and maximum circuit pressure is set. With a T piece device, gas flows into a face mask or endotracheal tube through a patient supply line. Inflation is achieved by interrupting the escape of gas through an outlet hole on the T piece using a thumb so that the pressure rises and is displayed by a manometer. Adjusting the PEEP valve varies positive end expiratory pressure. The newborn is ventilated by placing a finger over the outlet aperture (hole in the PEEP valve) and removing it periodically at about 40-60 times a minute.

Fig. 1.12: T Piece Resuscitator

**Resuscitation masks**

Masks come in a variety of shapes, sizes and materials. Resuscitation masks should have cushioned rim for better seal. The rim conforms more easily to the shape of the infant’s face, making it easier to form a seal. It requires less pressure on the infant’s face to obtain a seal. There is less chance of damaging the infant’s eyes if the mask is correctly positioned. Masks come in several sizes (Figure 1.13). Masks suitable for small, premature infants as well as for term infants
should be available for use. For the mask to be of correct size, the rim will cover tip of the chin, the mouth and the nose but not the eyes.

**Fig. 1.13: Resuscitation masks**

**Assembling equipment**
The bag should be assembled and connected to oxygen so that it will provide the necessary 90% to 100% oxygen. If a self-inflating bag is used, be sure the oxygen reservoir is attached. Connect the mask to the bag.

**Testing equipment**
To check a self-inflating bag, block the mask or patient outlet by making an airtight seal with the palm of your hand (Figure 1.14). Then squeeze the bag:

- Do you feel pressure against you hand?
- Can you force the pressure release valve open?
- Is the valve assembly present and moving as it should?

If not:

- Is there a crack or leak in the bag?
- Is the pressure-release valve missing or stuck or closed?
- Is the patient outlet completely blocked?

If your bag generates adequate pressure and the safety features are working, while the mask patient outlet is blocked check to see:

- Does the bag re-inflate quickly when you release your grip?
Preparation

The need for possible resuscitation of a neonate should be anticipated. Bag mask ventilation may be attempted in the spontaneously breathing infant who remains cyanotic despite administration of 100% free-flow oxygen.

Bag and mask ventilation is indicated if heart rate of baby after 5 inflations is less than 100bpm.

In diaphragmatic hernia, bag and mask ventilation is contraindicated.

In meconium stained non-vigorous baby, ventilation is carried out after tracheal suction (skilled professional is required).

(Non-vigorous baby has presence of any one of three signs – limp, cyanotic, HR<100/mt)

Select equipment

The first step is to select the appropriate equipment:

- Obtain a resuscitation bag with oxygen reservoir and connect it to any oxygen source
- Select a mask of the proper size
- Quickly check the bag to make sure that it functions properly (if you did not do so previously)

![Fig. 1.15: Bag and mask ventilation](image)

Position mask and obtain seal

The infant’s neck should be slightly extended to ensure an open airway (Figure 1.15).

Place the mask in position and check the seal by ventilating two or three times. Observe for an appropriate rise of the chest (Figure 1.16).
Ventilate the newborn

Rate: 40 to 60 breaths per minute

Pressure: the best guide to adequate pressure during bag and mask ventilation is an easy rise and fall of the chest with each breath. Usual pressure required for the first breath is 30 – 40 cm of water. For subsequent breaths, pressures of 15-20 cm of water are adequate.

- 40 – 60 breaths per minute
  - Breath —— two ——three —— Breath

For babies born at term, it is best to begin PPV with room air rather than 100% oxygen.

Assessing effectiveness of ventilation

- Provide up to 5-10 manual breaths looking for chest rise
- Ask assistant to check for heart rate
If there is no chest rise or no increase in heart rate take ventilation corrective measures (Table 1.1)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Remedial steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>M Inadequate seal</td>
<td>Mask adjusted to ensure airtight seal</td>
</tr>
<tr>
<td>R Inappropriate position</td>
<td>Reposition the head in sniffing position</td>
</tr>
<tr>
<td>SO Blocked airway</td>
<td>Suction the airway Open baby’s mouth and ventilate</td>
</tr>
<tr>
<td>P Inadequate pressure</td>
<td>Increase Pressure by squeezing the bag with more pressure till a chest rise is visible</td>
</tr>
<tr>
<td>T No improvement with above steps</td>
<td>Consider endotracheal intubation</td>
</tr>
</tbody>
</table>

Provide uninterrupted effective ventilation for 30 seconds and assess for spontaneous breathing and heart rate. If spontaneous breathing is present and heart rate is 100 or more, then gradually discontinue PPV.

Effective ventilation will promote increase in heart rate and spontaneous breathing, improvement in color and muscle tone.

**What to do if baby is not improving (heart rate is > 60 but less than 100bpm)?**
- Ensure effective ventilation.
- Reassess respiratory effort, heart rate every 30 seconds (oxygen saturation may be monitored continuously if available)
- If PPV is prolonged (over several minutes) place an oro-gastric tube to prevent distention of abdomen which may interfere with ventilation.

**When to stop PPV?**
PPV is discontinued when the heart rate is above 100bpm
There is sustained spontaneous breathing.

**Observational care**
Newborns that have required PPV for less than 1 minute should be provided observational care which includes:
- Provide warmth
- Initiate breast feeding
- Monitor newborn (temperature, heart rate, breathing, and color every 30 minutes for 2 hours).

**Post resuscitation care**
Babies who have received PPV for more than 1 minute or more extensive resuscitation like intubation, chest compression are at high risk of further deterioration. These babies should be managed in NICU.
1.3.4 Chest Compressions

Indications
Heart rate of baby less than 60 bpm despite at least 30 seconds of effective positive pressure ventilation.

What is Chest Compression?
Also referred as external cardiac massage (Fig 1.17). Rhythmic compressions of the sternum that
1) Compress the heart against the spine
2) Increase the intrathoracic pressure
3) Circulate blood to the vital organs of the body.

Fig. 1.17: Phases of chest compression

Why perform chest compression?
In severe asphyxia both heart rate and myocardial contractility are decreased resulting in bradycardia and less powerful contractions. Myocardium is depressed because of poor oxygen levels – Low cardiac output. Mechanical pumping of heart is required to improve perfusion to the lungs. This results in decreased tissue perfusion and hence decreased oxygenation to vital organs.

Chest compressions provide an artificial heartbeat, thus restoring circulation to life-sustaining level. Positive pressure ventilation with 100 % oxygen must accompany chest compression to oxygenate circulating blood.

If in spite of being ventilated with 100% oxygen, a newborn fails to achieve an adequate heart rate, chest compressions must be performed. In most infants positive pressure ventilation (PPV) with 100% oxygen itself raises heart rate to adequate levels. Therefore, the decision to perform chest compression should be based on the heart rate obtained after 30 seconds of PPV and not on the heart rate obtained at delivery. If the heart rate is less than 60/min despite good assisted ventilation for at least 30 seconds, chest compressions should be started. Once the heart rate reaches 60, chest compressions are withdrawn.

Positioning for Chest Compression
By now, the baby is already positioned for PPV and is being ventilated with 100% oxygen. A person performing chest compression must gain access to the
chest and two persons should position in such a way that each one can do an
effective job without interfering with the other (Figure 1.18).

Endotracheal intubation at this time may help to ensure adequate ventilation and
facilitate the coordination of ventilation and chest compression.

**Techniques of Chest Compression:**

Two techniques are used:

1) Two thumb technique (Figure 1.19): two thumbs are used to depress the
sternum while the hands encircle the chest and fingers support the spine.

2) Two finger technique (Figure 1.20): Tips of the middle finger and index or
ring finger are used to compress the sternum. The spine is supported with
other hand or by placing the baby on a hard surface.
Location of Compression
Pressure is applied to the lower third of sternum strictly avoiding applying pressure on the xiphoid. The lower third of sternum is just below the line joining the two nipples (Fig. 1.21).

Depth of Compression
Enough pressure should be used to compress the sternum to approximately 1/3 of the antero-posterior diameter of the chest to generate a palpable impulse (Fig. 1.22). One compression consists of the downward stroke plus the release. Shorter compression phase than the relaxation phase has been proved to be more effective.
Rate of Compression

Compression / release action should be repeated 90 times per minute and ventilation 30 times per minute making the ratio as 3:1. This will be done by counting 1-2-3 for three compressions and 4 for the PPV (interposed ventilation) which together should take 2 seconds (½ second for each event) (Figure 1.23).

Coordinating ventilation and chest compression

Chest compression should be accompanied by PPV. Avoid giving compressions and ventilation simultaneously, hence they require coordination. For every 3 compressions 1 breath is delivered (in a minute 90 compressions and 30 breaths are given).

Dangers of Chest Compressions

Chest compression can cause trauma to the baby. Improper placement of fingers or thumb can cause:

- Damage to xiphoid
- Injury to internal organs like liver, spleen or lungs
- Fracture of ribs

Precautions

- Do not remove the finger or thumb in between compressions
• Feel the pulse for effectiveness of compression
• Do not squeeze the chest
• Continue positive pressure ventilation. If using bag and mask, interpose a ventilation every third compression.

**Checking effectiveness of Compressions**

Heart rate should be checked every 30 seconds. It should be checked for no longer than 6 seconds (this causes minimal interruption in chest compressions).

Ventilation should be discontinued while the heart rate is being checked so that breath sounds do not obscure the heart sounds. It is important to know whether the blood is being circulated effectively as a result of chest compressions. The pulse should be checked periodically if at all possible. This can be done at carotid, brachial and femoral.

**When to stop chest compressions?**

After approx. 30 seconds of chest compression and positive pressure ventilation (PPV)

• Count heart rate
• If >60 bpm, stop chest compressions
• Continue PPV at 40-60bpm till baby breathing spontaneously, heart rate >100 and baby begins to breathe spontaneously.

**If child is not improving?**

1) Check if PPV is effective; if baby is not intubated till now, consider intubating the baby. Assist in the procedure of intubation and collect all the articles required for intubation mentioned in preparation section.

2) Make sure that oxygen concentration is increased to 100%.

3) Check if depth of compression is adequate

4) Ensure that chest compression and ventilation are well coordinated.

**1.3.5 Drugs in Neonatal Resuscitation**

Neonatal resuscitation, as any other resuscitation procedure, is a team effort and before any medication is administered to a newborn, the team leader has to ensure that effective ventilation and compressions are being given to the baby.

Most newborns requiring resuscitation will improve without the need for medications, if timely and effective resuscitation steps are carried out.

**When should medications be administered during resuscitation?**

Medications should be administered during resuscitation when in spite of adequate ventilation and cardiac compression, together for more than 30 seconds, the heart rate remains < 60/min and is not improving or if there is initial asystole after 30 sec of BMV. Do not ‘wait’, to take ‘weight’, use approximation – 1, 2 or 3 kg?

**Establishing intravenous access in newborn during resuscitation**

Umbilical vein is the quickest venous access for neonatal resuscitation.
Steps of umbilical vein catheterization

1) Clean the cord with antiseptic solution
2) Place a loose tie of umbilical tape around the base of the cord. This can be tightened if there is excessive bleeding from the cut cord.
3) Pre-fill a 3.5 F or 5 F catheter with normal saline using a 2 ml syringe connected to a stopcock. The catheter should have a single end hold. Close stopcock of the catheter to prevent fluid loss and air entry.
4) Cut the cord using sterile technique with a scalpel, 1-2 cm from the skin line.
5) Umbilical vein can be located at 11 or 12\(^\text{o}\) clock position. It is a thin walled structure.
6) Insert the catheter into the umbilical vein, towards heart. Continue inserting the catheter 2-4 cm (less in preterm baby) till you get the free flow of blood on gentle aspiration.
7) Inject appropriate dose of epinephrine or volume expander followed by 0.5-1.0 ml of normal saline to clear the drug from the catheter to the baby.
8) Once the baby is successfully resuscitated, either suture the catheter or remove the catheter and tighten the cord tie.

What drugs may be required by the neonate?

- Epinephrine
- Volume expanders
- **Epinephrine**

It is the most effective medicine used during resuscitation. Babies who have a heart rate of less than 60 bpm despite adequate resuscitation for 90 seconds are likely to have low cardiac output to meet the oxygen requirement of vital organs. Epinephrine increases cardiac contractility and the cardiac output, which improves blood supply and oxygen to these organs.

**Epinephrine is not indicated before you have established adequate ventilation**

Epinephrine increases workload and oxygen consumption of the heart muscles, which, in the absence of available oxygen, may cause unnecessary myocardial damage.

**How to prepare epinephrine?**

Epinephrine is available as 1ml ampoule of 1:1,000 concentration, however for neonate take 1 ml of 1:1,000 solution and add 9 ml of normal saline. This makes 10 ml of 1:10,000 concentration.

**How to administer epinephrine?**

Epinephrine should be given intravenously. If administration is delayed due to placement of intravenous access, endotracheal route may be used to administer the drug. But the endotracheal route has unpredictable blood levels that may not be effective.
Dose of epinephrine

The recommended intravenous dose in newborns is 0.1 to 0.3 ml/kg of a 1:10,000 solution (equal to 0.01 to 0.03 mg/kg). When giving epinephrine by endotracheal tube, be sure to give the drug directly into the tube (3 times the I/V dose i.e. 0.3-0.9 ml/kg), being careful not to leave it deposited in the endotracheal tube connector or along the walls of the tube.

Check the baby’s heart rate 30 seconds after administering epinephrine. Continue giving positive pressure ventilation and chest compressions. The heart rate should increase to more than 60 bpm within 30 seconds after the administration of epinephrine. If this does not happen repeat the dose every 3 to 5 minutes.

Volume expander

Volume expander refers to saline or ringer lactate, indicated if the baby is in shock and is not responding to resuscitation. The baby appears pale, has weak pulse. O Rh negative packed red blood cells are also considered as part of the volume replacement when severe fetal anemia is expected.

Dose of volume expander

10 ml/kg is the initial dose. If baby shows minimal improvement after the first dose, another dose of 10 ml/kg can be given.

Volume expander is given through intravenous route. The umbilical vein is the most accessible vein in a newborn, therefore more commonly used.

What to do in case no improvement?

If the baby is severely compromised but all resuscitation efforts have gone smoothly, and baby’s heart rate continues to remain below 60bpm, you may consider mechanical causes of poor response such as air way malformation, pneumothorax, diaphragmatic hernia or congenital heart disease.

1.4 RECORDING/MONITORING

The entire process of neonatal resuscitation should be recorded in nurse’s record and these babies should be monitored regularly after resuscitation as described in the unit.

1.5 ACTIVITY AND GUIDELINES

Activity 1

Carrying out procedure of resuscitation:

i) Attend a case of normal delivery in labour room
ii) Receive the baby and maintain patency of airway at birth
iii) Provide routine care to the newborn baby

Activity 2

Observe the procedure of resuscitation of newborn on a manikin, practice and record the steps followed in resuscitation procedure as:

• Initial steps
Techniques in Newborn and Infant Care

- Bag mask ventilation
- Chest compression

Activity 3
Select two neonates in delivery room, observe/practice routine care and initial steps of resuscitation and record the procedure.

Guidelines
Record the procedure on work book as:

Name of the Newborn .................................................................
Date of Birth .............................................................................
Birth Weight .............................................................................
Type of Delivery ........................................................................
Method adopted to keep patent airway .....................................
Steps of initial resuscitation ....................................................

1.6 LET US SUM UP

In this practical on resuscitation, you have learnt the definition, indications, purposes, preparation – personnel, equipment, environment, and steps of resuscitation, drugs used in resuscitation and recording and monitoring the resuscitation.