National Medical Certifications Services, Inc.

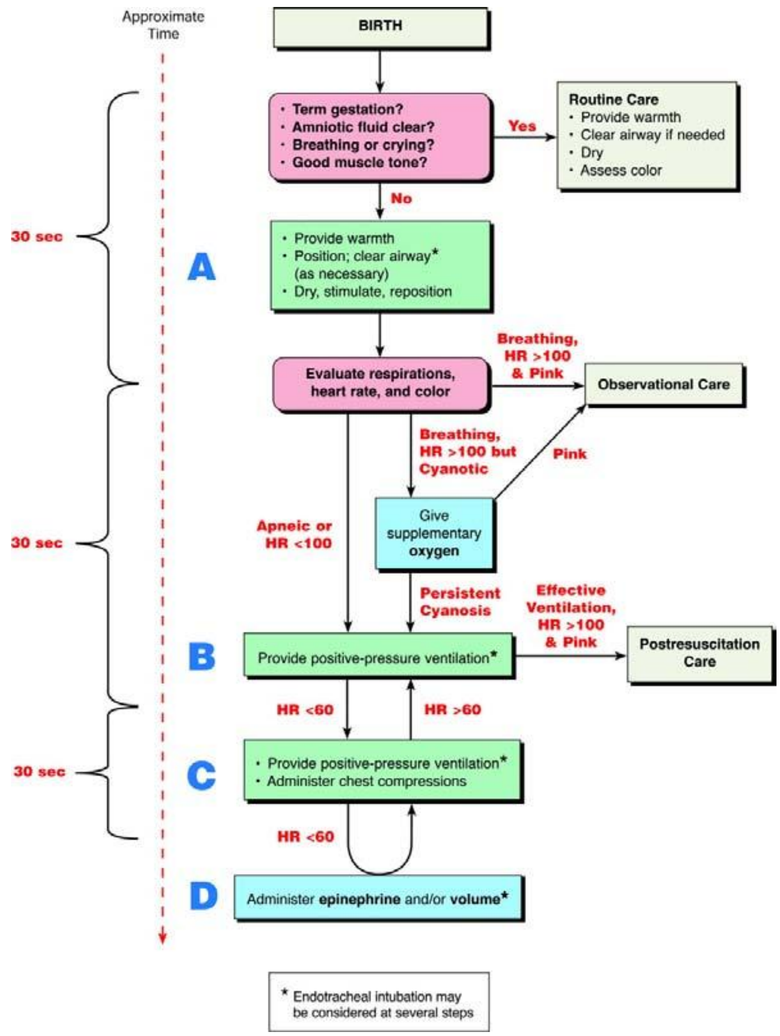
Neonatal Life Support Provider (NLSP)

Certification Preparatory Materials

NEONATAL LIFE SUPPORT PROVIDER (NRP) CERTIFICATION

TABLE OF CONTENTS

Neonatal Flow Algorithm



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INTRODUCTION

"Newborn" and "neonate" apply to any infant during initial hospitalization. "Newly born" applies specifically to an infant at the time of birth.

Nearly 10% of newborns require some assistance to begin breathing at birth. Approximately 1% require extensive resuscitative measures. Although the vast majority of newly born infants do not require intervention to make the transition from intrauterine to extrauterine life, because of the large number of births, a sizable number will require some degree of resuscitation.

Newly born infants not requiring resuscitation can generally be identified by a rapid assessment of the following 4 characteristics:

- Was the infant born after a full-term gestation?
- Is the amniotic fluid clear of meconium and evidence of infection?
- Is the infant breathing or crying?
- Does the infant have good muscle tone?

If the answer to all 4 of these questions is "yes," the infant does not need resuscitation and should not be separated from the mother. The infant can be dried, placed directly on the mother's chest, and covered with dry linen to maintain temperature. Observation of breathing, activity, and color should be ongoing.

If the answer to any of these assessment questions is "no," there is general agreement that the infant should receive 1 or more of the following 4 categories of action in sequence:

A. Initial steps in stabilization (provide warmth, position, clear airway, dry, stimulate, reposition)
B. Ventilation
C. Chest compressions
D. Administration of epinephrine and/or volume expansion

The decision to progress from one category to the next is determined by the simultaneous assessment of 3 vital signs: respirations, heart rate, and color. Approximately 30 seconds is allotted to complete each step, reevaluate, and decide whether to progress to the next step.

ANTICIPATION OF RESUSCITATION

One person at the delivery should be responsible for the care of the infant and must be capable of initiating resuscitation, including administration of positive-pressure ventilation and chest compressions. Either that person or someone else who is immediately available should have the skills required to perform a complete resuscitation, including endotracheal intubation and administration of medications.

If a preterm delivery (<37 weeks of gestation) is expected, special preparations will be required. Preterm infants have immature lungs that may be more difficult to ventilate and are also more vulnerable to injury by positive-pressure ventilation. Preterm infants also have immature blood vessels in the brain that are prone to hemorrhage; thin skin and a large surface area, which contribute to rapid heat loss; increased susceptibility to infection; and increased risk of hypovolemic shock caused by small blood volume.

TEMPERATURE CONTROL

Very low birth weight (<1500 g) preterm infants are likely to become hypothermic despite the use of traditional techniques for decreasing heat loss (level of evidence). For this reason it is recommended that additional warming techniques be used, such as covering the infant in plastic wrapping (food-grade, heat-resistant plastic) and placing him or her under radiant heat. Temperature must be monitored closely because of the slight but described risk of hyperthermia with this technique. Other techniques to maintain temperature during stabilization of the infant in the delivery room (eg, drying and swaddling, warming pads, increased environmental temperature, placing the infant skin-to-skin with the mother and covering both with a blanket) have been used but they have not been evaluated in controlled trials nor compared with the plastic-wrap technique for premature infants. All resuscitation procedures, including endotracheal intubation, chest compression, and insertion of lines, can be performed with these temperature-controlling interventions in place.

CLEARING THE AIRWAY OF MECONIUM

Aspiration of meconium before delivery, during birth, or during resuscitation can cause severe aspiration pneumonia. One obstetrical technique to try to decrease aspiration has been to suction meconium from the infant's airway after delivery of the head but before delivery of the shoulders (intrapartum suctioning). Although some studies suggest that intrapartum suctioning might be effective for decreasing the risk of aspiration syndrome, subsequent evidence from a large multicenter randomized trial did not show such an effect. Therefore, current recommendations no longer advise routine intrapartum oropharyngeal and nasopharyngeal suctioning for infants born to mothers with meconium staining of amniotic fluid.

Traditional teaching recommended that meconium-stained infants have endotracheal intubation immediately following birth and that suction be applied to the endotracheal tube as it is withdrawn. Randomized, controlled trials have shown that this practice offers no benefit if the infant is vigorous. A vigorous infant is defined as one who has strong respiratory efforts, good muscle tone, and a heart rate >100 beats per minute (bpm). Endotracheal suctioning for infants who are not vigorous should be performed immediately after birth.

PERIODIC EVALUATION AT 30-SECOND INTERVALS

After the immediate post birth assessment and administration of initial steps, further resuscitative efforts should be guided by simultaneous assessment of respirations, heart rate, and color. After initial respiratory efforts the newly born infant should be able to establish regular respirations that are sufficient to improve color and maintain a heart rate >100 bpm. Gasping and apnea indicate the need for assisted ventilation. Increasing or decreasing heart rate can also provide evidence of improvement or deterioration.

A newly born infant who is uncompromised will achieve and maintain pink mucous membranes without administration of supplementary oxygen. Evidence obtained with continuous oximetry, however, has shown that neonatal transition is a gradual process. Healthy infants born at term may take >10 minutes to achieve a preductal oxygen saturation >95% and nearly 1 hour to achieve postductal saturation >95%. Central cyanosis is determined by examining the face, trunk, and mucous membranes. Acrocyanosis (blue color of hands and feet alone) is usually a normal finding at birth and is not a reliable indicator of hypoxemia but may indicate other conditions, such as cold stress. Pallor or mottling may be a sign of decreased cardiac output, severe anemia, hypovolemia, hypothermia, or acidosis.

ADMINISTRATION OF OXYGEN

Supplementary oxygen is recommended whenever positive-pressure ventilation is indicated for resuscitation; free-flow oxygen should be administered to infants who are breathing but have central cyanosis. The standard approach to resuscitation is to use 100% oxygen. Some clinicians may begin resuscitation with an oxygen concentration of less than 100%, and some may start with no supplementary oxygen (ie, room air). There is evidence that employing either of these practices during resuscitation of neonates is reasonable. If the clinician begins resuscitation with room air, it is recommended that supplementary oxygen be available to use if there is no appreciable improvement within 90 seconds after birth. In situations where supplementary oxygen is not readily available, positive-pressure ventilation should be administered with room air.

Administration of a variable concentration of oxygen guided by pulse oximetry may improve the ability to achieve normoxia more quickly. Concerns about potential oxidant injury should caution the clinician about the use of excessive oxygen, especially in the premature infant.

POSITIVE-PRESSURE VENTILATION

If the infant remains apneic or gasping, if the heart rate remains <100 bpm 30 seconds after administering the initial steps, or if the infant continues to have persistent central cyanosis despite administration of supplementary oxygen, start positive-pressure ventilation.

INITIAL BREATHS AND ASSISTED VENTILATION

In term infants, initial inflations—either spontaneous or assisted—create a functional residual capacity. The optimum pressure, inflation time, and flow rate required to establish an effective functional residual capacity have not been determined. Average initial peak inflating pressures of 30 to 40 cm H_2O (inflation time undefined) usually successfully ventilate unresponsive term infants. Assisted ventilation rates of 40 to 60 breaths per minute are commonly used, but the relative efficacy of various rates has not been investigated.

The primary measure of adequate initial ventilation is prompt improvement in heart rate. Chest wall movement should be assessed if heart rate does not improve. The initial peak inflating pressures needed are variable and unpredictable and should be individualized to achieve an increase in heart rate and/or movement of the chest with each breath. If inflation pressure is being monitored, an initial inflation pressure of 20 cm H_2O may be effective, but $\geq$30 to 40 cm H_2O may be required in some term infants without spontaneous ventilation. If pressure is not monitored, the minimum inflation required to achieve an increase in heart rate should be used.

DEVICES

Effective ventilation can be achieved with a flow-inflating bag, a self-inflating bag, or with a T-piece. A T-piece is a valved mechanical device designed to control flow and limit pressure. The pop-off valves of self-inflating bags are flow-dependent, and pressures generated may exceed the value specified by the manufacturer. Target inflation pressures and long inspiratory times are more consistently achieved in mechanical models when T-piece devices are used rather than bags, although the clinical implications are not clear. To provide the desired pressure, health care providers need more training in the use of flow-inflating bags than with self-inflating bags (self-inflating bag, a flow-inflating bag, or a T-piece can be used to ventilate a newborn).

Laryngeal mask airways (LMAs) that fit over the laryngeal inlet have been shown to be effective for ventilating newly born near-term and full-term infants. There is limited data on the use of these devices in small preterm infants. Data from 3 case series show that the use of the LMA can provide effective ventilation in a time frame consistent with current resuscitation guidelines, although the infants being studied were not being resuscitated.

ASSISTED VENTILATION OF PRETERM INFANTS

When ventilating preterm infants after birth, excessive chest wall movement may indicate large-volume lung inflations, which should be avoided. Monitoring of pressure may help to provide consistent inflations and avoid unnecessary high pressures. If positive-pressure ventilation is required, an initial inflation pressure of 20 to 25 cm H_2O is adequate for most preterm infants. If prompt improvement in heart rate or chest movement is not obtained, higher pressures may be needed. If it is necessary to continue positive-pressure ventilation, application of positive end-expiratory pressure may be beneficial. Continuous positive airway pressure in spontaneously breathing preterm infants after resuscitation may also be beneficial.

ENDOTRACHEAL TUBE PLACEMENT

Endotracheal intubation may be indicated at several points during neonatal resuscitation:

- When tracheal suctioning for meconium is required
- If bag-mask ventilation is ineffective or prolonged
- When chest compressions are performed
- When endotracheal administration of medications is desired
- For special resuscitation circumstances, such as congenital diaphragmatic hernia or extremely low birth weight (<1000 g)

After endotracheal intubation and administration of intermittent positive pressure, a prompt increase in heart rate is the best indicator that the tube is in the tracheobronchial tree and providing effective ventilation. Exhaled CO_2 detection is effective for confirmation of endotracheal tube placement in infants, including very low birth weight infants. A positive test result (detection of exhaled CO_2) in patients with adequate cardiac output confirms placement of the endotracheal tube within the trachea, whereas a negative test result (i.e. no CO_2 detected) strongly suggests esophageal intubation. Poor or absent pulmonary blood flow may give false-negative results (i.e. no CO_2 detected despite tube placement in the trachea), but endotracheal tube placement is correctly identified in nearly all patients who are not in cardiac arrest. A false-negative result may also lead to unnecessary extubation in critically ill infants with poor cardiac output.

Other clinical indicators of correct endotracheal tube placement are evaluation of condensed humidified gas during exhalation and the presence or absence of chest movement, but these have not been systematically evaluated in neonates. Endotracheal tube placement must be assessed visually during intubation and by confirmatory methods after intubation if the heart rate remains low and is not rising. Except for intubation to remove meconium, exhaled CO_2 detection is the recommended method of confirmation.

CHEST COMPRESSIONS

Chest compressions are indicated for a heart rate that is <60 bpm despite adequate ventilation with supplementary oxygen for 30 seconds. Because ventilation is the most effective action in neonatal resuscitation and because chest compressions are likely to compete with effective ventilation, rescuers should ensure that assisted ventilation is being delivered optimally before starting chest compressions.

Compressions should be delivered on the lower third of the sternum to a depth of approximately one third of the anterior-posterior diameter of the chest. Two techniques have been described: compression with 2 thumbs with fingers encircling the chest and supporting the back (the 2 thumb-encircling hands technique) or compression with 2 fingers with a second hand supporting the back. Because the 2 thumb-encircling hands technique may generate higher peak systolic and coronary perfusion pressure than the 2-finger technique the 2 thumb-encircling hands technique is recommended for performing chest compressions in newly born infants. However, the 2-finger technique may be preferable when access to the umbilicus is required during insertion of an umbilical catheter.

A compression/relaxation ratio with a slightly shorter compression than relaxation phase offers theoretical advantages for blood flow in the very young infant. Also, compressions and ventilations should be coordinated to avoid simultaneous delivery. The chest should be permitted to fully re-expand during relaxation, but the rescuer's thumbs should not leave the chest. There should be a 3:1 ratio of compressions to ventilations with 90 compressions and 30 breaths to achieve ~120 events per minute to maximize ventilation at an achievable rate. Thus, each event will be allotted approximately second, with exhalation occurring during the first compression after each ventilation.

Respirations, heart rate, and color should be reassessed about every 30 seconds, and coordinated chest compressions and ventilations should continue until the spontaneous heart rate is ≥60 bpm.

MEDICATIONS

Drugs are rarely indicated in resuscitation of the newly born infant. Bradycardia in the newborn infant is usually the result of inadequate lung inflation or profound hypoxemia, and establishing adequate ventilation is the most important step to correct it. But if the heart rate remains <60 bpm despite adequate ventilation with 100% oxygen and chest compressions, administration of epinephrine or volume expansion, or both, may be indicated. Rarely, buffers, a narcotic antagonist, or vasopressors may be useful after resuscitation.

ROUTE AND DOSE OF EPINEPHRINE ADMINISTRATION

The recommended IV dose is 0.01 to 0.03 mg/kg per dose. If the endotracheal route is used, doses of 0.01 or 0.03 mg/kg will likely be ineffective. Therefore, IV administration of 0.01 to 0.03 mg/kg per dose is the preferred route. While access is being obtained, administration of a higher dose (up to 0.1 mg/kg) through the endotracheal tube may be considered, but the safety and efficacy of this practice have not been evaluated. The concentration of epinephrine for either route should be 1:10000 (0.1 mg/mL).

VOLUME EXPANSION

Consider volume expansion when blood loss is suspected or the infant appears to be in shock (pale skin, poor perfusion, weak pulse) and has not responded adequately to other resuscitative measures. An isotonic crystalloid rather than albumin is the solution of choice for volume expansion in the delivery room. The recommended dose is 10 mL/kg, which may need to be repeated. When resuscitating premature infants, care should be taken to avoid giving volume expanders too rapidly, because rapid infusions of large volumes have been associated with intraventricular hemorrhage.

POSTRESUSCITATION CARE

Infants who require resuscitation are at risk for deterioration after their vital signs have returned to normal. Once adequate ventilation and circulation have been established, the infant should be maintained in or transferred to an environment in which close monitoring and anticipatory care can be provided.

GLUCOSE

Low blood glucose has been associated with adverse neurologic outcome in a neonatal animal model of asphyxia and resuscitation. No clinical neonatal studies have investigated the relation between hyperglycemia and neurologic outcome, although hyperglycemia is associated with worse outcome. The range of blood glucose concentration associated with the least brain injury after asphyxia and resuscitation cannot be defined based on available evidence. Infants who require significant resuscitation should be monitored and treated to maintain glucose in the normal range.

INDUCED HYPOTHERMIA

Modest hypothermia is associated with bradycardia and elevated blood pressure that do not usually require treatment, but a rapid increase in body temperature may cause hypotension . Cooling to a core temperature <33°C may cause arrhythmia, bleeding, thrombosis, and sepsis, but studies so far have not reported these complications in infants treated with modest (eg, 33–34.5°C [91.4–94.1°F]) hypothermia.

There is insufficient data to recommend routine use of modest systemic or selective cerebral hypothermia after resuscitation of infants with suspected asphyxia. Further clinical trials are needed to determine which infants benefit most and which method of cooling is most effective. Avoidance of hyperthermia (elevated body temperature) is particularly important in infants who may have had a hypoxic-ischemic event.