

Part 13: Neonatal Resuscitation Guidelines

The following guidelines are intended for practitioners responsible for resuscitating neonates. They apply primarily to neonates undergoing transition from intrauterine to extrauterine life. The recommendations are also applicable to neonates who have completed perinatal transition and require resuscitation during the first few weeks to months following birth. Practitioners who resuscitate infants at birth or at any time during the initial hospital admission should consider following these guidelines. The terms *newborn* and *neonate* are intended to apply to any infant during the initial hospitalization. The term *newly born* is intended to apply specifically to an infant at the time of birth.

Approximately 10% of newborns require some assistance to begin breathing at birth. About 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.

Those newly born infants who do not require resuscitation can generally be identified by a rapid assessment of the following 4 characteristics:

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

If the answer to all 4 of these questions is “yes,” the baby does not need resuscitation and should not be separated from the mother. The baby 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 one 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 (see the Figure).

Anticipation of Resuscitation Need

Anticipation, adequate preparation, accurate evaluation, and prompt initiation of support are critical for successful neonatal resuscitation. At every delivery there should be at least one person whose primary responsibility is the newly born. This person 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.¹

With careful consideration of risk factors, the majority of newborns who will need resuscitation can be identified before birth. If the possible need for resuscitation is anticipated, additional skilled personnel should be recruited and the necessary equipment prepared. Identifiable risk factors and the necessary equipment for resuscitation are listed on the Neonatal Resuscitation Program website: www.aap.org/NRP. If a preterm delivery (<37 weeks of gestation) is expected, special preparations will be required. Preterm babies have immature lungs that may be more difficult to ventilate and are also more vulnerable to injury by positive-pressure ventilation. Preterm babies 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.

Initial Steps

The initial steps of resuscitation are to provide warmth by placing the baby under a radiant heat source, position the head in a “sniffing” position to open the airway, clear the airway with a bulb syringe or suction catheter, and dry the baby and stimulate breathing. Recent studies have examined several aspects of these initial steps. These studies are summarized below.

Temperature Control

Very low birth weight (<1500 g) preterm babies are likely to become hypothermic despite the use of traditional techniques for decreasing heat loss (LOE 5).² For this reason it is recommended that additional warming techniques be used, such as covering the baby in plastic wrapping (food-grade, heat-resistant plastic) and placing him or her under radiant heat (Class IIa; LOE 2^{3,4}; LOE 4^{5,6}; LOE 5⁷). Temperature must be monitored closely because of the slight but described (LOE 2)⁴ risk of hyperthermia with this technique. Other techniques to maintain temperature during stabilization of the baby in the delivery room (eg, drying and swaddling, warming pads, increased environmental temperature, placing the baby skin-to-skin with the mother and covering both with a blanket) have been used (LOE 8),^{8,9} but they have not been

(*Circulation*. 2005;112:IV-188-IV-195.)

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DOI: 10.1161/CIRCULATIONAHA.105.166574

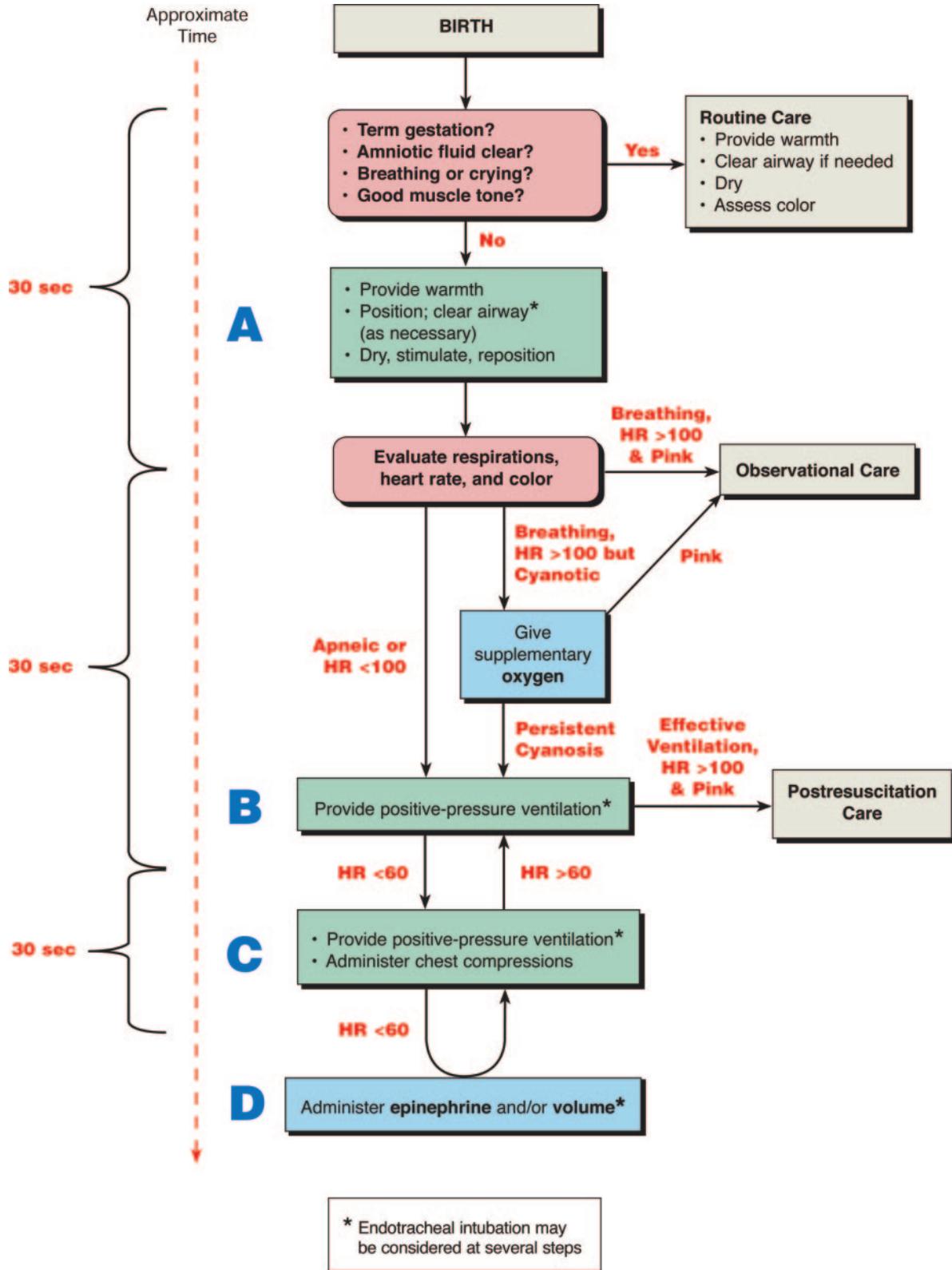


Figure. Neonatal Flow Algorithm.

evaluated in controlled trials nor compared with the plastic wrap technique for premature babies. All resuscitation procedures, including endotracheal intubation, chest compression, and insertion of lines, can be performed with these temperature-controlling interventions in place.

Infants born to febrile mothers have been reported (LOE 4)¹⁰⁻¹² to have a higher incidence of perinatal respiratory depression, neonatal seizures, and cerebral palsy and increased risk of mortality. Animal studies (LOE 6)^{13,14} indicate that hyperthermia during or after ischemia is associated with

progression of cerebral injury. Hyperthermia should be avoided (Class IIb). The goal is to achieve normothermia and avoid iatrogenic hyperthermia.

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 (LOE 3¹⁵; 4^{16,17}) suggested that intrapartum suctioning might be effective for decreasing the risk of aspiration syndrome, subsequent evidence from a large multicenter randomized trial (LOE 1)¹⁸ 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 (Class I).

Traditional teaching (LOE 5)^{19–21} 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 (LOE 1)^{15,22} have shown that this practice offers no benefit if the infant is vigorous (Class I). 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 (Class Indeterminate).

Periodic Evaluation at 30-Second Intervals

After the immediate postbirth 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.²³ 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 babies born at term may take >10 minutes to achieve a preductal oxygen saturation >95% and nearly 1 hour to achieve postductal saturation >95% (LOE 5).^{24–26} 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

There are concerns about the potential adverse effects of 100% oxygen on respiratory physiology and cerebral circulation and the potential tissue damage from oxygen free

radicals. Conversely there are also concerns about tissue damage from oxygen deprivation during and after asphyxia. Studies (LOE 6)^{27–31} examining blood pressure, cerebral perfusion, and various biochemical measures of cell damage in asphyxiated animals resuscitated with 100% oxygen versus 21% oxygen (room air) have shown conflicting results. One (LOE 2)³² study of preterm infants (<33 weeks of gestation) exposed to 80% oxygen found lower cerebral blood flow when compared with those stabilized using 21% oxygen. Some animal data (LOE 6)²⁷ indicated the opposite effect, ie, reduced blood pressure and cerebral perfusion with 21% oxygen (room air) versus 100% oxygen. Meta-analysis of 4 human studies (LOE 1)^{33,34} showed a reduction in mortality rate and no evidence of harm in infants resuscitated with room air versus those resuscitated with 100% oxygen, although these results should be viewed with caution because of significant methodological concerns.

Supplementary oxygen is recommended whenever positive-pressure ventilation is indicated for resuscitation; free-flow oxygen should be administered to babies who are breathing but have central cyanosis (Class Indeterminate). 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 (Class Indeterminate).

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 (LOE 5).^{35–41} 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 H₂O (inflation time undefined) usually successfully ventilate unresponsive term infants (LOE 5).^{36,38,40–43} 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 H₂O may be effective, but ≥ 30 to 40 cm H₂O may be required in some term babies without spontaneous ventilation (Class IIb). If pressure is not monitored, the minimum inflation required to achieve an increase in heart rate should be used. There is insufficient evidence to recommend an optimum inflation time. In summary, assisted ventilation should be delivered at a rate of 40 to 60 breaths per minute (Class Indeterminate; LOE 8) to promptly achieve or maintain a heart rate >100 bpm.

Devices

Effective ventilation can be achieved with a flow-inflating bag, a self-inflating bag, or with a T-piece (LoE 4^{44,45}; LOE 5⁴⁶). 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 (LOE 6).⁴⁷ Target inflation pressures and long inspiratory times are more consistently achieved in mechanical models when T-piece devices are used rather than bags (LOE 6),⁴⁸ although the clinical implications are not clear. To provide the desired pressure, healthcare providers need more training in the use of flow-inflating bags than with self-inflating bags (LOE 6).⁴⁹ A self-inflating bag, a flow-inflating bag, or a T-piece can be used to ventilate a newborn (Class IIb).

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 (LOE 2⁵⁰ and LOE 5⁵¹). There is limited (LOE 5)^{52,53} data on the use of these devices in small preterm infants. Data from 3 case series (LOE 5)^{51,54,55} shows that the use of the LMA can provide effective ventilation in a time frame consistent with current resuscitation guidelines, although the babies being studied were not being resuscitated. A randomized controlled trial (LOE 2)⁵⁰ found no clinically significant difference between the use of the LMA and endotracheal intubation when bag-mask ventilation was unsuccessful. It is unclear whether this study can be generalized because the LMA was inserted by experienced providers. Case reports (LOE 5)^{56–58} suggest that when bag-mask ventilation has been unsuccessful and endotracheal intubation is not feasible or is unsuccessful, the LMA may provide effective ventilation. There is insufficient evidence to support the routine use of the LMA as the primary airway device during neonatal resuscitation, in the setting of meconium-stained amniotic fluid, when chest compressions are required, in very low birth weight babies, or for delivery of emergency intratracheal medications (Class Indeterminate).

Assisted Ventilation of Preterm Infants

Evidence from animal studies (LOE 6)⁵⁹ indicates that preterm lungs are easily injured by large-volume inflations immediately after birth. Additional animal studies (LOE 6)^{60,61} indicate that when positive-pressure ventilation is applied immediately after birth, the inclusion of positive end-expiratory pressure (PEEP) protects against lung injury

and improves lung compliance and gas exchange (LOE 6).^{60,61} Evidence from case series in human infants indicates that most apneic preterm infants can be ventilated with an initial inflation pressure of 20 to 25 cm H₂O, although some infants who do not respond require a higher pressure (LOE 5).^{62,63}

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 (Class IIb). If positive-pressure ventilation is required, an initial inflation pressure of 20 to 25 cm H₂O is adequate for most preterm infants (Class Indeterminate). 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 PEEP may be beneficial (Class Indeterminate). Continuous positive airway pressure in spontaneously breathing preterm infants after resuscitation may also be beneficial⁶³ (Class Indeterminate).

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)

The timing of endotracheal intubation may also depend on the skill and experience of the available providers.

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 (LOE 5).⁶⁴ Exhaled CO₂ detection is effective for confirmation of endotracheal tube placement in infants, including very low birth weight infants (LOE 5).^{65–68} A positive test result (detection of exhaled CO₂) in patients with adequate cardiac output confirms placement of the endotracheal tube within the trachea, whereas a negative test result (ie, no CO₂ detected) strongly suggests esophageal intubation (LOE 5).^{65,67} Poor or absent pulmonary blood flow may give false-negative results (ie, no CO₂ detected despite tube placement in the trachea), but endotracheal tube placement is correctly identified in nearly all patients who are not in cardiac arrest (LOE 7).⁶⁹ 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 CO₂ detection is the recommended method of confirmation (Class IIa).

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^{70,71} 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^{72–74} (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 (LOE 5⁷⁵; LOE 6⁷⁶), 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.⁷⁷ Also, compressions and ventilations should be coordinated to avoid simultaneous delivery (LOE 6).⁷⁸ The chest should be permitted to fully reexpand 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 approximately 120 events per minute to maximize ventilation at an achievable rate (Class Indeterminate). Thus, each event will be allotted approximately ½ 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 (Class IIa; LOE 8).

Medications

Drugs are rarely indicated in resuscitation of the newly born infant.⁷⁹ 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

Past guidelines recommended that initial doses of epinephrine be given through an endotracheal tube because the dose can be administered more quickly than when an intravenous route must be established. But animal studies (LOE 6)^{80–82} that

showed a positive effect of endotracheal epinephrine used considerably higher doses than are currently recommended, and the one animal study (LOE 6)⁸³ that used currently recommended doses given endotracheally showed no effect. Given the lack of data on endotracheal epinephrine, the IV route should be used as soon as venous access is established.

The recommended IV dose is 0.01 to 0.03 mg/kg per dose. Higher IV doses are not recommended (Class III) because animal (LOE 6)^{84,85} and pediatric (LOE 7)⁸⁶ studies show exaggerated hypertension, decreased myocardial function, and worse neurologic function after administration of IV doses in the range of 0.1 mg/kg. 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 (Class IIa). While access is being obtained, administration of a higher dose (up to 0.1 mg/kg) through the endotracheal tube may be considered (Class Indeterminate), but the safety and efficacy of this practice have not been evaluated. The concentration of epinephrine for either route should be 1:10 000 (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 (Class IIb; LOE 7).^{87–89} 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.

Naloxone

Administration of naloxone is not recommended as part of initial resuscitative efforts in the delivery room for newborns with respiratory depression. If administration of naloxone is considered, heart rate and color must first be restored by supporting ventilation. The preferred route is IV or intramuscular. Given the lack of clinical data in newborns, endotracheal administration of naloxone is not recommended (Class Indeterminate). The recommended dose is 0.1 mg/kg, but no studies have examined the efficacy of this dose in newborns. In one case report, naloxone given to a baby born to an opioid-addicted mother was associated with seizures (LOE 8).⁹⁰ Therefore, naloxone should be avoided in babies whose mothers are suspected of having had long-term exposure to opioids (Class Indeterminate). Naloxone may have a shorter half-life than the original maternal opioid; therefore the neonate should be monitored closely for recurrent apnea or hypoventilation, and subsequent doses of naloxone may be required.

Postresuscitation Care

Babies 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 (LOE 6).⁹¹ Neonatal animals (LOE 6)^{92,93} that were hypoglycemic at the time of an anoxic or hypoxic-ischemic insult had larger areas of cerebral infarction or decreased survival, or both, when compared with controls. One clinical study (LOE 4)⁹⁴ showed an association between hypoglycemia and poor neurologic outcome after perinatal asphyxia.

No clinical neonatal studies have investigated the relation between hyperglycemia and neurologic outcome, although hyperglycemia in adults (LOE 7 [extrapolated]⁹⁵) 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 (Class Indeterminate).

Induced Hypothermia

In a multicenter trial (LOE 2)⁹⁶ involving newborns with suspected asphyxia (indicated by need for resuscitation at birth, metabolic acidosis, and early encephalopathy), selective head cooling (34°C to 35°C) was associated with a nonsignificant reduction in the overall number of survivors with severe disability at 18 months but a significant benefit in the subgroup with moderate encephalopathy. Infants with severe electrographic suppression and seizures did not benefit from treatment with modest hypothermia (LOE 2).⁹⁶ A second large multicenter trial (LOE 2)⁹⁷ of asphyxiated newborns (indicated by need for resuscitation at birth or presence of metabolic encephalopathy) involved treatment with systemic hypothermia to 33.5°C (92.3°F) following moderate to severe encephalopathy. Hypothermia was associated with a significant (18%) decrease in death or moderate disability at 18 months.⁹⁷ A third small controlled pilot study (LOE 2)^{98,99} in asphyxiated infants with early induced systemic hypothermia found fewer deaths and disability at 12 months.

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 (LOE 5).¹⁰⁰ 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°C to 34.5°C [91.4°F to 94.1°F]) hypothermia (LOE 2).^{96,101}

There is insufficient data to recommend routine use of modest systemic or selective cerebral hypothermia after resuscitation of infants with suspected asphyxia (Class Indeterminate). 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 babies who may have had a hypoxic-ischemic event.

Guidelines for Withholding and Discontinuing Resuscitation

Morbidity and mortality for newborns varies according to region and availability of resources (LOE 5).¹⁰² Social science studies¹⁰³ indicate that parents desire a larger role in decisions to initiate resuscitation and continue life support of

severely compromised newborns. Opinions among neonatal providers vary widely regarding the benefits and disadvantages of aggressive therapies in such newborns (LOE 5).¹⁰⁴

Withholding Resuscitation

It is possible to identify conditions associated with high mortality and poor outcome in which withholding resuscitative efforts may be considered reasonable, particularly when there has been the opportunity for parental agreement (LOE 5).^{2,105}

A consistent and coordinated approach to individual cases by the obstetric and neonatal teams and the parents is an important goal. Noninitiation of resuscitation and discontinuation of life-sustaining treatment during or after resuscitation are ethically equivalent, and clinicians should not hesitate to withdraw support when functional survival is highly unlikely. The following guidelines must be interpreted according to current regional outcomes:

- When gestation, birth weight, or congenital anomalies are associated with almost certain early death and when unacceptably high morbidity is likely among the rare survivors, resuscitation is not indicated (Class IIa). Examples may include extreme prematurity (gestational age <23 weeks or birth weight <400 g), anencephaly, and chromosomal abnormalities incompatible with life, such as trisomy 13.
- In conditions associated with a high rate of survival and acceptable morbidity, resuscitation is nearly always indicated (Class IIa). This will generally include babies with gestational age ≥25 weeks (unless there is evidence of fetal compromise such as intrauterine infection or hypoxia-ischemia) and those with most congenital malformations.
- In conditions associated with uncertain prognosis in which survival is borderline, the morbidity rate is relatively high, and the anticipated burden to the child is high, parental desires concerning initiation of resuscitation should be supported (Class Indeterminate).

Discontinuing Resuscitative Efforts

Infants without signs of life (no heart beat and no respiratory effort) after 10 minutes of resuscitation show either a high mortality or severe neurodevelopmental disability (LOE 5).^{106,107} After 10 minutes of continuous and adequate resuscitative efforts, discontinuation of resuscitation may be justified if there are no signs of life (Class IIb).

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Part 13: Neonatal Resuscitation Guidelines

Circulation. 2005;112:IV-188-IV-195; originally published online November 28, 2005;

doi: 10.1161/CIRCULATIONAHA.105.166574

Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

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Print ISSN: 0009-7322. Online ISSN: 1524-4539

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