सत्यमेव जयते

Facility Based Newborn Care (FBNC)

Neonatal Resuscitation Module

2014

NATIONAL HEALTH MISSION
राष्ट्रीय स्वास्थ्य मिशन

Ministry of Health and Family Welfare
Government of India

Facility Based
Newborn Care (FBNC)

Neonatal Resuscitation Module

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FOREWORD

Birth of a newborn baby is a special moment, a moment of joy and hope. Most babies go through the transition from the mother's womb to the outside world smoothly; a mere ten percent may need some degree of assistance during this process. Providing appropriate resuscitation to newborns helps prevent asphyxia, which accounts for 23% of neonatal deaths in India. Delay in providing help to the newborn at this crucial juncture is an impediment to ensuring survival and more importantly intact survival.

Newborn resuscitation is needed at all delivery points including community settings for home births, rural health centers, district-level facilities and urban referral and tertiary care centers. Health care providers at all these facilities need to be trained in neonatal resuscitation to prevent asphyxia related morbidity and mortality as far as possible.

The American Academy of Pediatrics (AAP) and American Heart Association (AHA) developed the Neonatal Resuscitation Program (NRP) in 1987 to provide resuscitation training to all health care providers attending deliveries.

NRP training program for instructors and providers was launched in India, under the aegis of the National Neonatology Forum (NNF) and has also been introduced into the curricula of medical and nursing students. India, with 27 million deliveries per year requires training more than 0.25 million health professionals in Neonatal Resuscitation in a short span of time to meet the MDG 4 goal deadline of 2015.

This updated Indian version of Neonatal resuscitation guidelines, 2010 is being disseminated countrywide. I am sure that this module will be of great help to all health care providers working in the field of newborn care and dealing with the newborn.

(Anuradha Gupta)

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PREFACE

The birth of a new-born is a joyous occasion for the entire family as well as the health care providers but it also requires planning and anticipation.

Fortunately ninety percent of new-born babies make the transition from intrauterine life to extra uterine life without any difficulty and require no assistance in initiating spontaneous breathing. Only ten percent of new-borns require some help and only one percent need advanced neonatal resuscitation. Asphyxia, however, contributes to about 19% of neonatal deaths. Requisite knowledge and skills are needed to provide both, basic assistance and advanced resuscitation to these babies at birth.

The present guidelines have incorporated the best practice evidence currently available and are now being adapted for use in our country. Resuscitation skills that are provided in this manual teach not only basic resuscitation skills but additional skills needed for advanced resuscitation.

I am sure this manual will be useful to all health care providers working in the field of new-born care and help them manage babies at birth in a planned and organized way. This would help reduce morbidity and mortality due to asphyxia to a large extent.

(Dr. Rakesh Kumar)

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ACKNOWLEDGEMENT

The Government of India has given the 'call to action' on achieving the goals of reducing maternal, infant and neonatal mortality through the implementation of Reproductive, Maternal, Neonatal, Child and Adolescent health (RMNCH+A) strategy. Keeping these goals in view, training in neonatal resuscitation and facility based newborn care gains great significance. Quality of care at these facilities for newborns will play a key role in the RMNCH+A strategy.

The training manual prepared and being used by the experts of National Neonatology Forum (NNF) for the trainings of doctors and

nurses has been adapted and updated by Ministry of Health and Family Welfare for Facility Based Newborn Care training package.

National Collaborative Centre for Facility Based New Care Programme at Kalawati Saran Children's Hospital New Delhi, under the aegis of MoHFW led a group of experts from various institutions along with other organisations namely UNICEF, NNF, UNDP-NIPI, NCHRC and USAID-MCHIP for updating, editing, designing, proofing and printing the manual and giving it the final shape.

The effort of all the experts from different organizations and the National Collaborative Centre for preparing the training manual for doctors and nurses working at the Facility Based Newborn Care (FBNC) units is greatly acknowledged. Capacity building process using this manual will go a long way in saving the lives of the newborns of the country.

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Contents

Facility Based Newborn Care (FBNC)

Neonatal Resuscitation Module

Resuscitation: Overview

About 10% of neonates require assistance to breathe at birth. Birth asphyxia contributes to about 25% of all neonatal deaths. The training in neonatal resuscitation will help you learn how newborns should be resuscitated. Reading this book and practicing the skills during the training course will help you acquire the skills needed.

Learning objectives

After reading this chapter you will learn

- the physiological changes that occur at birth
- the sequence of steps to be followed during resuscitation
- risk factors that could predict which babies may need resuscitation
- equipment and personnel needed for neonatal resuscitation

What are the transitional changes at birth which help the lungs to supply oxygen to the baby?

Oxygen is needed for survival both during fetal life and after birth. Before birth the oxygen to the fetus is supplied by diffusion across the placental membranes from maternal blood. Most of the oxygenated blood enters the right side of the fetal heart and flows through the low resistance ductus arteriosus into the aorta (Fig 1.1). This is because the blood vessels in the fetal lungs are constricted and offer high resistance to the blood flow. The fetal lungs even though expanded are filled with fluid and do not play a major role in fetal oxygenation. After birth, the placenta no longer supplies oxygen to the baby. The baby now depends on its lungs for supply of oxygen. This transition occurs within seconds. The major changes during this transition are:

1. ***Absorption of fetal alveolar fluid:*** The initial breaths of baby result in the absorption of fetal lung fluid into the pulmonary lymphatics. Air now replaces the lung fluid. Since this inspired air contains 21% oxygen, this diffuses into the blood vessels surrounding the alveoli.
2. ***Closure of the umbilical vessels:*** The clamping of the cord removes the low resistance placental circuit and increases baby's systemic blood pressure.
3. ***Decreased Pulmonary resistance:*** As air fills the alveoli, the increased oxygen levels in alveoli *decrease the resistance of the pulmonary blood vessels*. This increases the blood flow into the lungs. The increase in systemic blood pressure results in decreased blood flow through the ductus arteriosus, contributing further towards increasing the pulmonary blood flow. The increase in oxygen levels also results in constriction of ductus arteriosus (Fig. 1.2).

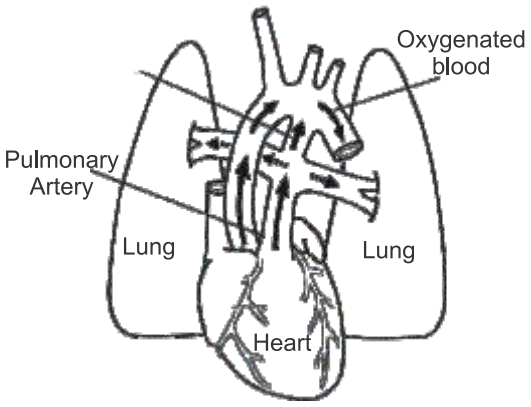


Figure. 1.1. Normal fetal circulation

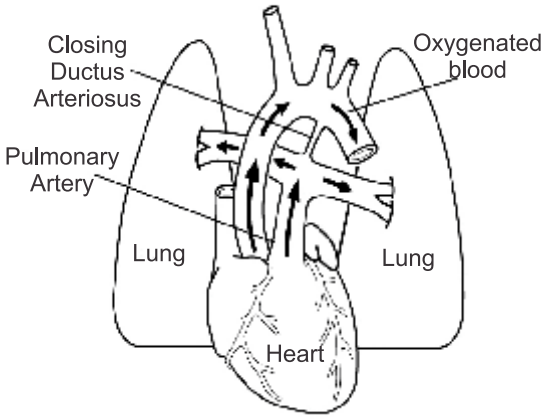


Figure. 1.2. Constriction of ductus arteriosus

Baby's initial breaths fill the lungs with air and initiate the oxygenation by lungs for survival. Although most of the transition takes place within a few minutes after birth, the process may take several hours for its completion. Studies have shown that it may take upto 10 minutes for babies to achieve oxygen saturation of 90% or more. Functional closure of the ductus arteriosus may not occur upto 24 hours and complete relaxation of the lung blood vessels may take upto several months.

What can go wrong during transition at birth?

The baby may encounter difficulties either before labor, during labor or after birth. Problems before and during labor reflect compromise in placental blood flow. Difficulties after birth usually reflect problems with baby's airway and/or lungs. Normal transition may be disrupted by the following problems:

Lungs do not fill with air because the baby does not breathe or has inadequate spontaneous breaths. Hence oxygen may not reach the baby's blood.

The expected increase in systemic blood pressure may fail to occur either because of excessive blood loss or neonatal hypoxia; these may cause poor cardiac contractions or bardycardia and result in hypotension.

Pulmonary arterioles may remain constricted because of inadequate gaseous distention of the lungs or lack of oxygen. This results in decreased blood flow into the lungs and reduced oxygen supply to the tissues.

How does the fetus/newborn respond to interruption in transition?

When the normal transition is interrupted, the oxygen supply to tissues is decreased, and the baby may exhibit one or more of the following clinical signs:

- Poor muscle tone due to insufficient oxygen delivery to the brain, muscles and other organs.
- Poor respiratory drive due to insufficient oxygen supply to the brain.
- Bradycardia due to insufficient oxygen supply to the heart muscle or brain stem.
- Low blood pressure from insufficient oxygen to the heart muscle or blood loss.
- Tachypnea (fast breathing) due to failure to absorb fetal lung fluid.
- Persistent cyanosis or low oxygen saturation on pulse oximeter, due to insufficient oxygen in blood.

Which babies require resuscitation?

Approximately 10% of newborns need some assistance to begin breathing at birth. The presence of risk factors like meconium staining of amniotic fluids, etc. (Table 1.1) can help identify those who may need additional steps of resuscitation, but you must be always prepared to resuscitate, as even some with no risk factors will require resuscitation. Every birth should be attended by someone who is trained in initiating neonatal resuscitation. Additional personnel should be available when further resuscitation is required. Figure 1.3 illustrates the relationship between resuscitation procedures and the proportion of newborns that need them. At the top are the procedures needed by all newborns. At the bottom are procedures needed by very few.

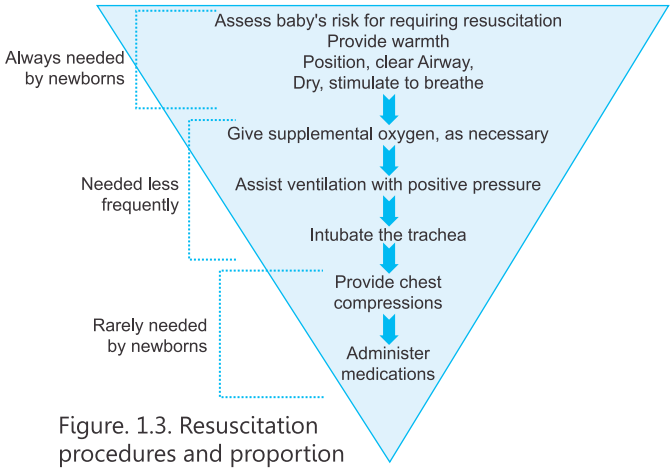


Figure. 1.3. Resuscitation procedures and proportion of neonates needing them

The resuscitation flow diagram

The flow diagram chart 1.1 describes all the 'Neonatal Resuscitation Program-India (NRP-India)' procedures. The diamonds and rectangles symbolize assessment and actions, respectively. As you go through the description, follow the steps in the flow diagram in parallel.

Initial assessment: At the time of birth, as you receive the baby in dry, warm linen observe if the baby is breathing/crying? If the answer is "Yes", then the baby should stay with the mother. If the answer is "No", you should clamp and cut the cord immediately and proceed to initial steps of resuscitation.

Section A (Airway). These are the initial steps you should take to establish an Airway and begin resuscitating a newborn.

- Provide warmth by placing the baby under a radiant warmer
- Position the head to open the airway; clear the airway as necessary (it may involve suctioning the trachea to remove meconium)
- Dry the baby. Discard wet linen
- Stimulate the baby to breathe, and reposition the head to maintain an open airway

Evaluation of the effect of Section A. You should evaluate the newborn's respiration and heart rate simultaneously during these first interventions, and this should not take more than 30 seconds to complete. If the baby is not breathing (is gasping or has apnea) or has a heart rate below 100 beats per minute (bpm), you should immediately proceed to Section B (left side). If the baby's respiration appears labored or is persistently cyanotic proceed to Section B (right side).

Section B (Breathing). If the baby has apnea or is gasping or has a heart rate below 100 bpm, you should assist the baby's breathing by providing positive pressure ventilation (PPV).

If the baby is breathing, but has persistent respiratory distress (labored breathing), attach a pulse oximeter (if available) to consider need for supplemental oxygen. If the baby is preterm with labored respiration consider administering continuous positive airway pressure (CPAP) by face mask (if facilities available). If pulse oximeter and/or CPAP are not available, initiate supplemental oxygen and shift baby to NICU. The technique of oximetery and interpretation of oxygen saturation tables will be discussed in Lesson 2

Evaluation of the effect of Section B. After 30 seconds of PPV, CPAP and/or supplemental oxygen, evaluate the newborn again to ensure that ventilation is adequate before moving to the next step. With appropriate ventilation, in almost all cases, the heart rate would rise to above 100 bpm. If the heart rate is below 60 bpm, you should proceed to Section C.

Section C (Circulation). You support Circulation by starting chest compressions. while continuing PPV. At this stage, it is strongly recommended to perform endotracheal intubation (if skilled), if not done earlier. This is for more effective coordination of chest compressions and PPV

Evaluation of the effect of Section C. After 30 seconds of chest compressions and PPV, evaluate the newborn again. If the heart rate is still below 60 bpm, proceed to Section D.

Section D (Drug). You administer epinephrine as you continue PPV and chest compressions.

Evaluation of the effect of Section D. If the heart rate remains below 60 bpm, the actions of Section C and D are continued and repeated (lower curved arrow).

When the heart rate rises above 60 bpm, chest compressions are stopped. PPV is continued until the

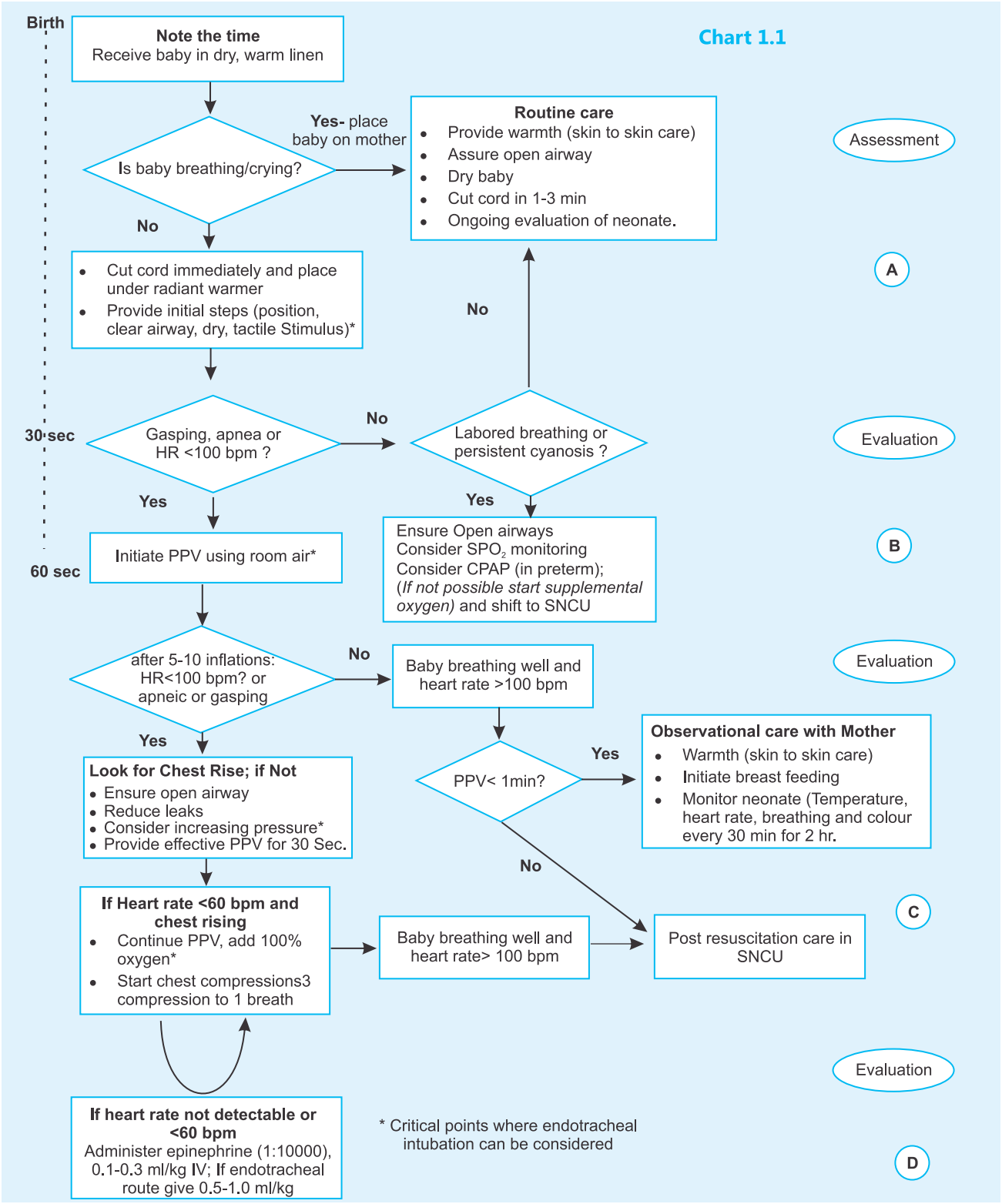
heart rate is above 100 bpm and the baby is breathing well.

Evaluation occurs after initiation of each action and is based on the following two signs:

- Respiration
- Heart rate

Also, oxygenation can be assessed by oximetry when facilities are available.

This process of evaluation, decision and action is repeated frequently throughout resuscitation.



Note the following important points about the flow diagram:

- There are 2 heart rates to remember: 60 bpm and 100 bpm. A heart rate below 60 bpm indicates that additional resuscitation steps are needed. A heart rate above 100 bpm usually indicates that resuscitation procedures beyond those in Section A can be stopped, unless the patient is apneic or has persistently low oxygen saturation levels.
- The asterisks (*) in the flow diagram indicate points at which endotracheal intubation may be needed.
- The primary actions in neonatal resuscitation are aimed at ventilating the baby's lungs (Section A and B). Once this has been accomplished, heart rate, blood pressure and pulmonary blood flow will improve spontaneously provided there is continued effective ventilation. But, if blood and tissue oxygen levels are low, cardiac output may have to be assisted by chest compressions and epinephrine (Section C and D) for blood to reach the lungs and pick up oxygen.
- Think in terms of 30 seconds intervals as you progress through the flow diagram. As soon as the baby is handed over to you, ask the initial question and perform initial steps within about 30 seconds. Next, you should not take longer than another 30 seconds to further stimulate the baby to breathe. The first 60 seconds after birth is called the "Golden Minute". If the baby does not begin to breathe after 60 seconds of initial steps, you should begin PPV. During subsequent steps too, you should ensure that each assessment and decision cycle should not last longer than 30 seconds.

What risk factors may be associated with the need for resuscitation at birth?

Table 1.1 below lists some of the risk factors that may be associated with the need for neonatal resuscitation in the delivery room

Table 1.1. Resuscitation at birth: Risk factors

Antepartum Risk Factors	
• Maternal Hypertension	• Multiple gestation
• Diabetes in mother	• Premature rupture of membranes
• Ante-partum bleed (2nd or 3rd trimester)	• Post-term gestation
• Maternal infections	• Intra-uterine growth restriction
• Maternal medical problems (cardiac, pulmonary, renal, thyroid, etc.)	• Malformations in fetus
• Poly-hydramnios	• Mothers <18 yrs or older than 35 yrs
• Oligo-hydramnios	• Inadequate antenatal care
	• Previous fetal or neonatal deaths
Intrapartum Risk Factors	
• Abnormal fetal heart rate patterns (late and variable decelerations)	• Emergency cesarean section
• Meconium stained amniotic fluid	• General anesthesia to mother
• Significant intra-partum hemorrhage (Abruptio placentae, placenta previa)	• Premature labor
• No-vertex presentation	• Chorioamnionitis
• Forcep/vacuum deliveries	• Prolonged labor (>24 hrs)
	• Cord prolapse
	• Macrosomic (Large) fetus

Box: 1.1. Equipment needed for neonatal resuscitation in delivery room

- Radiant warmer
- Clock with seconds hand
- Warm linen
- Shoulder roll
- Oxygen source
- Stethoscope
- Mucus extractor
- Suction facilities with 10F or larger suction catheters, sizes 5F or 6F and 8F for suctioning the endotracheal tube
- Positive-pressure device: Self inflating bag (250-500 ml.) and masks (size 0 and 1); and oxygen tubing. Self-inflating bag must have oxygen reservoir
- Laryngoscope with an extra set of batteries and extra bulbs. Blades: No. 1 (term newborn), No. 0 (preterm newborn), No. 00 (optional for extremely preterm newborn). Use straight blade.
- Endotracheal tubes with internal diameters of 2.5, 3.0, 3.5 and 4.0 mm
- Endotracheal tube stylet (optional)
- Scissors and adhesive tape for fixing endotracheal tube
- Medications: Epinephrine, Normal saline and Ringer's Lactate
- Umbilical catheters 3.5, 5F
- Three way stop-cock
- Syringes 1, 3, 5, 10, 20 ml
- Sterile gloves
- 8 French feeding tube

What equipment should be available?

All equipment necessary for complete neonatal resuscitation should be available in the delivery room and should be fully functional. A complete list of neonatal resuscitation equipment is given in Box: 1.1.

What do you do after resuscitation?

Routine care: Almost 90% of newborns are vigorous term babies with no risk factors. They do not need to be separated from their mothers at birth. Thermal control can be provided by putting the baby directly on the mother's abdomen without cutting the cord and covering with dry linen. Clearing the upper airway can be provided as necessary by wiping the baby's mouth and nose.

After 1-3 minutes, the cord can be cut and the baby placed on the mother's chest and breast feeding initiated. Ongoing breathing and activity can be observed with the baby on the mother's chest.

Figure 1.4: Newborn on mother's chest

Observational care: Babies who have received PPV for < 1 minute to help them initiate breathing can also be cared for with their mothers. Besides the thermal control and breast feeding (as in routine

care), breathing, activity and colour of these babies should be monitored atleast once every 30 minutes during the first 2 hours after birth.

Post resuscitation care: Babies who have received PPV for more than 1 minute or more extensive resuscitation are at high risk of further deterioration. These babies should be managed in a neonatal intensive care unit (NICU) or special newborn care unit (SNCU) for more intensive monitoring. Neonates with respiratory distress after birth or preterms in whom CPAP has been initiated in the delivery room also need to be shifted to SNCU.

Summary: Lesson 1

1. Most newborn babies are vigorous at birth. Only about 10% require some resuscitative assistance and about 1% need intensive resuscitative measures (intubation, chest compressions and/or medications) at birth.
2. The most important and effective action in neonatal resuscitation is to ventilate the baby's lungs.
3. Lack of ventilation of newborn lungs results in sustained constriction of pulmonary arterioles preventing oxygenation. Prolonged lack of perfusion and oxygenation to the baby's organs can lead to damage to the brain, other organs or death.
4. Many, but not all babies, who will need resuscitation at birth, can be identified by the presence of ante-partum or intra-partum risk factors.
5. All newborns at birth need to be initially assessed to determine if they need resuscitation.
6. Every birth should be attended by at least 1 person who is capable of initiating resuscitation. When resuscitation is anticipated, additional personnel should be present in the delivery room to assist in the resuscitation procedures.
7. Resuscitation should proceed rapidly.
8. You have approximately 30 seconds to achieve a response from one step before deciding to go to the next.
9. Evaluation and decision making are based primarily on respiration, heart rate and oxygenation.
10. The steps of neonatal resuscitation are as follows:
    A. Receive baby in prewarmed linen
    B. Initial steps
        - Provide warmth
        - Position head and clear airway as necessary
        - Dry baby and discard wet linen
        - Reposition and stimulate to breathe
        - Evaluate respiration, heart rate and oxygenation
    C. Provide positive pressure ventilation
    D. Provide chest compression as you continue ventilation
    E. Administer epinephrine as you continue chest compression and assisted ventilation.

Initial Steps in Resuscitation

Learning objectives

In this lesson you will learn how to:

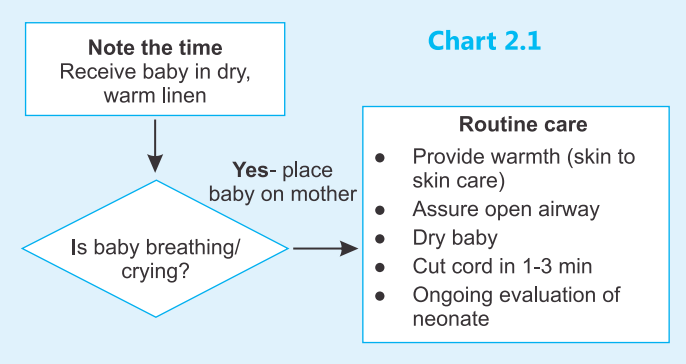
- Determine if a newborn needs resuscitation
- Open the airway and perform initial steps
- Resuscitate a newborn born with Meconium stained amniotic fluid
- Provide free flow oxygen

The following scenarios will help you to understand the initial steps of evaluation and resuscitation. You are requested to imagine yourself as a part of the resuscitation team as you read through the scenarios.

Case scenario 1

A 28 year old primigravida is admitted to the Labor room in active labor. Her membranes have ruptured on the way to the hospital 2 hrs back. The female attender with the woman says that the amniotic fluid was clear. In the labor room the obstetrician notices that the cervix dilates progressively and after 4 hrs a baby girl is born vaginally by vertex presentation. The baby is active and crying.

As soon as the baby is delivered, she is received in a pre-warmed towel and immediately placed on the mother's abdomen for skin-to-skin care. The time of birth is noted. Baby's face is turned to one side and secretions if any are wiped. The baby is dried wet towel discarded and the mother baby duo is covered with dry warm linen. The cord is cut between 1 and 3 minutes of birth. The baby is allowed to continue transition as the colour becomes increasingly pink.

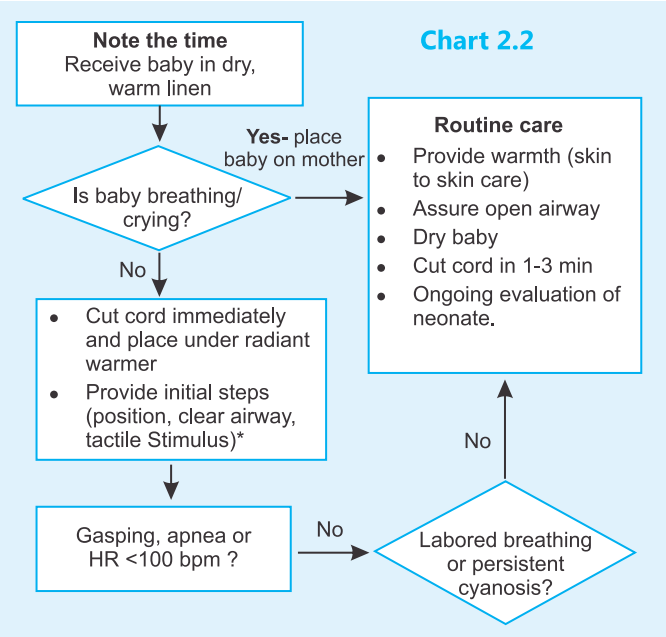


Case scenario 2

A 34 year old multi-parous woman is admitted to the labor room in early labor. After some time the membranes rupture to reveal Meconium stained amniotic fluid. The obstetrician looks at the fetal heart rate. She decides to allow a vaginal delivery.

Immediately after birth, the baby is observed to have minimal breathing efforts and poor tone. The cord is cut immediately and, the baby is taken under a preheated warmer. The head is positioned by placing a shoulder roll. The oropharynx is cleared with a large bore suction catheter of size 12-14F. The trachea is then intubated and suction is applied to the endotracheal tube as it is slowly withdrawn from the trachea. However, no meconium is noticed on aspiration. The baby is still having very poor respiratory efforts.

The baby is dried with a warm towel and stimulated to breathe by rubbing the back of the baby 2 to 3 times. At the same time the baby is repositioned to open the airway, following which she begins to breathe more effectively. The heart rate is evaluated to be more than 120 beats per minute. The baby is placed on the mother's chest and covered with linen and monitored for breathing, heart rate, colour and activity.



Determining if a baby needs resuscitation

The need for resuscitation in a baby is determined by looking at the breathing of the baby. Breathing is evident by watching the baby's chest. Breathing is indicated if a baby is vigorously crying or has good rhythmic chest movements with no pauses. One should not be misled by a baby who is gasping. Gasping baby takes a series of deep, single irregular inspirations. Such breathing occurs when the baby is hypoxic/ischemic and is indicative of severe neurologic and respiratory depression.

What are the initial steps and how are they administered?

Once it is decided that a baby needs resuscitation, the Initial steps should be initiated immediately. One should administer these steps in a particular order. These steps should be applied throughout the resuscitation process where ever required.

Provision of Warmth

The cord of the baby needing the initial steps should be cut (without delay) and the baby should be placed under the radiant warmer (Fig. 2.1). In all deliveries the warmer should be pre warmed prior to the delivery for at least 20 minutes in the manual mode. In this way the resuscitation team will have access to the baby and the heat loss is prevented by the radiant warmer. At this stage full visualization of the baby is needed and the baby should not be covered. In case of suspicion of severe birth asphyxia, due care should be taken not to overheat the baby.

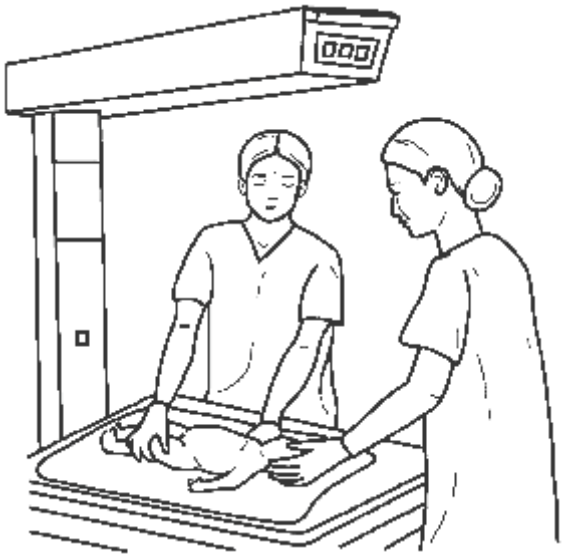


Figure 2.1: A Baby placed under the radiant warmer for provision of warmth during Initial Steps

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 anterior as possible. Care should be taken to prevent hyperextension or flexion of the neck, since either may restrict the air entry. To attain a correct posture, a rolled piece of cloth/gauze piece (Shoulder Roll)

Figure 2.2: Positioning of the baby with shoulder roll in place

may be placed under the shoulder of the baby (Fig. 2.2). This is particularly useful when there is a large occiput (back of head) resulting from molding or edema.

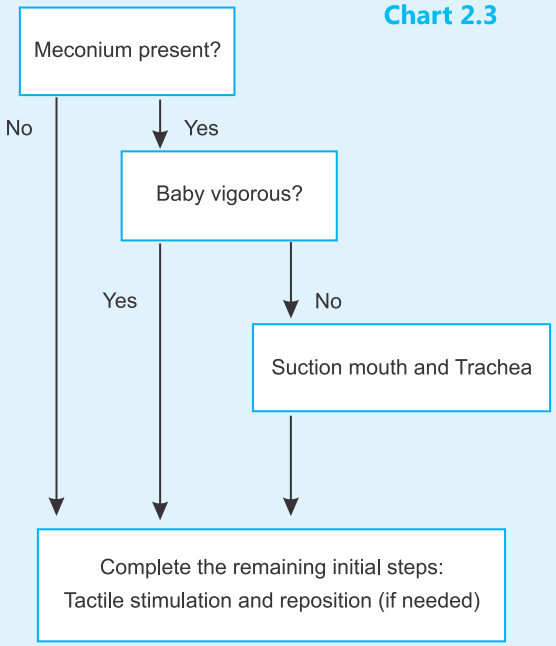
An appropriate position as described facilitates an unrestricted air entry by bringing the posterior pharynx, larynx and trachea in line. This alignment in the supine position is also the best position for assisted ventilation with bag and mask or the placement of an endotracheal tube.

Clearing the Airway

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

1. Presence of meconium stained amniotic fluid at the time of delivery
2. The level of activity of the baby (Is the baby depressed or vigorous at birth): **Vigorous is defined as strong respiratory efforts, good muscle tone and a heart rate greater than 100 bpm**

Chart 2.3



Clearing the airway when amniotic fluid is free of meconium

Secretions 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. The turning of the head to one side will allow the secretions to collect in the cheek where they can be removed easily. This is important when there are copious secretions. When using suction from the wall or from an electric suction machine, the suction pressure should be set so that when the suction tubing is blocked, the negative pressure (vacuum) reads approximately 100 mm Hg.

The mouth is suctioned before the nose to ensure that there is nothing for the newborn to aspirate if he or she should gasp when the nose is suctioned. You can remember 'mouth before nose' by thinking 'M' comes before 'N' in the alphabet (Fig. 2.3). If material in the mouth and nose is not removed before the newborn breathes, the material can be aspirated into the trachea and lungs and this may have serious respiratory consequences. Suctioning, in addition to clearing the airway to allow unrestricted air entry to the lungs, also provides a degree of stimulation. In some cases this is all the stimulation needed to initiate respirations in the newborn.

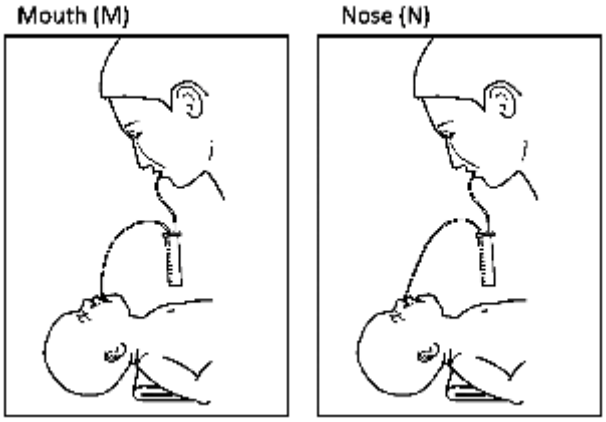


Figure 2.3: Sequence of Oral suction; 'M' first and 'N' later

Caution: One should be very careful while suctioning as stimulation of the posterior pharynx during the first few minutes after birth can produce a vagal response, causing severe bradycardia or apnea.

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 can be cleared simply by use of mucus extractor or large-bore suction catheter (12F or 14F). The steps of clearance are same as in a baby born without meconium stained liquor.

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

In a baby born through meconium-stained fluid and non-vigorous, direct suctioning of the trachea soon after delivery is performed before any respiration has occurred. This may reduce the chances of the baby developing meconium aspiration syndrome, a very serious respiratory disorder:

The following steps may be followed

- Insert a laryngoscope and use a 12F or 14F suction catheter to clear the mouth and posterior pharynx so that the glottis can be visualized.
- Insert an endotracheal tube into the trachea and attach the endotracheal tube to a suction source. (A special aspirator device will be needed.). One could also directly insert the suction catheter of a mucus extractor into the trachea and attach it directly to a suction device.
- Apply suction for several seconds when the tube is in the trachea and continue as the tube is slowly withdrawn. One can count, 'one-thousand-one, one-thousand-two, one-thousand-three and withdraw'.
- Repeat as necessary until little additional meconium is recovered, or until the baby's heart rate indicates that resuscitation must proceed without delay.
- Details of performing endotracheal intubation are described in Lesson 5. Individuals who will be initiating resuscitation, but who will not be intubating newborns, should still be competent in assisting with endotracheal intubation. This is also described in Lesson 5.
- Various techniques such as squeezing the chest, inserting a finger in the baby's mouth, or externally occluding the airway, have been proposed to prevent babies from aspirating meconium. None of these techniques have been subjected to rigorous research evaluation and may be harmful to the baby. They are not recommended.

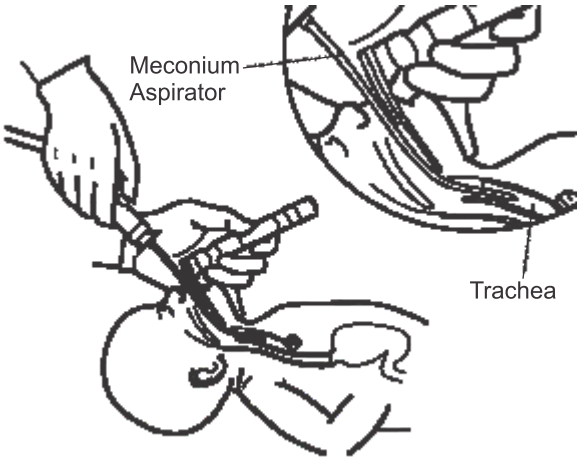


FIgure 2.4: Procedure of visualizing the trachea and of meconium using laryngoscope and endotracheal tube.

The baby should be dried and wet linen discarded

Other forms of stimulation that may help a baby to breathe

Drying and suctioning stimulate a baby to breathe. For many newborns, these are sufficient to initiate respiration. If a 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 steps of resuscitation but also may be used to stimulate continued breathing after positive pressure ventilation (PPV).

The only safe and appropriate methods of providing tactile stimulation are:

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

If a baby is in primary apnea, any form of stimulation will initiate breathing. Therefore 1 or 2 flicks or slaps to the sole; or gently rubbing the back once or twice is sufficient.

Inappropriate and vigorous stimulation is not helpful and can cause serious injury. Shaking the baby should be strictly avoided.

If a baby remains apneic despite tactile stimulation positive pressure ventilation should be immediately initiated (*discussed in Lesson 3*).

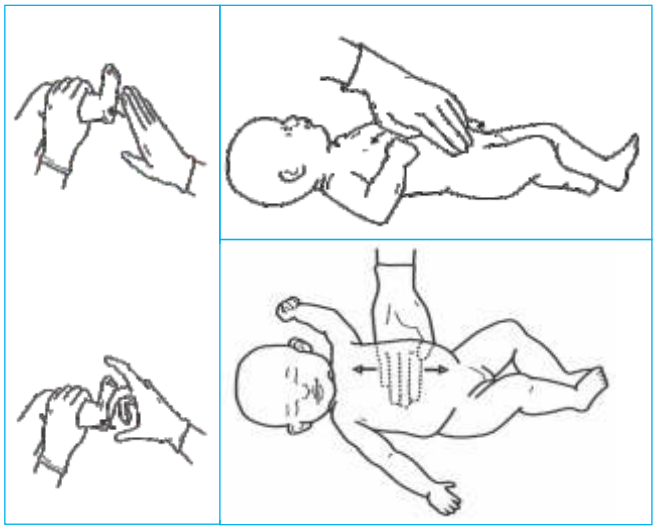


Figure 2.5: Appropriate methods of stimulation

After initial steps, what do you do next?

Evaluate the Baby

The next step is to evaluate the baby to assess if further resuscitation is needed. The entire process of resuscitation up to this point should not take more than 60 seconds. This may take more time in case tracheal suctioning is needed in a meconium stained depressed baby. The vital signs to be evaluated are 'Respiration' and 'Heart rate'.

Respiration

The baby is assessed to have good respiration if there are good chest movements. The rate and depth of respirations should increase after few seconds of tactile stimulation.

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

Heart Rate

The easiest way to rapidly determine the heart rate is by palpating the umbilical cord at its base near the baby's abdomen. Not uncommonly, the umbilical vessels are constricted and the pulse may not be palpable. If the pulse is not felt one should use the stethoscope to listen to the heartbeats over the left side of the chest. Tapping the table with each beat of the heart rate will assist other members of the team to know the heart rate.

One can multiply the number of beats in 6 seconds by 10 to provide a quick estimate of the beats per minute. The heart rate should be more than 100 bpm.

What do you do if the heart rate or respirations are abnormal?

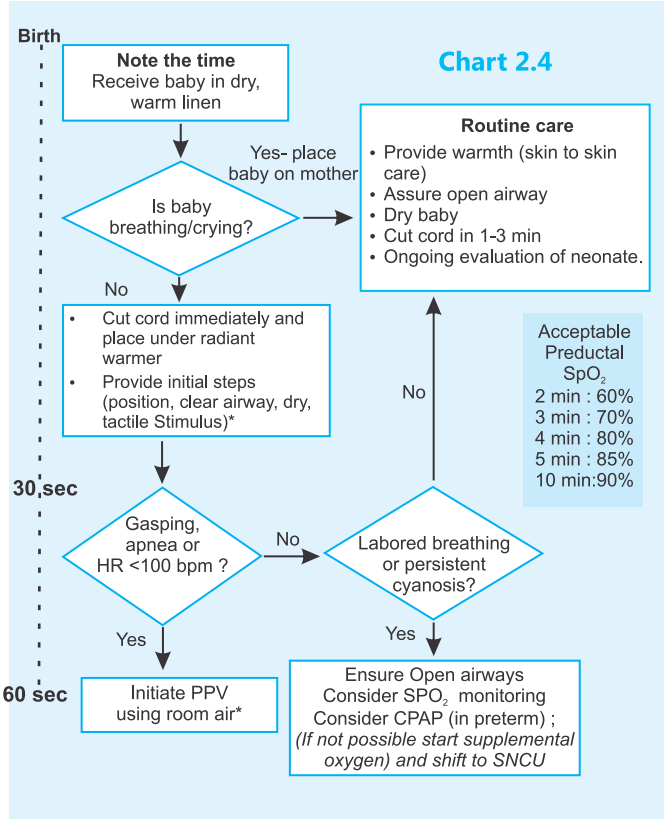
On evaluation of the breathing and the heart rate after initial steps if the baby is apneic or has gasping respirations, or the heart rate is less than 100, one should proceed immediately to provide positive pressure ventilation (PPV).

Continuing to provide tactile stimulation or administering free–flow oxygen to a non breathing baby or a baby with a heart rate below 100 bpm is harmful and delays appropriate management. This is described in detail in Lesson 3.

If a baby is breathing well and heart rate is above 100 BUT respirations are labored OR you believe that the baby is persistently cyanotic?

A baby may be breathing and have a heart rate of more than 100, but his breathing may be labored or he may be centrally cyanosed on evaluation after

initial steps. Such a baby needs additional respiratory support (especially if preterm) and tailored optimal oxygen delivery. The CPAP machine for the respiratory support and the blender with pulse oximeter for optimization of the oxygen delivery may not be available in the delivery room. In such circumstances these babies are started on supplemental oxygen and immediately shifted to the Neonatal Intensive Care Unit/SNCU.



SPO_2 Monitoring and Optimal Oxygen Delivery

The state of oxygenation of the baby can be suggested by the baby's skin colour. Cyanosis, caused by low oxygen in blood, will appear as blue colour over lips, tongue and trunk. Acrocynosis (blue hue of the hands and feet) is often due to the decreased circulation to the extremities and is not, by itself, an indication of decreased blood oxygen levels.

- Studies have now shown that clinical assessment of skin colour is not reliable, and may vary with the skin pigmentation.
- A baby, who is undergoing a normal transition to extra uterine life, may take several minutes after birth to increase blood oxygen saturation from approximately 60% (normal in intrauterine state) to more than 90%, which is the normal for a healthy newborn. These values may be lower in babies born by cesarean section compared to vaginally born babies.

Hence, if 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 (see box) and are not increasing, one may need to provide supplemental oxygen.

The table provides an easy to remember accepted ranges of the pre-ductal oximetery (right hand or wrist) values during the first 10 minutes following birth of uncomplicated babies born at term.

Acceptable Preductal SpO_2
2 min : 60%
3 min : 70%
4 min : 80%
5 min : 85%
10 min : 90%

Resuscitation Steps to be Taken:

Administration of Supplemental Oxygen:

How?

Free flow oxygen can be given to a spontaneously breathing baby by using one of the following delivering methods (Fig. 2.6)

- Oxygen mask
- Flow Inflating bag and mask
- Oxygen tubing held close to the baby's nose and mouth
- T piece resuscitator

Free flow oxygen cannot be given reliably by a mask attached to the self – inflating bag.

When unregulated oxygen is administered to a baby who is cyanosed or the oximeter readings are lower than the expected range, the oxygen levels may

increase very quickly to levels that may be toxic to the baby at that time. The likelihood of this situation increases when the baby is preterm.

Thus, it is best to use an oxygen concentration that can be varied throughout the range of 21% to 100%. This will be possible only with the availability of a compressed air source and an oxygen blender.

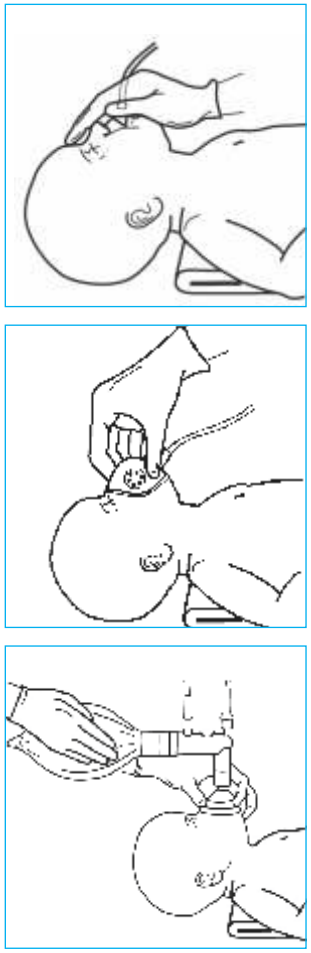


Figure 2.6: Methods by which free flow oxygen can be administered to a baby- oxygen tubing, face mask, bag and mask

How Much?

The normal intra-uterine oxygen saturation is 60% that increase gradually to 90% only by about 10 minutes of birth. Because of this normal transition pattern and the possibility of oxygen toxicity there is an ongoing controversy as to how much oxygen is safe during resuscitation. It is best to give oxygen to maintain the saturation of the baby in the acceptable ranges. This will require the use of a blender for graded delivery and a good pulse oximeter for optimal monitoring of oxygen saturation in the earliest minutes of life. If these are not available in the delivery room, it is best to shift these babies to a Neonatal Intensive Care unit/SNCU for further management.

How Long?

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

When central cyanosis improves and the oxygen saturation of the baby is above 85% to 90%, supplemental oxygen is gradually decreased. If the cyanosis or low oxygen saturation (less than 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 congenital cyanotic heart disease or persistent pulmonary hypertension of the newborn should be strongly considered.

Summary Lesson 2

1. Vigorous is defined as a newborn who has strong respiratory efforts, good muscle tone and a heart rate greater than 100 bpm.
2. If meconium is present and the newborn is vigorous, suction the mouth and nose only and proceed to place the baby in skin to skin contact on the mother and do further assessment. If newborn is not vigorous, suction the mouth and if skilled perform tracheal suction before proceeding to other steps.
3. Open the airway by positioning the newborn in the 'sniffing' position.
4. Appropriate tactile stimuli are
   - Slapping or flicking the soles of feet
   - Gently rubbing the back
5. Continued use of tactile stimulation in an apneic baby wastes valuable time. For persistent apnea start positive pressure ventilation immediately.
6. Acceptable methods for administering free flow oxygen are:
   - Oxygen mask
   - Flow inflating bag and mask
   - Oxygen tubing held close to the baby's nose and mouth
   - T-piece resuscitator
7. Free flow oxygen cannot be given reliably by mask attached to a self inflating bag.
8. Decisions and actions during newborn resuscitation are based on newborn's:

   (a) Respiration

   (b) Heart rate

   (c) Oxygen Saturations (by pulse Oximeter).

Positive Pressure Ventilation (PPV)

Learning objectives

In this lesson you will learn:

- When to initiate positive pressure ventilation (PPV)
- What are the devices used for PPV
- How to check the PPV device for functionality
- How to select appropriate size bag and mask
- What is the technique for providing PPV and the expected response
- What to do if there is no desired response following PPV

The following case scenario will illustrate how positive pressure ventilation (PPV) is provided during resuscitation. Imagine yourself as part of the team as you read through the case.

Case scenario 3

A 25-year-old Primigravida with non-progress of labor delivers a male baby at term gestation. The baby is limp, not breathing and has a large caput. There is no meconium staining of liquor.

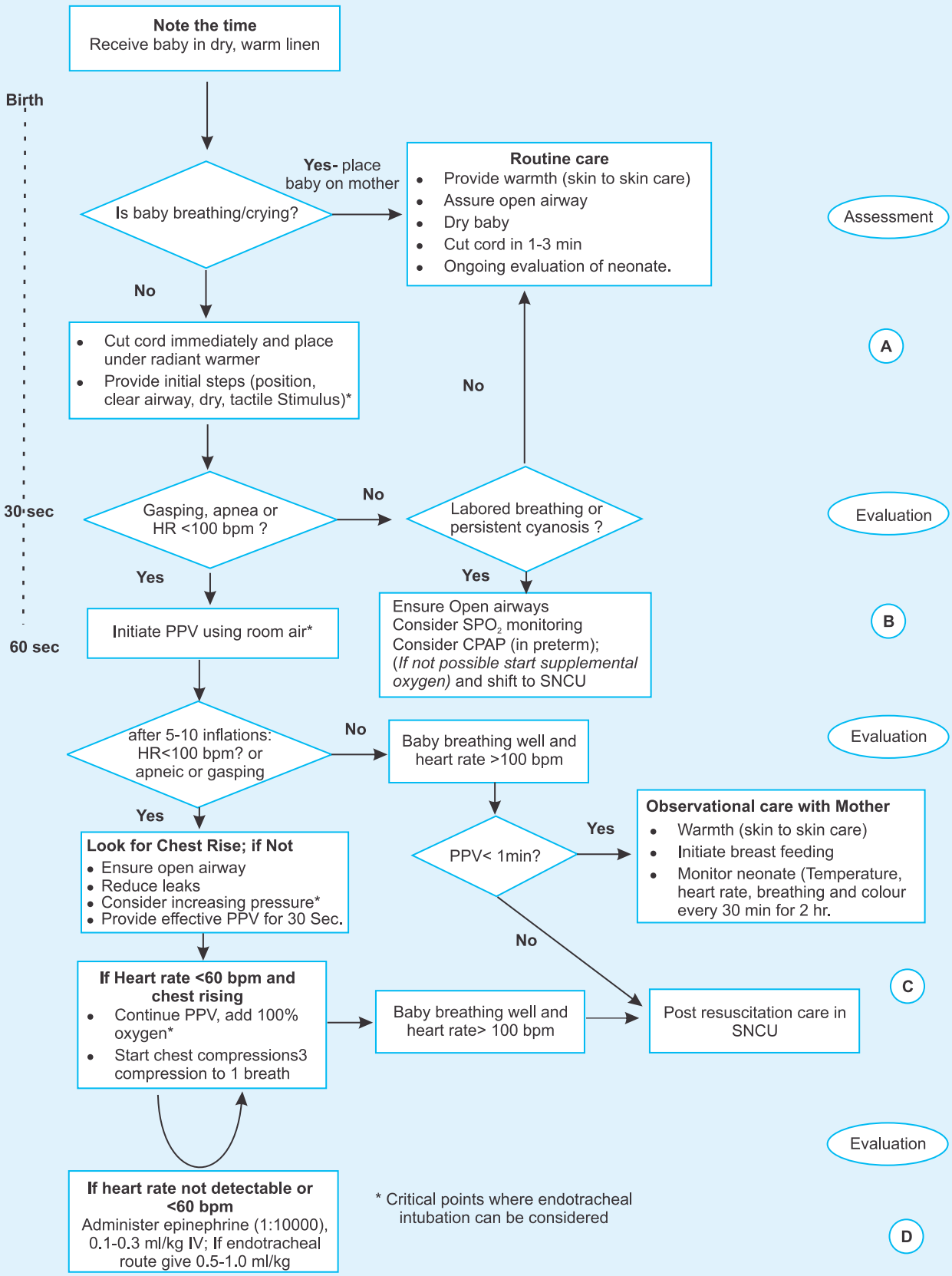
The cord is cut immediately and the baby is placed under a radiant warmer. The baby is positioned using a shoulder roll to keep the airway open. A quick suction is done of the mouth followed by the suction of nose. The nurse dries the baby with pre-warmed sheets and then removes the wet linen. The head is repositioned and brief stimulation done by flicking the soles of the baby.

The baby is still not breathing after these initial steps. The resuscitation team takes a decision to initiate positive pressure ventilation. A team member initiates positive pressure ventilation (PPV) with a bag and mask using 21% oxygen (room air) and calls for help. A second team member auscultates the chest and reports heart rate as 70/min. The team member providing PPV takes corrective ventilation steps by reapplying the mask to the face and repositioning the baby's head to open the airway. At the end of 30 seconds of positive pressure ventilation the baby still does not have spontaneous breathing and the assistant reports that the heart rate has risen to 110/min. Ventilation is continued further, ensuring adequate chest rise with each breath for another 30 seconds. The baby is about 2 minutes old; has some spontaneous breaths, a heart rate of 140/min and is pink. The PPV is continued and soon the baby starts crying. PPV is then discontinued.

The baby's cord is tied and the baby is shown to the mother. Skin to skin contact is provided by placing the baby over the mother's chest, covering the baby and mother with a clean sheet. The baby is then shifted to the SNCU for post-resuscitation care.

In the previous lesson (Lesson 2) you learnt how to determine whether the baby needs some form of resuscitation and how to perform the initial steps of resuscitation. In this lesson you will learn what to do next if the baby is not breathing effectively or is bradycardic after initial steps of resuscitation.

Chart 3.1


Note the time
Receive baby in dry, warm linen
Birth
Is baby breathing/crying?
Yes- place baby on mother
Routine care
Provide warmth (skin to skin care)
Assure open airway
Dry baby
Cut cord in 1-3 min
Ongoing evaluation of neonate.
Assessment
No
Cut cord immediately and place under radiant warmer
Provide initial steps (position, clear airway, dry, tactile Stimulus)*
A
No
30 sec
Gasping, apnea or HR <100 bpm ?
No
Labored breathing or persistent cyanosis ?
Evaluation
Yes
Yes
Initiate PPV using room air*
Ensure Open airways
Consider SPO2 monitoring
Consider CPAP (in preterm);
(If not possible start supplemental oxygen) and shift to SNCU
B
60 sec
after 5-10 inflations: HR<100 bpm? or apneic or gasping
No
Baby breathing well and heart rate >100 bpm
Evaluation
Yes
Look for Chest Rise; if Not
Ensure open airway
Reduce leaks
Consider increasing pressure*
Provide effective PPV for 30 Sec.
PPV< 1min?
Yes
Observational care with Mother
Warmth (skin to skin care)
Initiate breast feeding
Monitor neonate (Temperature, heart rate, breathing and colour every 30 min for 2 hr.
No
If Heart rate <60 bpm and chest rising
Continue PPV, add 100% oxygen*
Start chest compressions3 compression to 1 breath
Baby breathing well and heart rate> 100 bpm
Post resuscitation care in SNCU
C
Evaluation
If heart rate not detectable or <60 bpm
Administer epinephrine (1:10000), 0.1-0.3 ml/kg IV; If endotracheal route give 0.5-1.0 ml/kg
* Critical points where endotracheal intubation can be considered
D

When should you provide positive pressure ventilation?

PPV should be initiated if:

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

What are the equipments available for PPV in newborns?

The three types of equipment available for providing PPV in the newborn are:

i) Self inflating bag

ii) Flow inflating bag (Anesthesia bag)

iii) T-piece resuscitator

The **Self inflating bag** is presently the most commonly used ventilation device (Fig. 3.1). The bag remains inflated following compression due to elastic recoil and does not need a compressed gas source to keep it inflated. It has a pressure limiting valve (pop off valve) regulated to limit inflation pressure to around 35-40 cm H_2O. The bag can be used with or without an attached manometer and/or oxygen reservoir (Fig.3.2). When squeezed, a self-inflating bag delivers a breath.

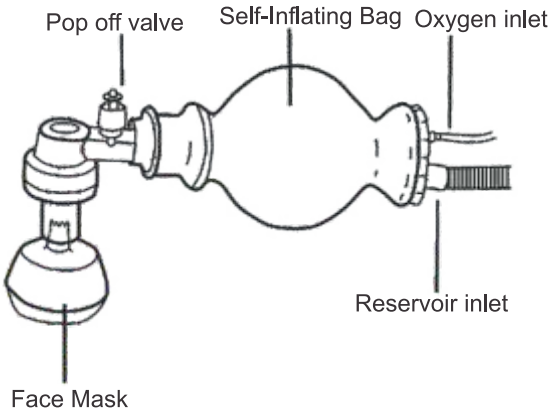


Figure 3.1: Self inflating bag

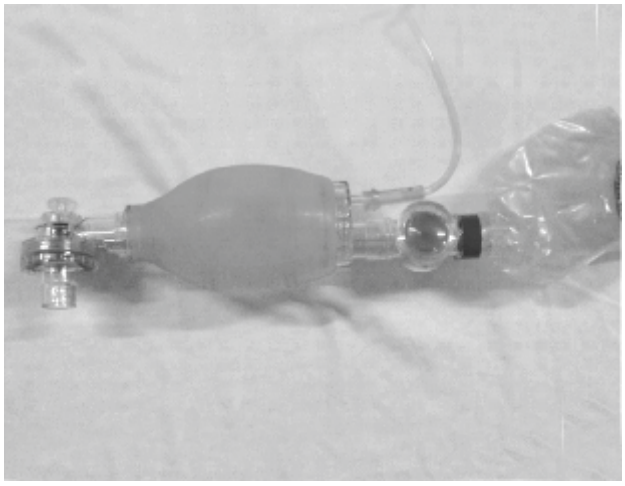


Figure 3.2: Self inflating bag with oxygen tubing and reservoir

Self-inflating bag	
Advantages	• Will always refill after being squeezed, even without compressed gas source • Pressure limiting valve reduces risk of over-inflation
Disadvantages	• Will inflate even if there is no seal between mask and patient's face • Requires oxygen reservoir to provide high oxygen concentration • Cannot deliver free flow oxygen reliably through face mask • Cannot be used to deliver continuous positive airway pressure (CPAP); (can only deliver CPAP if positive end-expiratory pressure (PEEP) valve and pressurized gas is used).

The **Flow inflating bag (Anaesthesia bag)** (Fig. 3.3) fills only when a source of compressed gas (oxygen, air, or a mix of the two) is connected. They do not usually 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.

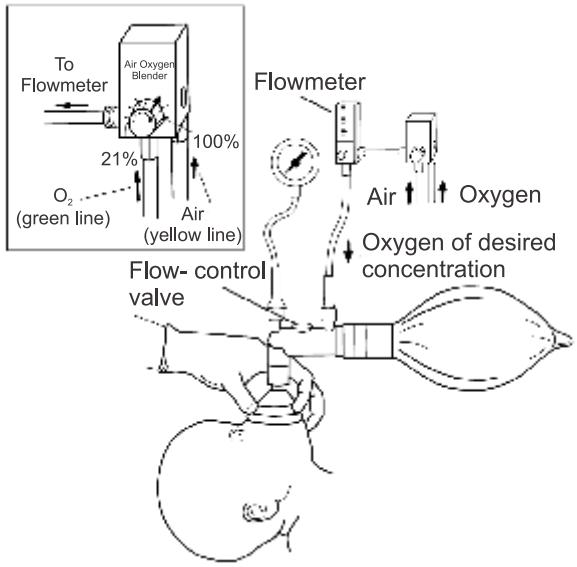


Figure 3.3: Flow inflating bag

Flow inflating bag	
Advantages	• Can deliver free flow oxygen up to 100%, depending on source • Easy to determine when there is a seal on the patient's face.
Disadvantages	• Needs compressed gas source to work. • Requires a tight seal between the mask and the patient's face to remain inflated. • Usually does not have a safety pop-off valve; requires a pressure gauge to monitor pressure being delivered

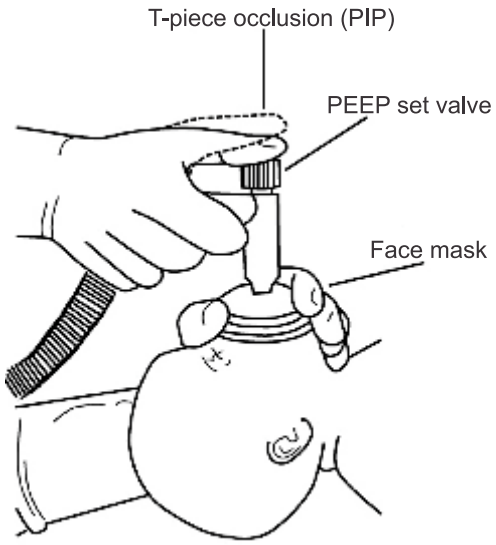


Figure 3.4: T piece resuscitator

T-piece resuscitator	
Advantages	• Consistent delivery of PIP and PEEP. • Can be used to provide free flow oxygen reliably – 21-100 % (with blender) • Provider does not get tired while ventilating.
Disadvantages	• Needs compressed gas with a blender. • Requires pressures to be set prior to use. • Changing inflation pressure during resuscitation is more difficult. • Risks of prolonged inspiratory time

A self-inflating bag should always be available as a back-up to flow-dependent devices in case of failure of compressed gas supply

T-piece resuscitator is a flow controlled pressure limited ventilator device (Fig. 3.4). 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 (PEEP). Varying the duration of occlusion of the outlet hole alters the inflation time. 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. The inspiratory and expiratory pressure settings can be altered upwards or downwards as needed during use, depending on the infant's response.

What are the important features of resuscitation equipment used in newborns?

The equipment should be designed for use in newborns and the following features must be given consideration.

Appropriate sized face masks

Masks come in a variety of shapes, sizes, and materials. An appropriate face mask must seal around the mouth and nose but not cover the eyes or overlap the chin. It can be difficult to establish and maintain a good seal between the mask and the infant's face and so it cannot be assumed that just because the mask is on the face, there is a good seal. Masks with a cushioned rim and round shape are preferable.

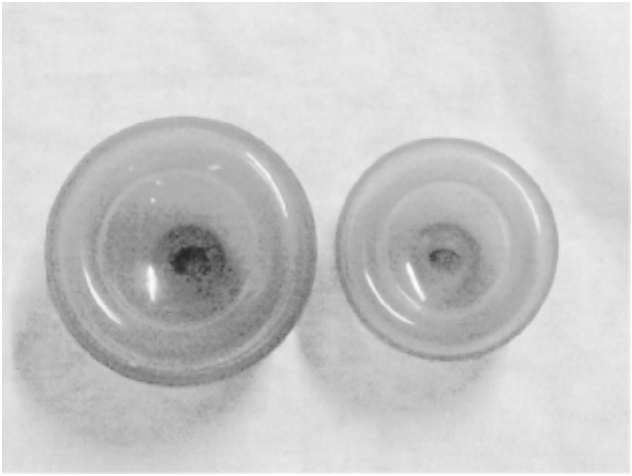


Figure 3.5. Two sizes of face masks 1 and 0 used in newborns

Appropriate sized bag

Bags used for newborn resuscitation should have a volume between 250-750 ml. Term newborns require about 10-25 ml with each breath (4-6 ml/kg). Bags larger than 750 ml cannot deliver such small volumes and bags smaller than 250 ml will not adequately re-inflate between breaths when 40-60 breaths/min are used.

Safety features in PPV devices

Self-inflating bags should have a pressure relief valve (commonly known as a pop off valve) (Fig. 3.1) which is usually set at 30-40 cm H_2O by the manufacturer. If peak inspiratory pressure exceeds this limit, the valve opens limiting the pressure transmitted to the newborn lungs. There is no direct control for PEEP. Many self-inflating bags also are equipped with a pressure gauge or a port to attach a pressure gauge. The pressure manometer is used to adjust pressures.

Flow inflating bags have a flow control valve which can be adjusted to deliver the desired PEEP. Inspiratory pressures have to be measured by attaching pressure gauge.

A T-piece resuscitator has 2 controls. The inspiratory pressure control sets the amount of pressure delivered during a normal assisted breath. The maximum pressure relief control is a safety feature that prevents the pressure from exceeding a preset value (usually 40 cm H_2O, but adjustable).

How to check functionality of self-inflating bag

- Assemble the device correctly.
- With a flow/self-inflating bag occlude the face mask against the palm.
- Look for following features as you squeeze the bag:
  a) You should feel pressure against the palm.
  b) The fish mouth valve should open and close.
  c) The pop off valve should make a hissing sound or move up and down.
  d) The bag should recoil instantly when pressure is released.
  e) If a pressure manometer is attached it should display the pressure when bag is squeezed.

Absence of any of the above features suggests malfunction.

How to provide ventilation using self-inflating bag

- Complete the initial steps (warm position and clear the airway as necessary, dry and stimulate), re-evaluate the infant within 30 seconds.
- Assess condition: Heart rate [HR] and breathing and begin positive pressure ventilation (PPV) within first 60 seconds.

- Ensure the device is assembled correctly and is functional.
- Ensure oxygen source, tube, reservoir and additional help is available.
- Call for HELP as you decide to provide PPV.

Positioning

- Place the baby on firm, flat and clean surface.
- Position the head of the baby in a neutral position to open the airway.
- The rescuer should stand at the head end of the baby.
- Use of shoulder roll may be required in presence of large caput or in preterm infants.

Figure: 3.7

Applying face mask

- Apply the face mask firmly and gently to fit snugly covering the chin, mouth and nose to achieve an airtight seal.

Figure: 3.8

- The mask usually is held on the face with the thumb, index, and/or middle finger encircling much of the rim of the mask using the non dominant hand.
- Ensure that the mask does not extend on the eyes or beyond the chin.

Figure: 3.9

Providing ventilation (Fig. 3.6)

- Squeeze the bag between thumb and two fingers using the dominant hand.
- Deliver a rate of 40-60 breaths per minute. Call loudly 'squeeze, two-three'. Deliver a breath when you call squeeze and allow the bag to recoil during calling 'two-three'.

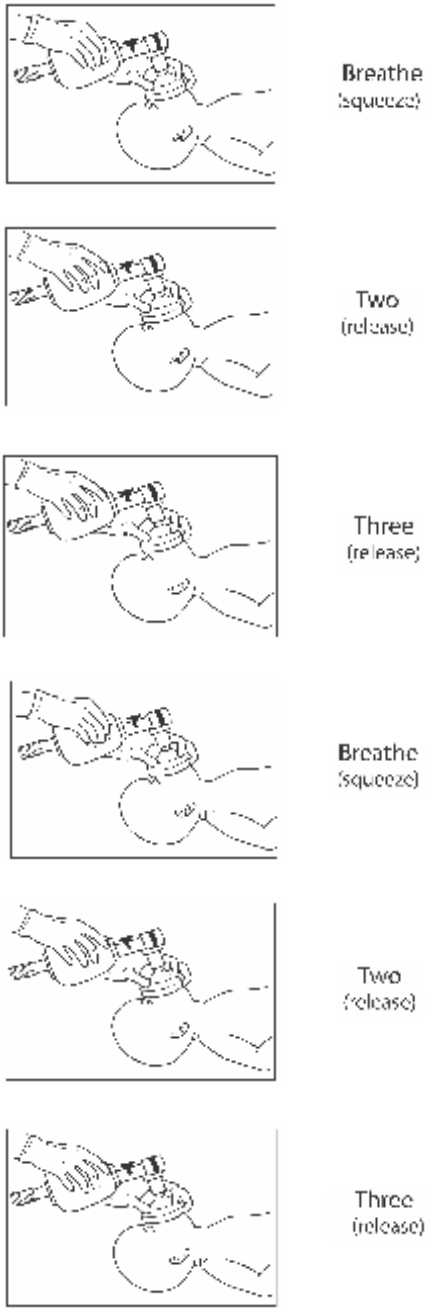


Figure 3.10: Delivering 40-60 breaths using self inflating bag. If one is using a T-piece resuscitator, occlude the PEEP valve when saying “squeeze” and release it while saying “two, three”.

Oxygen delivery with self-inflating bag

- For babies born at term, it is best to begin positive pressure ventilation 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 there is no rise in heart rate take ventilation corrective measures.

(Table 3.1)

Table: 3.1 Techniques to improve PPV using bag and mask

	Problem	Remedial step
M	Inadequate seal	Mask adjusted to ensure airtight seal
R	Inappropriate position	Reposition the head in sniffing position
S O	Blocked airway	Suction the airway Open baby's mouth and ventilate
P	Inadequate pressure	Increase pressure by squeezing the bag with more pressure till a chest rise is visible
A	No improvement with above steps	Consider alternative airway like endotracheal intubation (or laryngeal mask airway if expertise present)

Remember to follow the corrective steps in the sequence indicated in Table 3.1

- Provide un-interrupted effective ventilation for 30 seconds and assess for spontaneous breathing. If spontaneous breathing present gradually discontinue PPV.

What is effective ventilation?

- Prompt increase in heart rate is the best indicator of adequacy of ventilation.
- Additional signs of effective ventilation include appearance of spontaneous breathing, improving colour and muscle tone.

What to do if baby is not improving?

You have so far done the following:

- Initiated PPV at a rate of 40-60 breaths/minute.
- Called for assistance.
- If chest rise or rise in heart rate was not evident after 5-10 breaths, you initiated ventilation corrective steps (Table 3.1)
- Provided effective PPV for 30 sec.

Now evaluate heart rate:

If the heart rate is more than 60 bpm but less than 100 bpm, continue PPV as long as the baby is showing improvement.

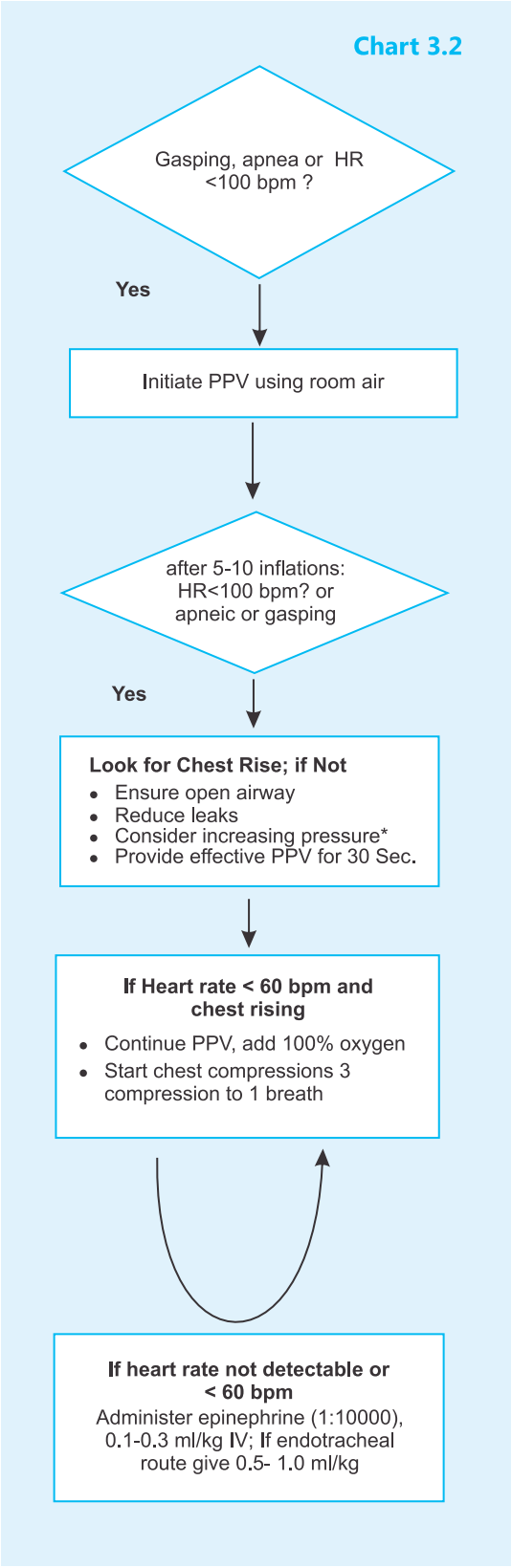
- Ensure effective ventilation
- Reassess respiratory effort, heart rate every 30 secs (oxygen saturations may be monitored continuously if available)
- If PPV is prolonged over several minutes place an orogastric tube to prevent distention of stomach with air which may interfere with ventilation

If the baby's heart rate is below 60 bpm despite 30 seconds of effective PPV (chest rise with ventilation), your next step will be to initiate chest compression (This will be described in lesson 4). Increase oxygen concentration to 100% when you initiate chest compressions.

When to stop PPV ?

PPV can be discontinued when:

- When the heart rate is above 100 bpm
- Sustained spontaneous breathing



Post resuscitation care

- Newborn infants requiring PPV for less than 1 minute should be provided observational care with the mother.
- Preterm infants with labored breathing should be shifted to SNCU for considering CPAP.
- Newborns requiring PPV for more than one minute or needing intubation, or chest compressions should be shifted to SNCU for post-resuscitation care.

Observational care with mother

- Warmth (skin to skin care)
- Initiate breastfeeding
- Monitor neonate (Temperature, heart rate, breathing and colour every 30 min for 2 hr.)

Summary: Lesson 3

1. Effective ventilation is the key to nearly all successful neonatal resuscitations.
2. Be familiar with the type of resuscitation device(s) you are using.
3. Ensure the ventilation device is in working order before each delivery and after every use.
4. The primary measure of adequate initial ventilation is prompt improvement in heart rate. Assess chest wall movement if heart rate does not improve.
5. Begin resuscitation in room air for term babies and preterm babies > 34 weeks.
6. A common source of error is inadequate seal of mask with face, hence always optimize airseal.

Chest Compressions

Learning objectives

In this lesson you will learn:

- When to start chest compressions.
- How to perform chest compressions.
- How to coordinate chest compressions with positive pressure ventilation.
- When to stop chest compressions.

The following case scenario will illustrate how chest compressions are provided as part of more advanced resuscitation. Imagine yourself as part of the team providing resuscitation. The details of chest compressions will be described later in this lesson.

Case scenario 4

A primigravida woman with term pregnancy was admitted in labor with poor fetal movements. The obstetric team notified the pediatric team to be in the delivery room. The radiant warmer was turned on and resuscitation equipment checked.

The woman delivered a limp and apneic baby, who was immediately transferred by the resuscitation team to the radiant warmer. The baby was properly positioned, suctioned, dried and stimulated by flicking the soles. But, 30 seconds after birth the baby was still limp, apneic and cyanotic.

One member of the team initiated positive pressure ventilation with bag and mask using room air. Another member checked the heart rate by palpating the umbilical cord for pulse. After 5-10 inflations the baby had a heart rate below 60 bpm. The care provider performing PPV checked the mask for its seal, proper position of the head, that airway is clear, and chest rises with each breath.

Despite these steps, after 30 seconds of effective ventilation the baby's heart rate was below 60 bpm, so 100% oxygen was added to PPV and the second team member began chest compressions coordinated with PPV using 3:1 ratio of compressions to ventilation. After another 45 seconds, the baby started making breathing efforts; the heart rate was more than 60 bpm but less than 100 bpm.

The team stopped chest compression but continued PPV for another 30 seconds. The baby now had evidence of spontaneous breathing and the heart rate went above 100 bpm. The rate of PPV was gradually slowed down and after one minute of observation the baby was found to be breathing regularly, the heart rate was 120 per minute, and was pink. The baby was then shifted to the SNCU for post-resuscitation care.

Why perform chest compressions?

Chest compressions are required to ensure that heart is able to pump the blood being oxygenated in the lung by mechanical ventilation. In babies with heart rate below 60 bpm despite PPV, the oxygen level drops to cause acidosis and significant myocardial dysfunction. Chest compressions are performed to supplement the mechanical ability of the heart to maintain circulation till the time myocardium is oxygenated to perform adequate function and deliver oxygen to the brain. Bag and mask can be used to provide ventilation but to make it more effective during chest compressions, endotracheal intubation should be performed.

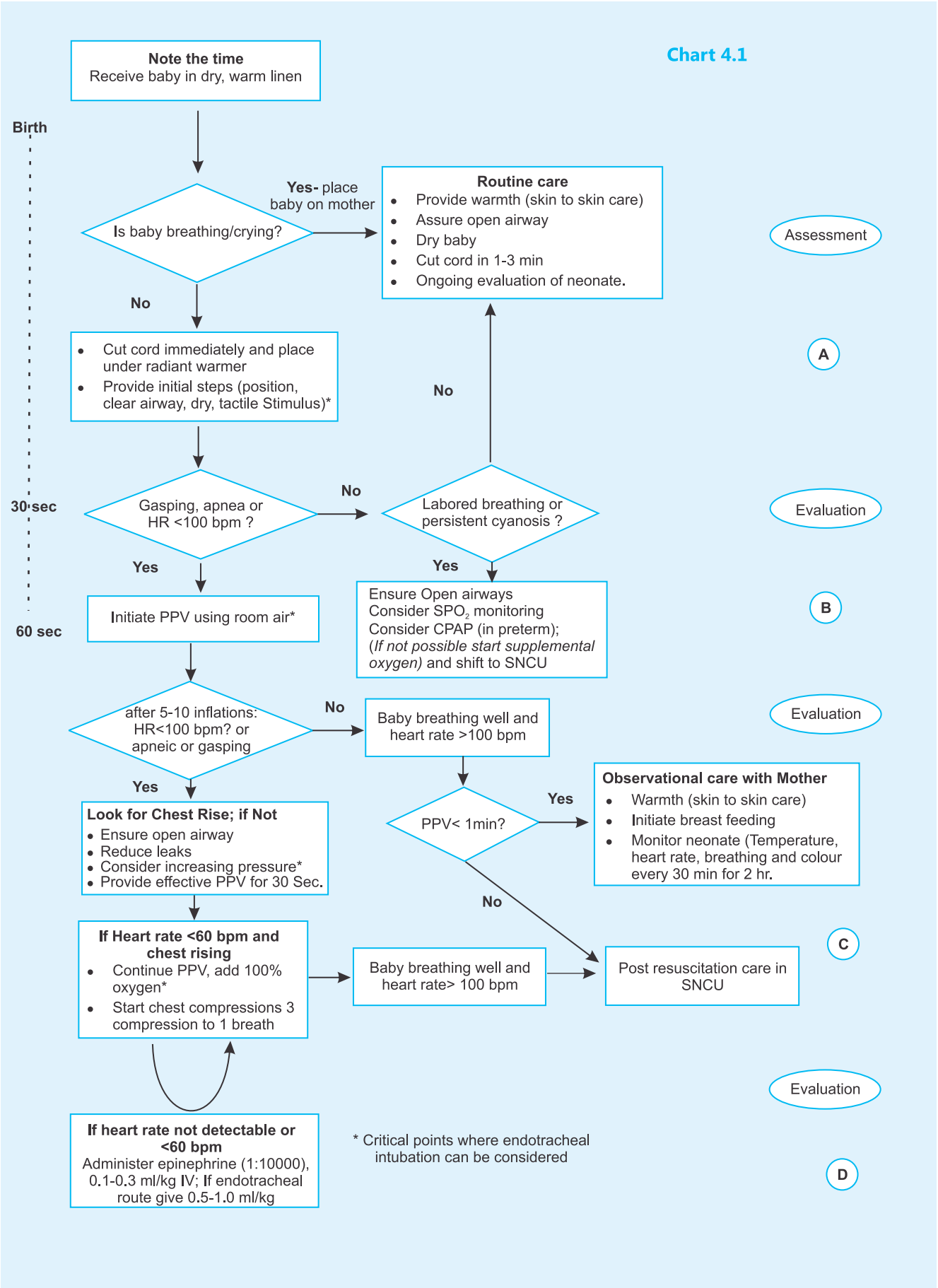


Chart 4.1
Note the time
Receive baby in dry, warm linen
Birth
Is baby breathing/crying?
Yes- place baby on mother
Routine care
Provide warmth (skin to skin care)
Assure open airway
Dry baby
Cut cord in 1-3 min
Ongoing evaluation of neonate.
Assessment
No
Cut cord immediately and place under radiant warmer
Provide initial steps (position, clear airway, dry, tactile Stimulus)*
A
No
30 sec
Gasping, apnea or HR <100 bpm ?
No
Labored breathing or persistent cyanosis ?
Evaluation
Yes
Yes
Initiate PPV using room air*
Ensure Open airways
Consider SPO2 monitoring
Consider CPAP (in preterm);
(If not possible start supplemental oxygen) and shift to SNCU
B
60 sec
after 5-10 inflations: HR<100 bpm? or apneic or gasping
No
Baby breathing well and heart rate >100 bpm
Evaluation
Yes
Look for Chest Rise; if Not
Ensure open airway
Reduce leaks
Consider increasing pressure*
Provide effective PPV for 30 Sec.
PPV< 1min?
Yes
Observational care with Mother
Warmth (skin to skin care)
Initiate breast feeding
Monitor neonate (Temperature, heart rate, breathing and colour every 30 min for 2 hr.
No
If Heart rate <60 bpm and chest rising
Continue PPV, add 100% oxygen*
Start chest compressions 3 compression to 1 breath
Baby breathing well and heart rate> 100 bpm
Post resuscitation care in SNCU
C
Evaluation
If heart rate not detectable or <60 bpm
Administer epinephrine (1:10000), 0.1-0.3 ml/kg IV; If endotracheal route give 0.5-1.0 ml/kg
* Critical points where endotracheal intubation can be considered
D

What are chest compressions?

Chest compressions are rhythmic compressions of the sternum that

- Compress the heart between the sternum and spine
- Increase the intrathoracic pressure
- Pump the blood into the circulatory system

Blood enters the heart from the veins when pressure from sternum is released.

When to initiate chest compressions?

Chest compressions are initiated if after 30 seconds of effective PPV the heart rate remains below 60 bpm.

Technique of chest compressions

You will learn two different techniques for chest compressions

- Thumb technique – where two thumbs are used to depress the sternum while the hands encircle the chest and fingers support the spine.

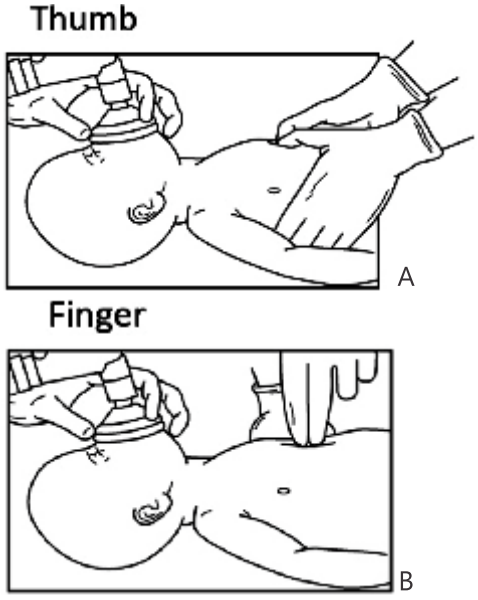


Figure 4.1: Techniques of chest compressions (A-thumb; B-two finger)

- 2- Finger technique – where the tips of middle finger and index or ring finger are used to compress the sternum. The spine is supported by the other hand or by placing the baby on a hard surface.

The thumb technique is preferred since it is able to provide consistent pressure and depth of compression.

Thumb technique

Points to Note:

- Baby's back is firmly supported
- Neck is slightly extended
- Compressions should be at appropriate location, depth and rate.

Site of compressions

It is done in lower third of sternum in midline. The area lies between xiphoid and a line drawn between nipples. This can also be located by running ones fingers along the costal margin and localizing the xiphoid and placing the fingers above the xiphoid.

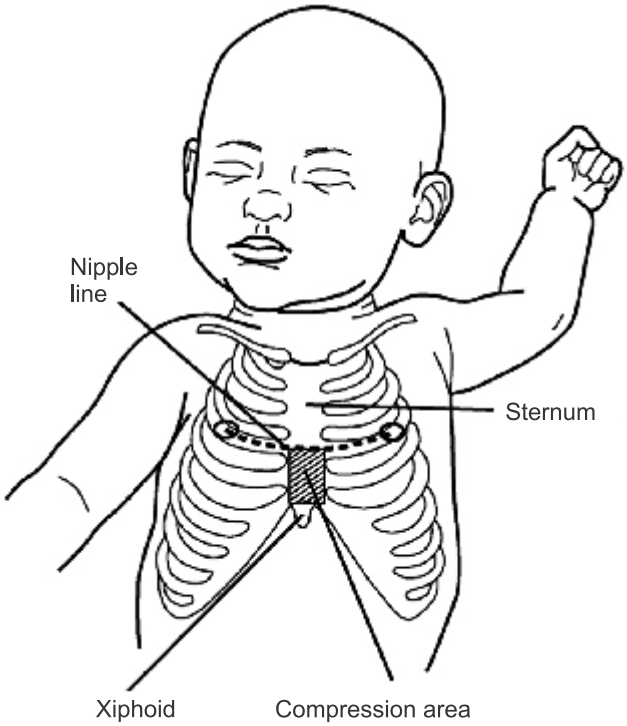


Figure 4.2: Landmarks for chest compression

The thumbs should be along each other but can overlap if baby is very small. If baby is large it is occasionally difficult to use 2 thumbs and in the event of making umbilical cord accessible for cannulation one may have to move to head end or use 2 finger technique.

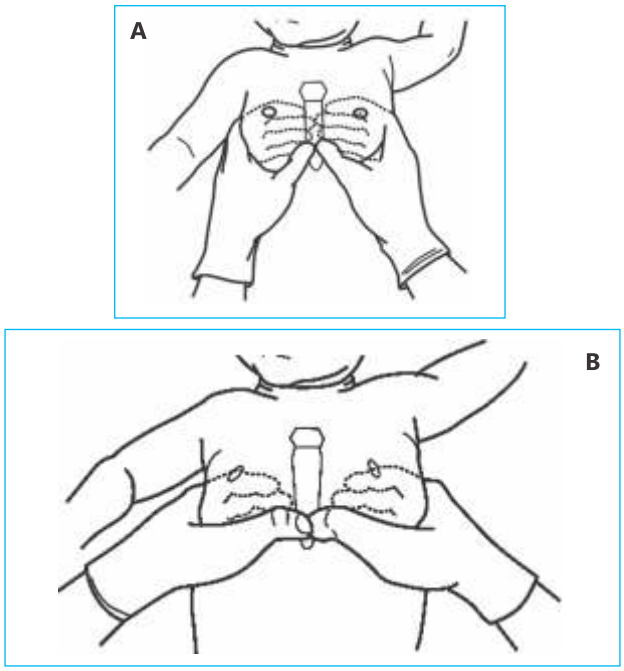


Figure 4.3: Thumb technique of chest compressions administered from foot end (A), and with thumbs overlapped (B)

Two-Finger Technique Finger tips of middle finger along with index/ring finger is used.

The fingers should be kept directly perpendicular to the sternum. Site of compression remains the same as the thumb technique.

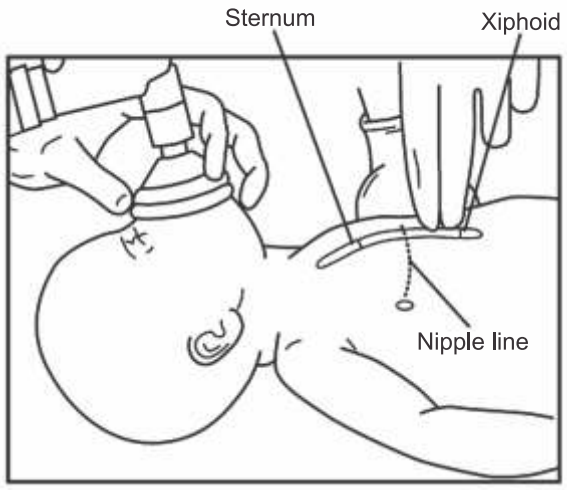


Figure 4.4: Correct finger position for two-finger technique

Points to Note:

- Only two-finger tips should rest on the sternum.
- Either the free hand or a hard surface should support the back.
- Pressure is to be applied vertically.
- This technique is more tiring than thumb technique.

What is the pressure required for compression?

The sternum should be depressed to a depth of approximately one third of the anterior-posterior diameter of the chest.

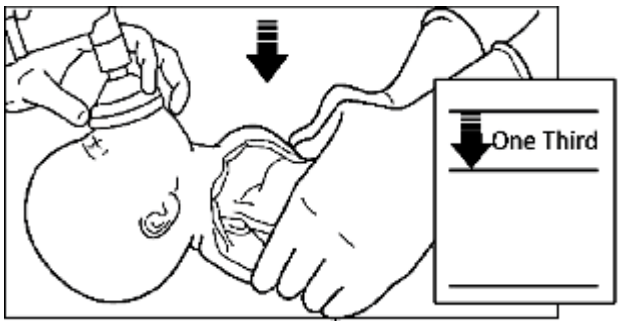


Figure 4.5: Compression depth should be approximately one-third of the antero posterior diameter of the chest

- Duration of downward stroke is shorter than the duration of release to permit the heart to fill.
- On complete release, the fingers should maintain contact with the chest to avoid relocating compression area and loss of control over compression

What are the dangers with chest compressions?

Chest compressions can cause trauma to the baby. Improper placement of finger or thumb can cause:

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

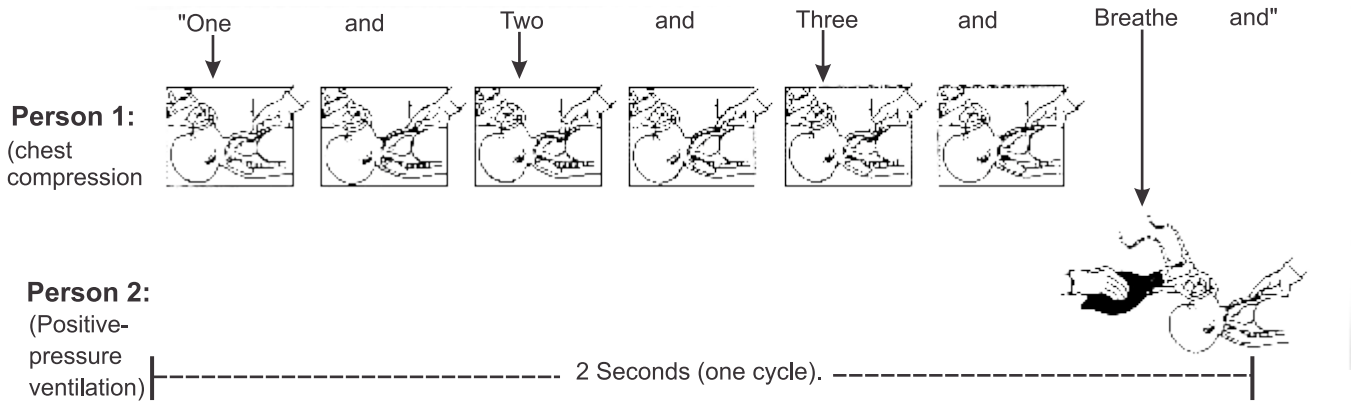


Figure 4.6: Coordination of chest compressions and ventilation

What should be the rate of compression and how is it coordinated with PPV?

Chest compressions should always be accompanied by positive pressure ventilation. Compressions and ventilation should be coordinated. For every 3 compressions 1 breath is delivered (hence in a minute, 90 compressions and 30 breaths are given).

The person compressing should call out the counting sequence of **"One and Two and Three and Breathe and"**. The person ventilating squeezes the bag during 'Breathe and' and releases during 'One and'.

Practicing rhythm of chest compression and ventilation imagine yourself as the person giving chest compressions. Repeat the sequence 'One and Two and Three and Breathe and' loudly and move your hands to compress at 'One and' and 'Two and' and 'Three and' but not at 'Breathe and'. Practise this several times so that you can do 5 cycles in 10 seconds.

Since chest compression has to be coordinated with ventilation, now imagine yourself as the person giving ventilation. Repeat the sequence 'One and Two and Three and Breathe and' loudly but do not move hands when you say 'One and Two and' and 'Three and' but only when you say 'Breathe and'. Practice this several times so that you can do 5 cycles in 10 seconds.

When to stop chest compressions?

The heart rate should be above 60 bpm to stop chest compressions but the PPV is continued. After stopping the chest compression effective ventilation is delivered at 40-60 breaths/minute. Then ventilation is stopped gradually later when the heart rate goes above 100bpm and the baby begins to breathe spontaneously. The baby is then shifted to SNCU for post resuscitation care as described in Lesson 3.

If the child is not improving

1. Check if PPV is effective; if the baby is not intubated then perform endotracheal intubation.
2. Make sure you have increased oxygen supplementation to 100%.
3. Check if the depth of compression is adequate.
4. Ensure that chest compression and ventilation are well coordinated.

If you cannot intubate make sure you call someone who is skilled in endotracheal intubation. In the mean time continue PPV with bag and mask. The technique of endotracheal intubation will be described in lesson 5.

If the baby's heart rate remains below 60 bpm then you should insert an umbilical catheter and give epinephrine (this is described in lesson 6).

Summary: Lesson 4

1. The compression ventilation ratio is 3:1 and in a minute 90 compressions to 30 PPV are delivered.
2. It is preferable to intubate the baby at this stage to provide effective ventilation.
3. Ventilate with 100% oxygen.
4. If the heart rate is above 60 bpm stop chest compressions.
5. If the heart rate remains below 60 bpm after 40-60 secs of chest compressions, insert umbilical catheter and give epinephrine.

Endotracheal Intubation

Learning objectives

In this lesson you will learn:

- The indications for endotracheal intubation during resuscitation
- How to select and prepare the appropriate equipment for endotracheal intubation
- How to use the laryngoscope to insert an endotracheal tube
- How to determine if the endotracheal tube is in the trachea
- How to use the endotracheal tube to suction meconium from the trachea
- How to use the endotracheal tube to administer positive-pressure ventilation

When is endotracheal intubation required?

Endotracheal intubation may be performed at various points during resuscitation as indicated by the asterisks (*) in the resuscitation algorithm.

Indications for endotracheal intubation are:

- If the baby is born through meconium stained amniotic fluid and is depressed. (Endotracheal intubation may be required to perform tracheal suction for meconium).
- If positive-pressure ventilation is not resulting in adequate clinical improvement i.e. if the heart rate is not increasing or if chest rise is not good.
- If there is a need for positive-pressure ventilation for more than a few minutes.
- If chest compressions are required. (Endotracheal intubation may be performed to improve the efficiency of positive pressure breaths).
- For special situations, such as giving endotracheal medications and suspected diaphragmatic hernia.

What equipment and supplies are needed?

The supplies and equipment necessary to perform endotracheal intubation should be kept together and readily available. Each delivery room, nursery, and emergency department should have at least one complete set of the following items (Figure 5.1):

- Laryngoscope (1) with an extra set of batteries (6) and extra bulbs
- Blades: No. 1 (term newborn), No. 0 (preterm newborn), No. 00 (Optional for extremely preterm newborn) Use straight blade (8)
- Endotracheal tubes with internal diameters of 2.5, 3.0, 3.5 and 4.0 mm (4)
- Endotracheal tube stylet (optional) (5)
- Suction facilities with 10 F or larger suction catheters, and sizes 5F or 6F and 8F for suctioning the endotracheal tube (7)
- Meconium aspirator (11)
- Stethoscope (neonatal head preferred) (10)
- Positive-pressure device (12 & 13) and oxygen tubing. Self-inflating bag must have oxygen reservoir.
- Scissors (9) and adhesive tape (2) for fixing endotracheal tube
- Oral airways (3)

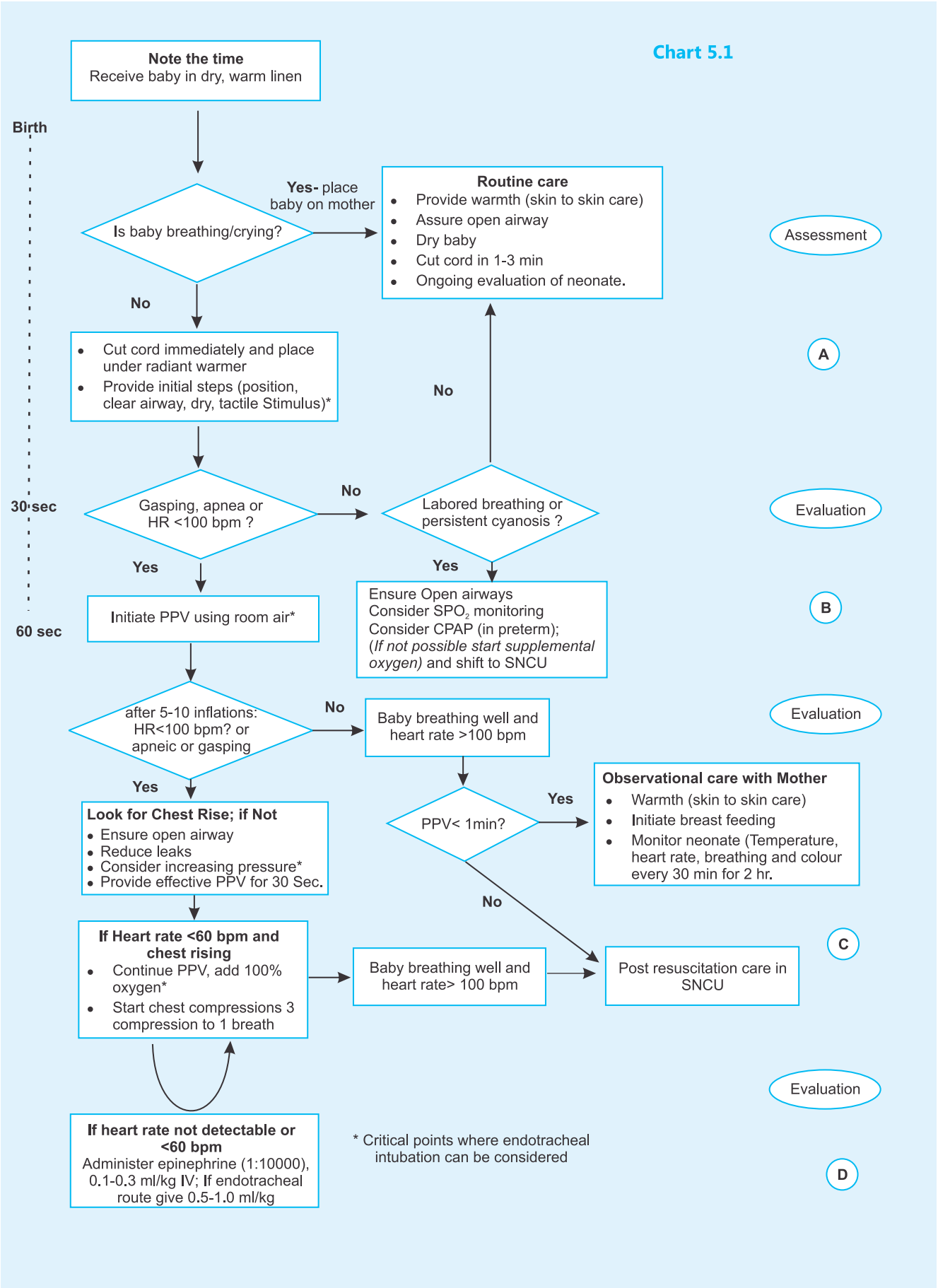


Chart 5.1
Note the time
Receive baby in dry, warm linen
Birth
Is baby breathing/crying?
Yes- place baby on mother
Routine care
Provide warmth (skin to skin care)
Assure open airway
Dry baby
Cut cord in 1-3 min
Ongoing evaluation of neonate.
Assessment
No
Cut cord immediately and place under radiant warmer
Provide initial steps (position, clear airway, dry, tactile Stimulus)*
A
No
30 sec
Gasping, apnea or HR <100 bpm ?
No
Labored breathing or persistent cyanosis ?
Evaluation
Yes
Yes
Initiate PPV using room air*
Ensure Open airways
Consider SPO2 monitoring
Consider CPAP (in preterm);
(If not possible start supplemental oxygen) and shift to SNCU
B
60 sec
after 5-10 inflations: HR<100 bpm? or apneic or gasping
No
Baby breathing well and heart rate >100 bpm
Evaluation
Yes
Look for Chest Rise; if Not
Ensure open airway
Reduce leaks
Consider increasing pressure*
Provide effective PPV for 30 Sec.
PPV< 1min?
Yes
Observational care with Mother
Warmth (skin to skin care)
Initiate breast feeding
Monitor neonate (Temperature, heart rate, breathing and colour every 30 min for 2 hr.
No
If Heart rate <60 bpm and chest rising
Continue PPV, add 100% oxygen*
Start chest compressions 3 compression to 1 breath
Baby breathing well and heart rate> 100 bpm
Post resuscitation care in SNCU
C
Evaluation
If heart rate not detectable or <60 bpm
Administer epinephrine (1:10000), 0.1-0.3 ml/kg IV; If endotracheal route give 0.5-1.0 ml/kg
* Critical points where endotracheal intubation can be considered
D

This equipment should be stored together in a clearly marked container and placed in a readily accessible location. Intubation should be performed as a clean procedure. Preferably use disposable endotracheal tubes. The laryngoscope blades and handles should be cleaned after each use

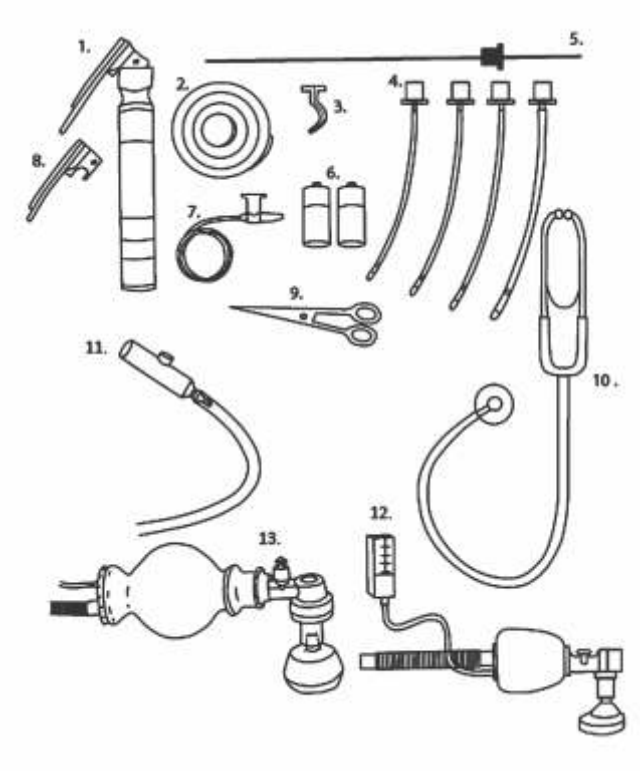


Figure 5.1: Neonatal resuscitation equipment and supplies

What kind of endotracheal tubes are best to use?

1. Endotracheal tubes are supplied in sterile packages and should be handled with clean technique.
2. ET tubes with uniform diameter throughout the length of the tube should be used (Figure 5.2).
3. Most endotracheal tubes for newborns have a black line near the tip of the tube, which is called a 'vocal cord guide' (Figure 5.3). The vocal cord guide is placed at the level of the vocal cords. This usually positions the tip of the tube above the bifurcation of the trachea (carina). The length of the trachea in a premature newborn is less than that in a term newborn – 3 cm versus 5 to 6 cm. Therefore, the smaller the tube, the closer the vocal cord guide is to the tip of the tube. However, there is some variability among tube manufacturers regarding the placement of the vocal cord guide.
4. Use non cuffed ET tubes for neonatal resuscitation.
5. Most endotracheal tubes made for newborns come with centimeter markings along the tube, identifying the distance from the tip of the tube as explained later in this chapter.

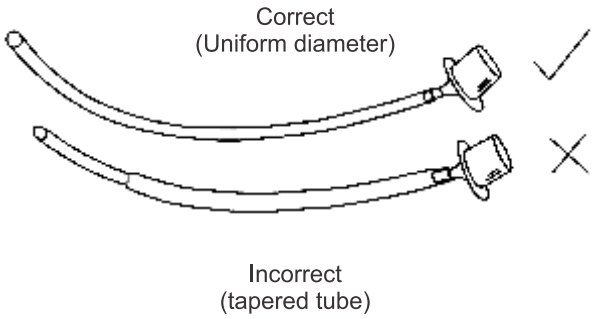
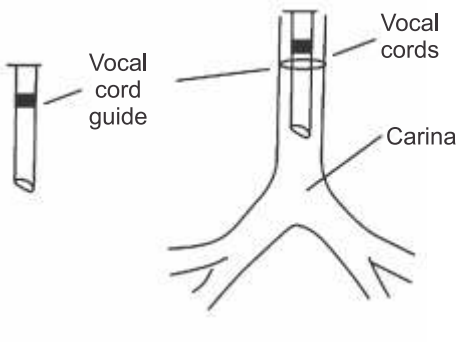


Figure 5.2: Endotracheal tubes with uniform diameters are preferred for newborns



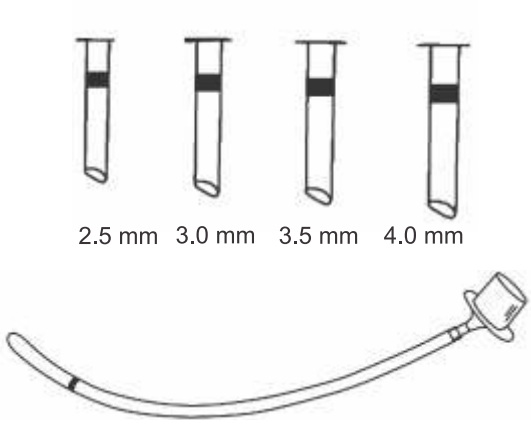


Figure 5.3: Characteristics of endotracheal tubes used for neonatal resuscitation.

How do you prepare the endotracheal tube for use?

Select the appropriate-sized tube.

Table 5.1: Endotracheal tube sizes for babies of different weights/gestations

Weight (g)	Gestational age (wks)	Tube size (mm) (inside diameter)
Below 1000	Below 28	2.5
1000 - 2000	28 - 34	3.0
2000 - 3000	34 – 38	3.5
Above 3000	Above 38	3.5 – 4.0

Endotracheal tube size for babies of various weights and gestational ages should be available. One should not waste time once the resuscitation is underway. Therefore, preparation of equipment before a high-risk delivery is important. The approximate size of the endotracheal tube is determined from the baby's weight. Table 5.1 gives the tube size for various weight and gestational age categories. It may be helpful to display the table in each delivery room, on or near the radiant warmers.

Consider cutting the tube to a shorter length.

Many endotracheal tubes come from the manufacturer much longer than necessary for orotracheal use. The extra length will increase resistance to airflow. Some clinicians find it helpful to shorten the endotracheal tube before insertion (Fig. 5.4). The endotracheal tube may be shortened to 13 to 15 cm to make it easier to handle during intubation and lessen the chance of inserting the tube too far. A 13- to 15-cm tube will provide enough tube extending beyond the baby's lips for you to adjust the depth of insertion if necessary, and to properly secure the tube to the face. Remove the connector (note that the connection to the tube may be tight), and then cut the tube diagonally to make it easier to reinsert the connector. Replace the endotracheal tube connector. The fitting should be tight so that the connector does not inadvertently separate during insertion or use. Ensure that the connector and the tube are properly aligned so that kinking of the tube is avoided. Connectors are made to fit a specific tube. They cannot be interchanged between tubes of different sizes. Some prefer to leave the tube long initially and then cut the tube to length after insertion if it is decided to leave it in place for longer than the immediate resuscitation.

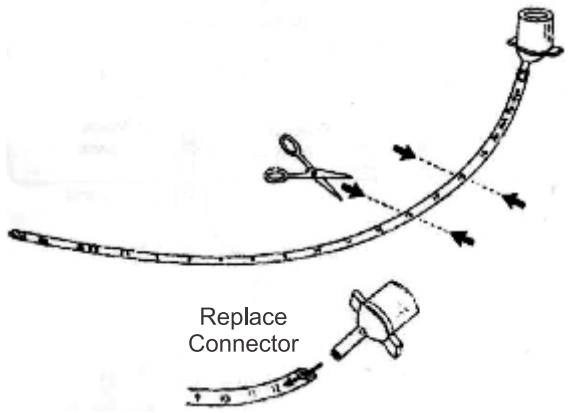


Figure 5.4. Where to cut endotracheal tube to shorten it.

How do you prepare the laryngoscope and additional supplies?

Select blade and attach to handle. First, select the appropriate-sized blade and attach it to the laryngoscope handle.

- No 0 for preterm newborns
- No 1 for term newborns

Next, turn on the light by clicking the blade into the "open" position to determine that the batteries and bulb are working. Check to see that the bulb is screwed in tightly to ensure that it will not flicker or fall out during the procedure.

Prepare suction equipment. Suction equipment should be available and ready for use.

- Adjust the suction source to 100 mm Hg by increasing or decreasing the level of suction while occluding the end of the suction tubing.

- Connect a 10F (or larger) suction catheter to the suction tubing so that it will be available to suction secretions from the mouth and nose.
- Smaller suction catheters (5F, 6F, or 8F, depending on the size of the endotracheal tube) should be available for suctioning the tube if it becomes necessary to leave the endotracheal tube in place. Appropriate sizes are listed in Table 5.2.

Table 5.2: Suction catheter sizes for varying endotracheal tube sizes

Endotracheal tube size	Catheter size
2.5	5F or 6F
3.0	6F or 8 F
3.5	8 F
4.0	8F or 10F

Prepare device for administering positive-pressure.

A resuscitation bag and mask or T-piece resuscitator capable of providing 90% to 100% oxygen should be available to ventilate the baby between intubation attempts or if intubation is unsuccessful. The resuscitation device without the mask will be required to ventilate the baby after intubation to initially check tube placement and to provide continued ventilation if necessary. Check the operation of the resuscitation device as described in Lesson 3.

Turn on oxygen. The oxygen tubing should be connected to an oxygen source and be available to deliver up to 100% free-flow oxygen and to connect to the resuscitation bag. The oxygen flow should be turned on to 5 to 10 1/min. The use of oxygen during resuscitation should be as per guidelines provided in Lesson 3.

A stethoscope will be required to check for air entry in the chest.

What anatomy do you need to know to insert the tube properly?

The anatomic landmarks that relate to intubation are labeled in Figure 5.5 and 5.6. Study the relative position of these landmarks, using all the figures, because each is important for your understanding of the procedure.

1. Epiglottis – A lid like structure overhanging the entrance to the trachea.
2. Vallecula – A pouch formed by the base of the tongue and the epiglottis.
3. Esophagus – The food passageway extending from the throat to the stomach.
4. Cricoid – Cartilage of the larynx.
5. Glottis – The opening of the larynx leading to the trachea, flanked by the vocal cords.

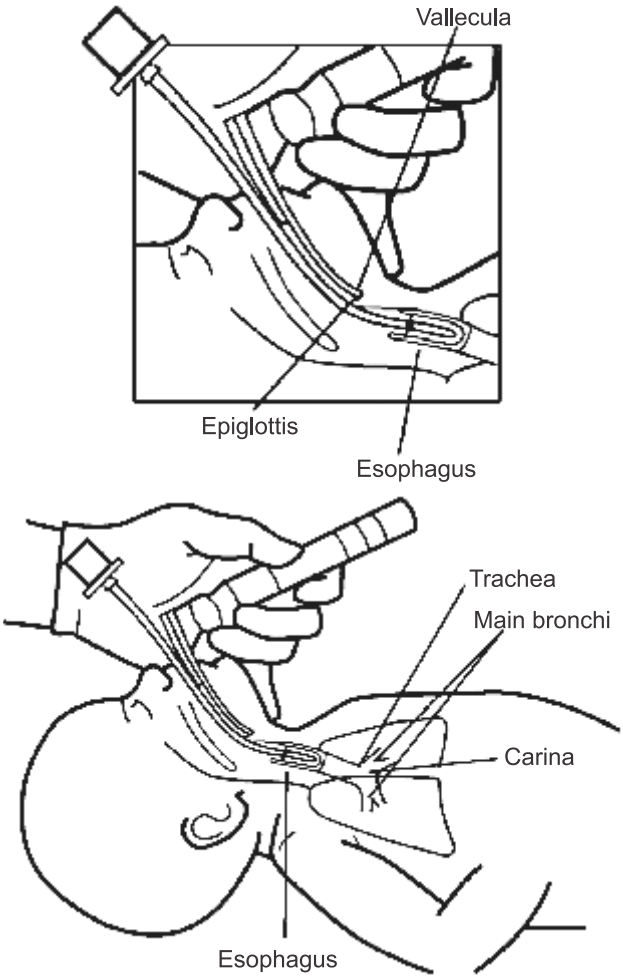


Figure 5.5: Diagram of upper airway, showing position of laryngoscope and endotracheal tube

6. Vocal cords – Mucous membrane covered ligaments on both sides of the glottis.
7. Trachea – The windpipe or air passageway, extending from the throat to the main bronchi.
8. Main bronchi – The two air passageways leading from the trachea to the lungs.
9. Carina – Where the trachea branches into the two main bronchi.

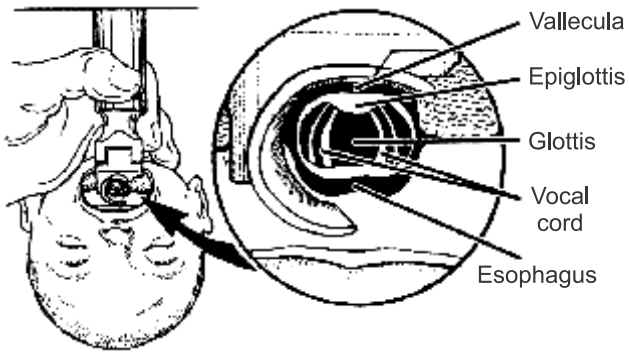


Figure 5.6: Digram showing the glottis and surrounding structures. (*Source: Textbook of Neonatal Resuscitation, 6th Edition, First Indian Edition 2012 by Jaypee Brothers Medical Publishers P. Ltd.*)

How should you position the newborn to make intubation easiest?

The correct position of the newborn for intubation is the same as for bag and mask ventilation – on a flat surface with the head in a midline position and the neck slightly extended. It may be helpful to place a roll under the baby's shoulders to maintain slight extension of the neck. This "sniffing " position aligns the trachea for optimal viewing by allowing a straight line of vision into the glottis once the laryngoscope has been properly placed. It is important not to hyperextend the neck, because this will raise the glottis above your line of vision and narrow the trachea. If there is too much flexion of the head toward the chest, you will be viewing the posterior pharynx and may not be able to directly visualize the glottis.

How do you hold the laryngoscope?

Turn on the laryngoscope light and hold the laryngoscope in your left hand, between your thumb and first two or three fingers, with the blade pointing away from you (Fig. 5.7). One or 2 fingers should be left free to rest on the baby's face to provide stability. The laryngoscope is designed to be held in the left hand – by both right and left handed persons. If held in the right hand, the closed curved part of the blade will block your view of the glottis, as well as make insertion of the endotracheal tube impossible.

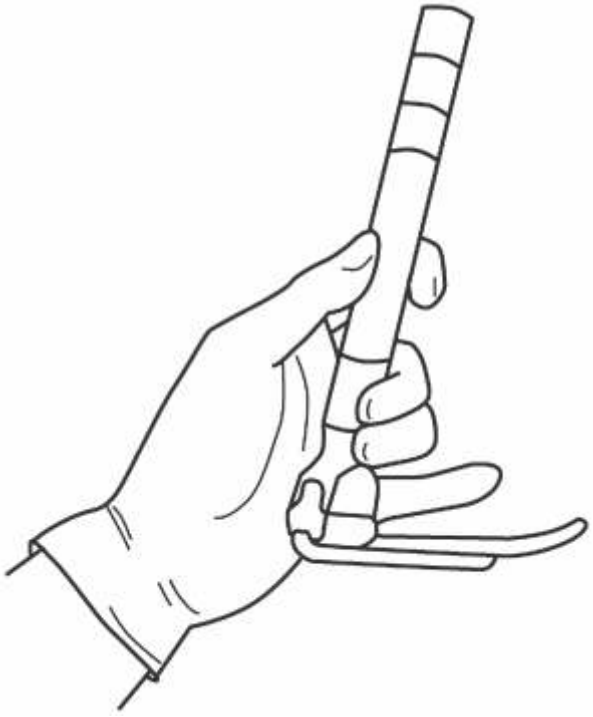


Figure. 5.7: Correct method of holding a laryngoscope.

How do you visualize the glottis and insert the tube?

The next few steps will be described in detail. However, during an actual resuscitation, they will need to be completed very quickly-within approximately 30 seconds. The baby will not be ventilated during this process, so quick action is essential.

Steps for Endotracheal Intubation:

1. Stabilize the baby's head with your right hand (Fig. 5.8). It may be helpful to have a second person hold the head in the desired "sniffing" position. Free-flow oxygen should be delivered throughout the procedure.

Note: Although a goal of 30 seconds is recommended to perform endotracheal intubation, studies have shown that a somewhat longer time may be required in clinical practice. The important concept is that the procedure be accomplished as quickly as possible. If the patient appears to be compromised, it is usually preferable to stop, resume positive-pressure ventilation with a bag and mask, and then try again.

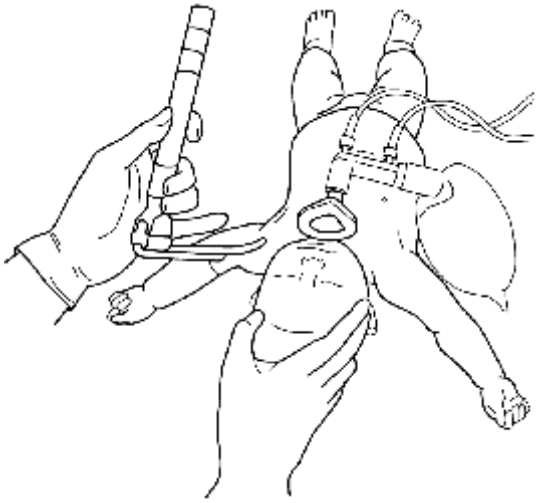


Figure. 5.8: Stabilizing the neonars head pre oral intubation.

2. Slide the laryngoscope blade over the right side of the tongue, pushing the tongue to the left side of the mouth and advance the blade until the tip lies in the Vallecula, just beyond the base of the tongue (Fig. 5.9). You may need to use your right index finger to open the baby's mouth to make it easier to insert the laryngoscope.

   Note: Although this lesson describes placing the tip of the blade in the Vallecula, some prefer to place it directly on the epiglottis, gently compressing the epiglottis against the base of the tongue.

3. Third, lift the blade slightly, thus lifting the tongue out of the way to expose the pharyngeal area (Fig. 5.10). When lifting the blade, raise the entire blade by pulling up in the direction the handle is pointing (Fig. 5.11).

> Do not elevate the tip of the blade by using a rocking motion and pulling the handle toward you.

Rocking rather than elevating the tip of the blade will not produce the view of the glottis you desire and will put excessive pressure on the alveolar ridge.

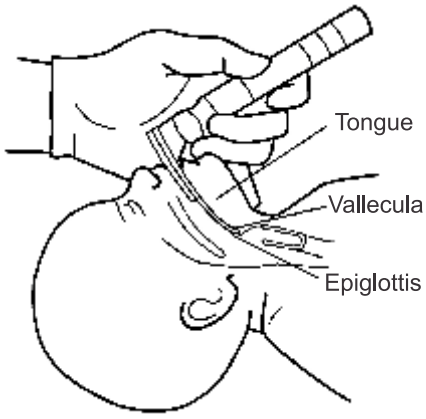


Figure 5.9: Correct method of inserting the laryngoscope blade.

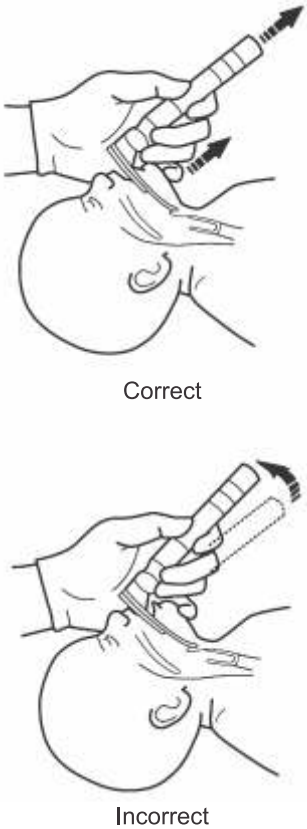


Figure 5.10: Correct (top) and Incorrect (bottom) method for lifting the laryngoscope blade to expose the larynx.

4. Fourth, look for landmarks (Fig. 5.11). If the tip of the blade is correctly positioned in the vallecula, you should see the epiglottis at the top, with the glottis opening below. You also should see the vocal cords appearing as vertical stripes on each side of the glottis or as an inverted letter 'V' (Fig. 5.11). If these structures are not immediately visible, quickly adjust the blade until the structures come into view. Applying downward pressure to the cricoid (the cartilage that covers the larynx) may help bring the glottis into view (Fig. 5.12). The pressure may be applied with your own little finger or by an assistant. Suctioning of secretions also may be helpful to improve your view. Inadequate visualization of the glottis is the most common reason for unsuccessful intubation.

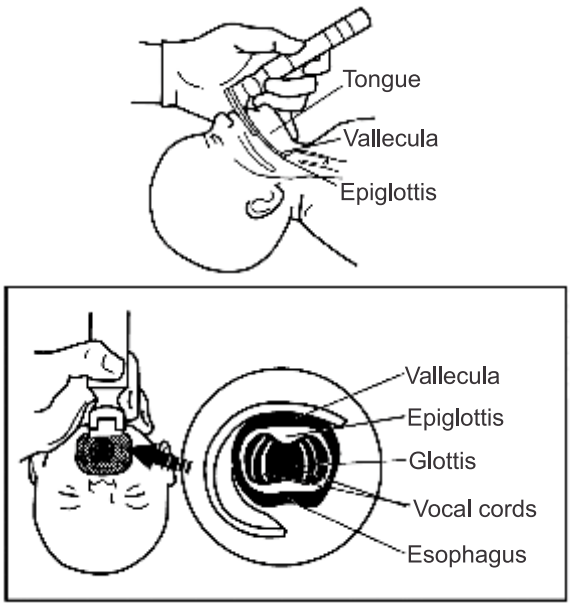
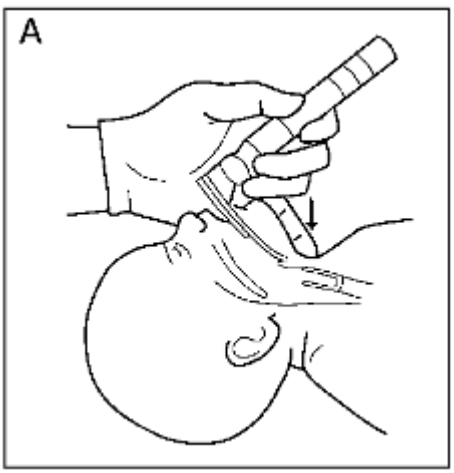


Figure 5.11: Visualisation of anatomic landmarks before intubating the newborn.



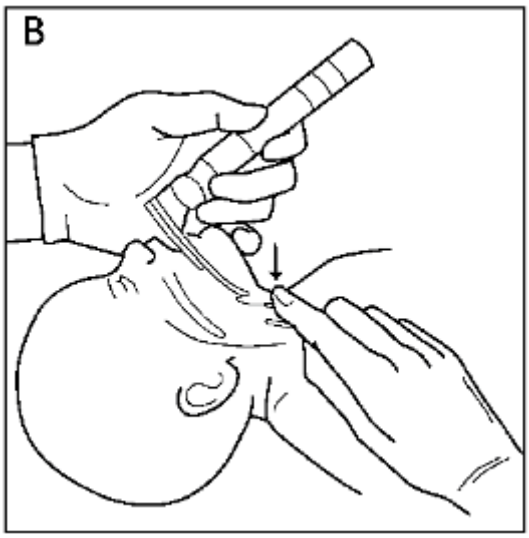


Figure 5.12: Improving visualization of larynx with pressure applied to cricoid

5. Fifth, insert the tube (Fig. 5.13). Holding the tube in your right hand, introduce it into the right side of the baby's mouth with the curve of the tube lying in the horizontal plane. This will prevent the tube from blocking your view of the glottis. Keep the glottis in view and, when the vocal cords are apart, insert the tip of the endotracheal tube until the vocal cord guide is at the level of the cords.

   If the cords are together, wait for them to open. Do not touch the closed cords with the tip of the tube because it may cause spasm of the cords. Never try to force the tube between closed cords. If the cords do not open within 30 seconds, stop and ventilate with a bag and mask. After the heart rate and colour have improved, you can then try again.

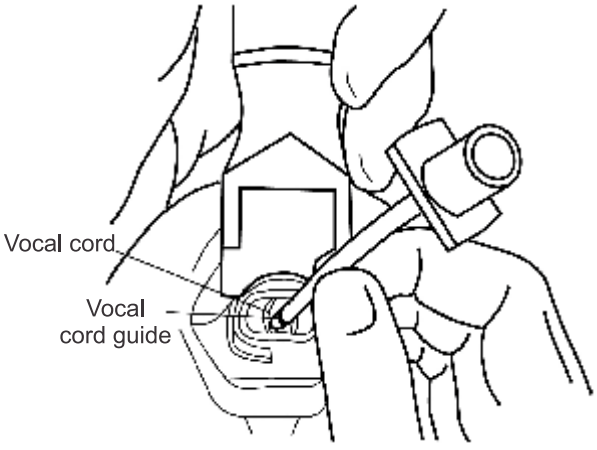


Figure 5.13: Insertion of endotracheal tube through the vocal cords.

Be careful to insert the tube only so far as to place the vocal cord guide at the level of the vocal cords. This positions the tube in the trachea approximately halfway between the vocal cords and the carina. Note the markings on the tube that align with the baby's lip.

6. Stabilize the tube with one hand, and remove the laryngoscope with the other (Fig. 5.14). With the right hand held against the face, hold the tube firmly at the lips and/or use a finger to hold the tube against the baby's hard palate. Use your left hand to carefully remove the laryngoscope without displacing the tube.

Figure 5.14: Stabilizing the tube while laryngoscope is withdrawn.

Although it is important to hold the tube firmly, be careful not to press the tube so tightly that the tube becomes compressed and obstructs airflow. You are now ready to use the tube for the reason you inserted it.

- If the purpose was to suction meconium, then you should use the tube to suction meconium, as described later in this section.
- If the purpose was to ventilate the baby, then you should quickly attach a ventilation bag or T-piece resuscitator to the tube, take steps to ascertain that the tube is in the trachea, and resume positive pressure ventilation.

What do you do next if the tube was inserted to suction meconium?

As described in Lesson 2, if there is meconium in the amniotic fluid and the baby has depressed muscle tone, depressed respirations, or a heart rate less than 100 beats per minute (bpm), (i.e. not vigorous) the trachea should be intubated and suctioned. As soon as the endotracheal tube has been inserted and the stylet, if used, has been removed:

- Connect the endotracheal tube to a meconium aspirator, which has been connected to a suction source (Fig. 5.15). Several alternative types of meconium aspirators are available commercially, some of which include the endotracheal tube as part of the device.
- Occlude the suction-control port on the aspirator to apply suction to the endotracheal tube, and gradually withdraw the tube as you continue suctioning.
- Further attempts at intubation and suction should be done after heart rate check. If there is significant bradycardia stop suctioning and proceed with resuscitation.

Figure 5.15: Using meconium aspirator for endotracheal suction.

For how long do you try to suction meconium?

Judgment is required when suctioning meconium. You have learnt that you should suction the trachea only if the meconium-stained baby has depressed respirations or muscle tone or has a heart rate less than 100 bpm. Therefore, at the time you begin to suction the trachea, it is likely that the baby will already be significantly compromised and will eventually need resuscitation. You will need to delay resuscitation for a few seconds while you suction meconium, but you do not want to delay more than is absolutely necessary. The following are a few guidelines:

- Do not apply suction to the endotracheal tube for longer than 3 to 5 seconds as you withdraw the tube.
- If no meconium is recovered, don't repeat the procedure; proceed with resuscitation.
- If you recover meconium with the first suction, check the heart rate. If the baby does not have significant bradycardia, reintubate and suction again. If the heart rate is low, you may decide to administer positive pressure without repeating the procedure.

If you intubated to ventilate the baby, how do you check to be sure that the tube is in the trachea?

Watching the tube pass between the cords, watching for chest movement following application of positive pressure, listening for breath sounds are all helpful signs that the tube is in trachea rather than esophagus. However, these signs can be misleading. An increasing heart rate is the primary method for confirming endotracheal tube placement.

If the tube is positioned correctly, you should observe the following:

- Improvement in heart rate and colour.
- Breath sounds over both lung fields but decreased or absent over the stomach.
- No gastric distention with ventilation.
- Vapor condensing on the inside of the tube during exhalation.
- Symmetrical movement of chest with each breath.

When listening to breath sounds, be sure to use a small stethoscope and place it laterally and high on the chest wall (in the axilla). A large stethoscope, or a stethoscope placed too central or too low, may transmit sounds from the esophagus or stomach. Observe for absence of gastric distension and movement of both sides of the chest with each ventilated breath. Listening for bilateral breath sounds and observing symmetrical chest movement with positive-pressure ventilation provide secondary confirmation of correct endotracheal tube placement in the airway with tip of the tube positioned above the carina. A rapid increase in heart rate is indicative of effective positive-pressure ventilation

> Be cautious when interpreting breath sounds in newborns. Since sounds are easily transmitted, those heard over the anterior portions of the chest may be coming from the stomach or esophagus. Breath sounds also can be transmitted to the abdomen.

What do you do if you suspect that the tube may not be in the trachea?

Be certain that the tube is in the trachea. A misplaced tube is worse than having no tube at all.

The tube is not likely to be in the trachea if:

- The newborn remains bradycardic and cyanotic despite positive-pressure ventilation.
- You do not hear good breath sounds over the lungs.
- The abdomen appears to become distended.
- You do hear air noises over the stomach.
- There is no mist in the tube.

- The chest is not moving symmetrically with each positive-pressure breath.

If you suspect the tube is not in the trachea, you should do the following:

- Use your right hand to hold the tube in place while you use your left hand to reinsert the laryngoscope so that you can visualize the glottis and see if the tube is passing between the vocal cords.

and/or

- Remove the tube, use a resuscitation device and mask to stabilize the heart rate and colour, and then repeat the intubation procedure.

How do you know if the tip of the tube is in the right location within the trachea?

You can use the tip-to-lip measurement to estimate if the tube has been inserted to the correct distance (table 5.3). Adding 6 to the baby's weight in kilograms will give you a rough estimate of the correct distance from the tube tip to the vermillion border of the upper lip. (Note: This rule is unreliable in those babies who have congenital anomalies of the neck and mandible (e.g. Robin syndrome.)

Table 5.3: Estimated distance from tube tip to lip of baby (based on birth weight)

Weight (kg)	Depth of insertion (cm) (tip to lip distance)
1	7
2	8
3	9
4	10

The tip to lip distance is only an approximation of the correct distance the tube is inserted. You should listen to breath sounds on both axillae after positioning the endotracheal tube. If properly positioned, you should be able to hear breath sounds on both sides with equal intensity.

If the tube is in too far, you will hear breath sounds that are louder on one side than the other (usually the right). If that is the case, pull back the tube very slowly while listening to the left side of the chest. When the tip reaches the carina, you should hear equal breath sounds.

After you have ensured that the tube is in the correct position, take note of the centimeter marking that appears at the upper lip. This can help you maintain the appropriate depth of insertion.

How do you continue resuscitation while you intubate?

Unfortunately, you cannot continue most resuscitation actions while intubating. Ventilation must be discontinued because the bag and mask must be removed from the airway during the procedure. Chest compressions generally must be interrupted because compressions cause movement and prevent you from seeing landmarks. Therefore, you should make every effort to minimize the amount of hypoxia imposed during intubation. The following will be helpful:

- Pre-oxygenate before attempting intubation. Oxygenate the baby appropriately with bag and mask before beginning intubation and between repeated intubation attempts. This will not be possible when intubation is being performed for suctioning meconium or when a baby is being intubated to improve ineffective positive-pressure ventilation.
- Deliver free-flow oxygen during intubation. Hold free-flow oxygen by the baby's face while the health care provider is clearing the airway and trying to visualize the landmarks. Then if the baby makes any spontaneous respiratory efforts during the procedure, he will be breathing oxygen-enriched air.
- Limit attempts to 30 seconds. Don't try to intubate for longer than approximately 30 seconds. If you are unable to visualize the glottis and insert the tube within 30 seconds, remove the laryngoscope and attempt to

oxygenate the baby with bag-and-mask ventilation. Ensure that the baby is stable, and then try again.

What can go wrong while you are trying to intubate?

Poor visualization of the glottis also may be caused by not elevating the tongue high enough to bring the glottis into view. Sometimes, pressure applied to the cricoid, which is the cartilage covering the larynx, will help to bring the glottis into view. This is accomplished by using the fourth or fifth finger of the left hand or by asking an assistant to apply the pressure. Practice intubating a manikin enough times so that you can find the correct landmarks quickly, thus allowing you to insert the tube within 30 seconds.

You may inadvertently insert the tube into the esophagus instead of the trachea.
An endotracheal tube in the esophagus will be worse than having no tube at all, since the tube will tend to obstruct the baby's pharyngeal airway without providing an artificial airway. Therefore:

- Be certain that you visualize the glottis before inserting the tube. Watch the tube enter the glottis between the vocal cords.
- Look carefully for signs of esophageal intubation after the tube has been inserted. Check air entry over chest and epigastrium.

If you have concerns that the tube may be in the esophagus, visualize the glottis and tube with a laryngoscope and/or remove the tube, oxygenate the newborn with a bag and mask, and reintroduce the tube.

Signs of endotracheal tube in the esophagus instead of the trachea

- Poor response to intubation (bradycardia, cyanosis, etc.).
- No audible breath sounds.
- Air heard entering the stomach.
- Gastric distention may be seen.
- No mist in tube.
- Poor chest movement

You may inadvertently insert the tube too far into the trachea, down the right main bronchus. If the tube is inserted too far, it usually will pass into the right main bronchus. When you insert the tube, it is important to remember to watch the vocal cord guide on the tube and to stop advancing the tube as soon as the vocal cord guide reaches the cords.

Signs of the tube being in the right main bronchus include

- Baby's heart rate or colour shows no improvement
- Breath sounds heard over the right but not the left side of the chest
- Breath sounds are louder on the right side of the chest than on the left side

If you think the tube may be down the right main bronchus, first check the tip-to-lip measurement to see if the number at the lip is higher than the estimated measurement (Table 5.3). Even if the measurement appears to be correct, if breath sounds remain asymmetric, you should withdraw the tube slightly while you listen over the left side of the chest to hear if the breath sounds improve.

Table 5.4: Common complications associated with endotracheal intubation.

Complication	Possible Causes	Prevention or Corrective Action to be Considered
Hypoxia	Taking too long to intubate Incorrect placement of tube	Pre-oxygenate with bag and mask. Provide free-flow oxygen during procedure. Halt intubation attempt after 30 seconds. Reposition tube
Bradycardia/apnea	Hypoxia Vagal response from laryngoscope or suction or catheter	Pre-oxygenate with bag and mask Provide free-flow oxygen during procedure. Oxygenate after intubation with bag and tube.
Pneumothorax	Overventilation of one lung due to tube in right main bronchus or excessive ventilation pressures	Place tube correctly.Use appropriate ventilating pressures Consider transillumination or needle aspiration if pneumothorax suspected
Contusions or lacerations of tongue, gums or airway	Rough handling of laryngoscope or tube, Inappropriate "rocking" rather than lifting of laryngoscope Laryngoscope blade too long or too short.	Obtain additional practice/ skill Select appropriate equipment.
Perforation of trachea or esophagus	Too vigorous insertion of tube Stylet protrudes beyond end of tube	Handle tube gently. Place stylet properly.
Obstructed endotracheal tube	Kink in tube or tube obstructed	Try to suction tube with catheter.
Infection	Introduction of organisms via hands or equipment	Pay careful attention to clean/sterile technique.

Summary: Lesson 5

1. A person experienced in endotracheal intubation should be available to assist at every delivery.
2. Indications for endotracheal intubation include the following:
   a. To suction trachea in presence of meconium when the newborn is not vigorous
   b. To improve efficacy of ventilation after several minutes of bag-and-mask ventilation or ineffective bag-and-mask ventilation
   c. To facilitate coordination of chest compressions and ventilation and to maximize the efficiency of each ventilation
   d. To administer epinephrine if required to stimulate the heart while intravenous access is being established
3. The laryngoscope is always held in the operator's left hand.
4. The correct-sized laryngoscope blade for a term newborn is No. 1. The correct-sized blade for a preterm newborn is No. 0.
5. Choice of the proper endotracheal tube size is based on weight.
6. The intubation procedure ideally should be completed within 30 seconds.
7. The steps for intubating a newborn are as follows:
   a. Stabilize the newborn's head in the 'sniffing' position. Deliver free-flow oxygen during procedure.
   b. Slide laryngoscope over the right side of the tongue, pushing the tongue to the left side of the mouth, and advancing the blade until the tip lies just beyond the base of the tongue.
   c. Lift the blade slightly. Raise the entire blade, not just the tip.
   d. Look for landmarks. Vocal cords should appear as vertical stripes on each side of the glottis or as an inverted letter 'V'.
   e. Suction if necessary for visualization.
   f. Insert the tube into the right side of the mouth with the curve of the tube lying in the horizontal plane.
   g. If the cords are closed, wait for them to open. Insert the tip of the endotracheal tube until the vocal cord guide is at the level of the cords.
   h. Hold the tube firmly against the baby's palate while removing the laryngoscope. Hold the tube in place while removing the stylet if one was used.
8. Correct placement of the endotracheal tube is indicated by
   a. Improved vital signs (heart rate, tone, colour, activity)
   b. Breath sounds over both lung fields but decreased or absent over the stomach
   c. No gastric distention with ventilation
   d. Vapor in the tube during exhalation
   e. Chest movement with each breath
   f. Tip-to-lip measurement: add 6 to newborn's weight in kilograms
   g. Direct visualization of the tube passing between the vocal cords.

Medications

Learning objectives

In this Lesson you will learn:

- What medications to give during resuscitation
- When to give medications during resuscitation
- Where to give medications during resuscitation
- How to insert an umbilical venous catheter
- How to administer epinephrine
- When and how to administer fluids- intravenously to expand blood volume during resuscitation

The following case scenario will illustrate how medications may be used during resuscitation. Imagine yourself as part of the team as you read through the case. The details of how to administer medications will be described later in this lesson.

Case scenario 5

A woman with term pregnancy was admitted to the emergency ward in early labor with profuse vaginal bleeding. A diagnosis of placental abruption is made. Fetal heart rate tracings show late deceleration. The obstetric team decides to deliver the fetus by emergency cesarean section and notifies the pediatric team to be in the delivery room. The radiant warmer is turned on and resuscitation equipment checked (including medications and umbilical vascular catheters).
A limp and apneic baby, weighing about 3 kg is delivered; the baby is immediately transferred by the resuscitation team to the radiant warmer. The baby is properly positioned, suctioned, dried and stimulated by flicking the soles. But, 30 seconds after birth the baby is still limp, apneic and cyanotic.

Positive pressure ventilation with bag and mask using room air is initiated. Another member checked the heart rate by palpating the umbilical cord for pulse. After 5 inflations the baby has a heart rate below 60 bpm. The care provider performing PPV checks the mask for its seal, if the head is positioned properly, if the airway is clear, and the chest is rising with each breath.

Despite these steps, after 30 seconds of effective ventilation the baby's heart rate is below 60 bpm, so 100% oxygen is added to PPV and the second team member begins chest compressions coordinated with PPV using 3:1 ratio of compressions to ventilation. After another 45 seconds, the baby's heart rate has not increased. The baby is intubated and 1.5 ml of 1:10,000 epinephrine is instilled into the endotracheal tube while another member of the team prepares to insert an umbilical venous line. Coordinated PPV and chest compressions are continued while monitoring the heart rate every 30 seconds. At 5 minutes the umbilical venous catheter has been inserted and checked to be in place by observing free flow of blood on aspiration. The heart rate is undetectable and the baby is pale. A dose of 0.6 ml of 1:10,000 epinephrine is infused into the umbilical catheter as PPV and chest compressions are continued. The heart beat becomes audible but is still below 60 bpm after 30 seconds. Because of persistent bradycardia and possible blood loss due to maternal bleeding, 30 ml of normal saline is given via the umbilical catheter. The heart rate gradually increases. At 8 minutes the

baby takes an initial gasp and the heart rate is over 60 bpm. Chest compression is stopped but PPV is continued. The heart rate rises to over 100 bpm and colour improves and the baby begins to breathe spontaneously. The baby was then shifted to the SNCU for post-resuscitation care with continued PPV.

When to give medications during resuscitation?

Most newborns requiring resuscitation will improve without the need for medications if timely and effective resuscitation steps are carried out. Fewer than 2 per 1000 births would need medication during resuscitation. Before administering medications, one should check the effectiveness of ventilation several times, ensuring good chest movement and audible bilateral breath sounds with each breath, and using 100% oxygen for positive-pressure ventilation. An endotracheal tube might have been put in place to ensure a good airway and effective coordination of chest compressions and positive-pressure ventilation.

> If the heart rate remains below 60 bpm despite administration of ventilation and chest compressions, one should ensure that ventilation and compressions are being given optimally and 100% oxygen is being used. If still the heart rate is low, consider use of medications.

How do you establish intravenous access during resuscitation of a newborn?

The umbilical vein is the quickest venous access for neonatal resuscitation. If the need for epinephrine is anticipated you need an additional member in the resuscitation team, who is competent to insert an umbilical venous catheter, while others continue with PPV and chest compression.

Steps of Umbilical Venous Catheterization

1. Clean the cord with an antiseptic solution. Place a loose tie of umbilical tape around the base of the cord. This tie can be tightened if there is excessive bleeding after you cut the cord.
2. Pre-fill a 3.5F or 5F umbilical catheter with normal saline using a 2 ml syringe connected to a stopcock. The catheter should have a single end-hold. Close the stopcock to the catheter to prevent fluid loss and air entry.
3. Using sterile technique cut the cord with a scalpel below the clamp and about 1 to 2 cm from the skin line. Make the cut perpendicular rather than at an angle.
4. The umbilical vein will be seen as a large, thin-walled structure, usually at the 11-to 12-o'clock position. The 2 umbilical arteries have thicker walls and usually lie close together somewhere in the 4 to 8-o'clock position. However, the arteries coil within the cord. Therefore, the longer the cord stump below your cut, the greater the likelihood that the vessels will not lie in the position described.

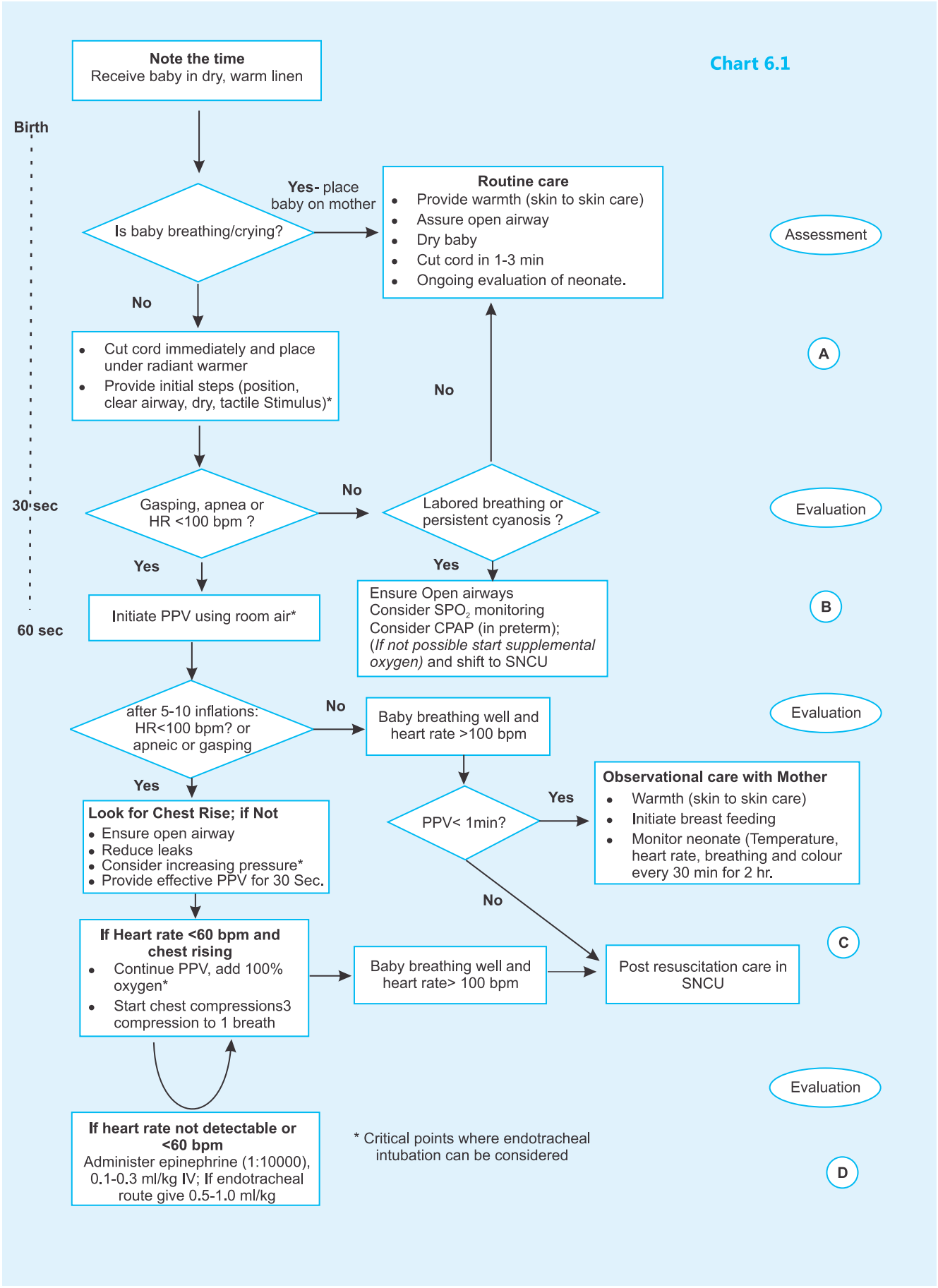


Chart 6.1
Note the time
Receive baby in dry, warm linen
Birth
Is baby breathing/crying?
Yes- place baby on mother
Routine care
Provide warmth (skin to skin care)
Assure open airway
Dry baby
Cut cord in 1-3 min
Ongoing evaluation of neonate.
Assessment
No
Cut cord immediately and place under radiant warmer
Provide initial steps (position, clear airway, dry, tactile Stimulus)*
A
No
30 sec
Gasping, apnea or HR <100 bpm ?
No
Labored breathing or persistent cyanosis ?
Evaluation
Yes
Yes
Initiate PPV using room air*
Ensure Open airways
Consider SPO2 monitoring
Consider CPAP (in preterm);
(If not possible start supplemental oxygen) and shift to SNCU
B
60 sec
after 5-10 inflations: HR<100 bpm? or apneic or gasping
No
Baby breathing well and heart rate >100 bpm
Evaluation
Yes
Look for Chest Rise; if Not
Ensure open airway
Reduce leaks
Consider increasing pressure*
Provide effective PPV for 30 Sec.
PPV< 1min?
Yes
Observational care with Mother
Warmth (skin to skin care)
Initiate breast feeding
Monitor neonate (Temperature, heart rate, breathing and colour every 30 min for 2 hr.
No
If Heart rate <60 bpm and chest rising
Continue PPV, add 100% oxygen*
Start chest compressions3 compression to 1 breath
Baby breathing well and heart rate> 100 bpm
Post resuscitation care in SNCU
C
Evaluation
If heart rate not detectable or <60 bpm
Administer epinephrine (1:10000), 0.1-0.3 ml/kg IV; If endotracheal route give 0.5-1.0 ml/kg
* Critical points where endotracheal intubation can be considered
D

5. Insert the catheter into the umbilical vein (Figure 6.1). The course of the vein will be up, toward the heart, so this is the direction you should point the catheter. Continue inserting the catheter 2 to 4 cm (less in preterm babies) until you get free flow of blood when you open the stopcock to the syringe and gently aspirate. For emergency use during resuscitation, the tip of the catheter should be located only a short distance into the vein – only to the point at which the blood is first able to be aspirated. If the catheter is inserted farther, there is risk of infusing solutions into the liver and possibly causing damage.
6. Inject the appropriate dose of epinephrine as soon as possible followed by 0.5-1.0 ml of normal saline to clear the drug from the catheter.
7. Once the baby has been fully resuscitated, remove the catheter and tighten the cord tie to prevent bleeding from the umbilical stump. Do not advance the catheter once the sterile field has been violated.

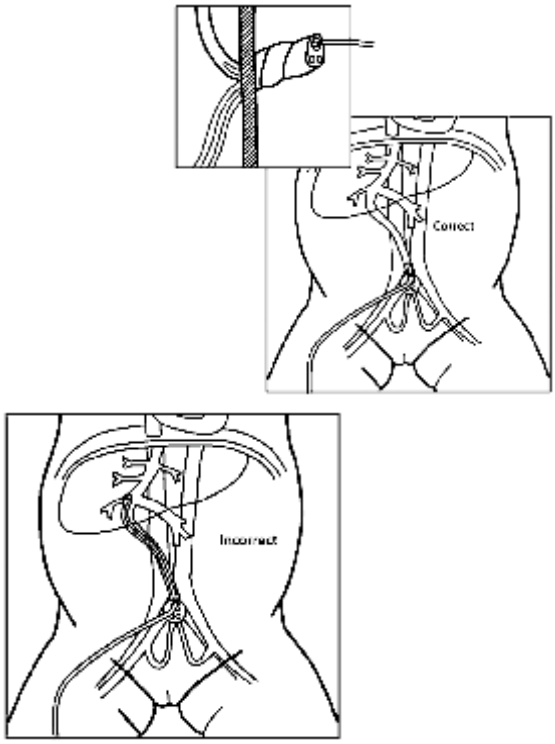


Figure 6.1: Correct (top) and incorrect (bottom) placement of an umbilical venous catheter

What medication to use and why?

Epinephrine is the most effective medication used during resuscitation. Babies who have a heart rate of less than 60 bpm despite adequate resuscitation for 90-120 seconds are likely to have low cardiac output. Epinephrine improves cardiac contractility thus increasing the cardiac output which improves blood supply and oxygen to vital organs.

Epinephrine is not indicated before you have established adequate ventilation because

- Time spent administering epinephrine is better spent on establishing effective ventilation and oxygenation.
- Epinephrine will increase workload and oxygen consumption of the heart muscle, which, in the absence of available oxygen, may cause unnecessary myocardial damage.

How to prepare epinephrine?

Epinephrine is available as 1 ml ampoule of 1:1,000 concentrations, however for neonate take one ml of 1:1000 solution and add 9 ml of water for injection. 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, the endotracheal route may be used to administer the drug. But the endotracheal route results in lower and unpredictable blood levels that may not be effective. Some clinicians may choose to give a dose of endotracheal epinephrine while the venous access is being established.

What is the dose of epinephrine during neonatal resuscitation?

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). You will need to estimate the baby's weight after birth.

Animal and adult human studies demonstrate that, when given via the trachea, significantly higher doses of epinephrine than previously recommended are required to show a positive effect. If you decide to give a dose endotracheally while intravenous access is being obtained, consider giving a higher dose (0.5 to 1 ml/kg or 0.05 to 0.1 mg/kg) by this route only. However, the safety of these higher tracheal doses has not been studied. **Do not give high doses intravenously.**

When giving epinephrine by endotracheal tube, be sure to give the drug directly into the tube, being careful not to leave it deposited in the endotracheal tube connector or along the walls of the tube. Some people prefer to use a catheter to give the drug deep into the tube. Because you will need to give a higher dose endotracheally, you will be giving a relatively large volume of fluid into the endotracheal tube (up to 1ml/kg). You should follow the drug with several positive-pressure breaths to distribute the drug throughout the lungs for absorption.

When the drug is given intravenously through a catheter, you should follow the drug with a 0.5 to 1 ml flush of normal saline to be sure that the drug has reached the blood.

How should you give epinephrine during neonatal resuscitation?

Administer epinephrine rapidly – as quickly as possible

What is the expected response after giving epinephrine?

Check the baby's heart rate 45-60 seconds after administering epinephrine. As you continue positive-pressure ventilation and chest compressions, the heart rate should increase to more than 60 bpm within 30 seconds after you give epinephrine. If this does not happen, you can repeat the dose every 3 to 5 minutes. **However, any repeat doses should be given intravenously if possible**. In addition, ensure that

- There is good air exchange as evidenced by adequate chest movement and presence of bilateral breath sounds.
- Chest compressions are given to a depth of one third the diameter of the chest and are well coordinated with ventilations.

Strongly consider placement of an endotracheal tube, if one has not already been inserted. Once in place, ensure that the tube has remained in the trachea during cardiopulmonary resuscitation activities. If the baby is pale and there is evidence of blood loss, and there is a poor response to resuscitation, you should consider the possibility of volume loss.

What should you do if the baby is in shock, there is evidence of blood loss, and the baby is responding poorly to resuscitation?

Babies in shock appear pale, have delayed capillary refill and weak pulses. They may have a persistently low heart rate, and circulatory status often does not improve in response to effective ventilation, chest compressions, and epinephrine.

If the baby appears to be in shock and is not responding to resuscitation, administration of a volume expander may be indicated.

What can you give to expand blood volume? How much and how to give it?

The recommended solution for treating hypovolemia is an isotonic crystalloid solution. Acceptable solutions include

- 0.9% NaCl ('Normal saline')
- Ringer's lactate.
- O Rh-negative packed red blood cells should be considered as part of the volume replacement when severe fetal anemia is documented or expected. If timely diagnosis permits, the donor unit can be cross-matched with the mother who would be the source of any problematic antibody. Otherwise, emergency-release of O-Rh negative packed cells may be necessary.

What is the dose of volume expander?

The initial dose is 10 ml/kg. However, if the baby shows minimal improvement after the first dose, you may need to give another dose of 10 ml/kg. In unusual cases of large blood loss additional dose might be considered.

How to give volume expander?

A volume expander must be given into the vascular system. The umbilical vein is usually the most accessible vein in a newborn, although other routes (e.g., intraosseous) can be used. If hypovolemia is suspected, fill a large syringe with normal saline or other volume expander while others on the team continue resuscitation.

How rapidly to give volume expander?

Acute hypovolemia, resulting in a need for resuscitation should be corrected fairly quickly, although some clinicians are concerned that rapid administration in a newborn may result in intracranial hemorrhage, particularly in preterm infants. No clinical trials have been conducted to define an optimum rate, but a steady infusion rate over 5 to 10 minutes is reasonable.

What should you do if there is still no improvement?

If the baby has been severely compromised but all resuscitation efforts have gone smoothly, you should have reached the point of giving epinephrine relatively quickly. Approximately 30 seconds each should be required for a trial of each of the following four steps of resuscitation:

1. Assessment and initial steps.
2. Positive-pressure ventilation.
3. Positive-pressure ventilation and chest compressions.
4. Positive-pressure ventilation, chest compressions and epinephrine.

Endotracheal intubation should preferably have been performed. You would have checked the efficacy of each of the steps, and you would have considered the possibility of hypovolemia. If the heart rate is detectable but remains below 60 beats per minute, it is still likely that the baby will respond to resuscitation, unless the baby is either extremely immature or has a lethal congenital malformation. If you are certain that effective ventilation, chest compressions, and medications are being provided, you might then consider mechanical causes of poor response, such as an airway malformation, pneumothorax, diaphragmatic hernia, or congenital heart disease. If the heart rate is absent, or no progress is being made in certain conditions, such as extreme prematurity, it may be appropriate to discontinue resuscitative efforts. You should be confident that optimum technique has been administered for a minimum of 10 minutes before considering such a decision.

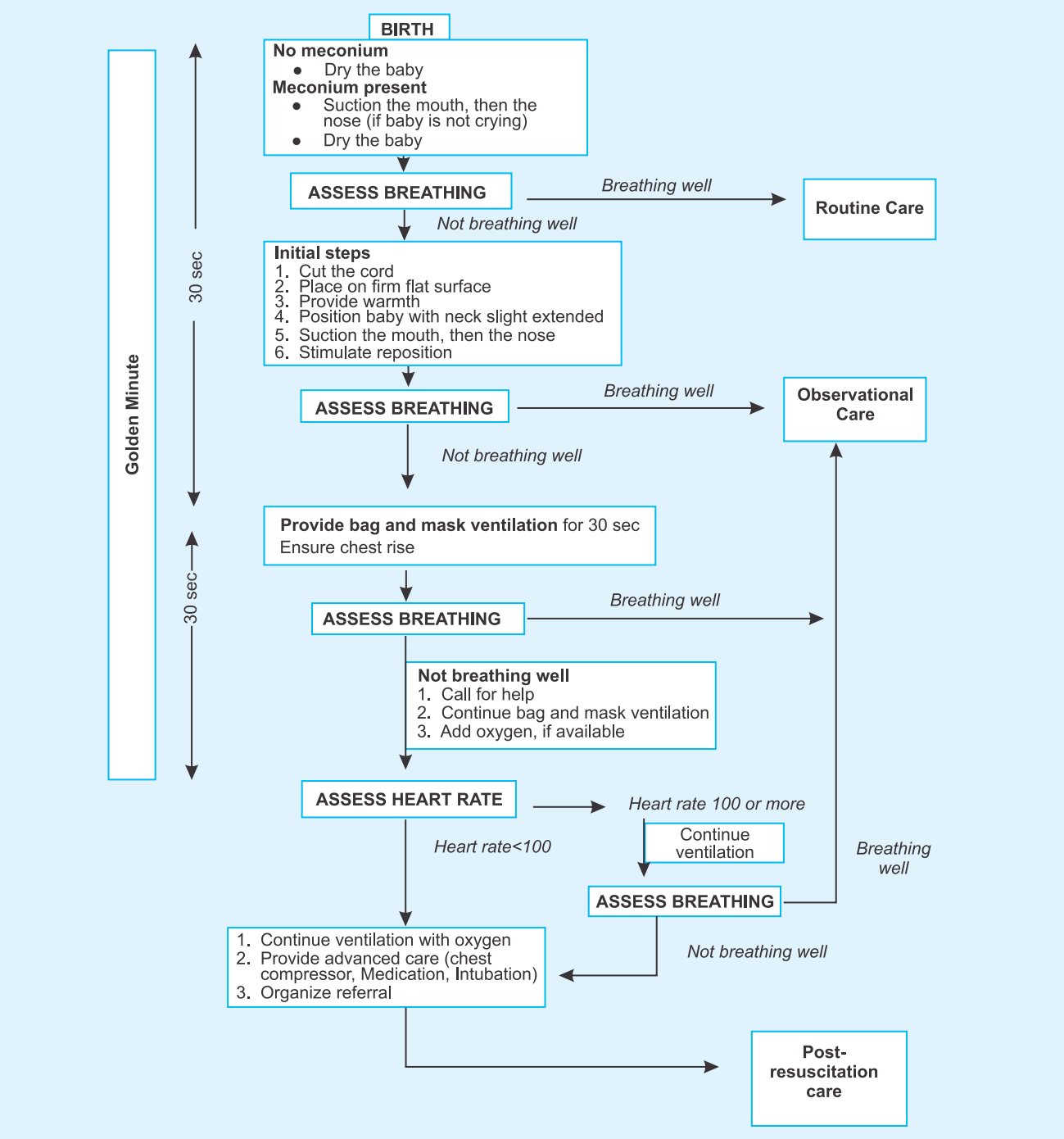
Summary: Lesson 6

1. Epinephrine, a cardiac stimulant, is indicated when the heart rate remains below 60 beats per minute, despite 30 seconds of assisted ventilation followed by another 30 seconds of coordinated chest compressions and ventilations.
2. Recommended epinephrine Concentration: 1:10,000 (0.1 mg/ml)
    a. Route: Intravenously. Endotracheal administration may be considered while intravenous access is being established.
    b. Dose: 0.1 to 0.3 ml/kg (consider higher dose, 0.5 to 1 ml/kg, for endotracheal route only).
    c. Preparation: 1:10,000 solution.
    d. Rate: Rapidly-as quickly as possible.
3. Epinephrine should be given by umbilical vein. The endotracheal route is often faster and more accessible than placing an umbilical catheter, but is associated with unreliable absorption and may not be effective at a lower dose.
4. Indications for volume expander include
    a. Baby is not responding to resuscitation.
    b. Baby appears in shock (pale colour, weak pulses, persistently low heart rate, no improvement in circulatory status despite resuscitation efforts).
    c. There is a history suggestive of any condition associated with fetal blood loss (e.g., extensive vaginal bleeding, abruptio placentae, placenta previa, twin-to-twin transfusion, etc.).
5. Recommended volume expander
    a. Solution: Normal saline, Ringer's lactate or O-Rh negative blood.
    b. Dose: 10ml/kg.
    c. Route: Umbilical vein.
    d. Preparation: Correct volume drawn into large syringe.
    e. Rate: Over 5 to 10 minutes.

Appendix

Basic neonatal resuscitation under NSSK

Flow diagram for basic neonatal resuscitation



Pretest/Post-test
Neonatal Resuscitation

Time: 20 Minutes

Name : _____ Date : _____

Q.1 If a baby does not begin breathing in response to stimulation, you should assume he is in _____ apnea and you should provide _____.

Q. 2 At birth, a baby's strong breathing causes _____ to be absorbed from the lungs and replaced with _____.

Q.3 Mention the four questions of initial assessment which must be performed on all newborns.

_____

_____

_____

_____

Q.4 When deciding which babies with meconium stained amniotic fluid need tracheal suctioning, the term "vigorous" is defined by what three characteristics.

_____

_____

_____

Q.5 Which of the following are recommended ways of providing tactile stimulations in an attempt to initiate respirations?

_____ A. Squeeze the rib cage

_____ B. Slapping or flicking the soles of feet

_____ C. Rubbing the back

_____ D. Force things onto abdomen

_____ E. Apply a cold compress

Q.6 List the two indications for positive pressure ventilation.

_____

_____

Q.7 List in order, the three signs on which an infant's condition is primarily evaluated.

_____

_____

_____

Q.8 When a suction catheter is used to clear the oropharynx of meconium before inserting and endotracheal tube, the appropriate size is _____ F to _____ F.

Q. 9 Free flow oxygen can be delivered reliably with _____ bag.

Q. 10 When selecting a face mask, make sure that the rim covers the tip of the _____ the _____ and the _____, but does not cover the eyes.

Q. 11 What is the purpose of using an oxygen reservoir with a self inflating bag?

_____

Q.12 State the rate at which a neonate should ventilated using bag valve mask device.
_____ per minute.

Q.13 What is the maximum permissible suction pressure while suctioning the airway?

_____

Q.14 When using bag and mask in neonatal resuscitation what should be the maximum volume of the bag.

_____

Q.15 You must hold the resuscitation bag so that you can see the newborn's _____ and _____.

Q.16 At what pressure should the safety pop off valve give way in bag and mask ventilation.

_____.

Q.17 After placing the mask in position and ventilating, you do no observe any appropriate rise of the chest. What could be the three reasons?

_____

_____

_____

Q. 18 The correct depth of chest compression is approximately _____ of the anterior-posterior diameter of the chest.

Q.19 The ratio of compression to ventilation is _____ to _____.

Q.20 At what heart rate should chest compressions be discontinued? _____ per minute.

Q.21 Chest compressions should be accompanied by _____.

Q.22 The following is the 6 second count of H.R. obtained on an infant. What is the Heart Rate per minute?

6 Second H.R.	H.R. per minute
6	_____
9	_____
12	_____
14	_____

Q.23 Indicate the correct ET tube size for infants with the following weights.

Weight	Tube size
800 gm	_____
3400 gm	_____
1200 gm	_____
2500 gm	_____

Q.24 If the baby is pale, there is evidence of blood loss, and resuscitation is not resulting in improvement, you should consider giving _____ ml/kg of _____ by _____.

Q.25 Ninety to one hundred and twenty seconds into resuscitation, the baby's heart rate is less than 60 beats per minute. You should now give _____ by the most quickly accessible route while continuing chest compressions and _____.

Q.26 During endotracheal intubation what is the maximum permissible time for successfully carrying out endotracheal intubation.

_____

Q.27 If you have not completed endotracheal intubation in the prescribed time limit, what should you do?

_____

Q. 28 The blade of a laryngoscope for preterm newborns should be No. _____. The blade for term newborns should be _____.

Q. 29 During Positive Pressure Ventilation with chest compressions, the rate of 'events' per minute should be _____ 'events' per minute.

Q.30 What concentration of epinephrine is recommended for neonatal resuscitation?

_____

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In collaboration with:

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