Resuscitation of the Newborn at Delivery

Diane Biehl MD, FRCP(C)

This section reviews the delivery-room management of the depressed newborn. The factors which contribute to the need for neonatal resuscitation will have been identified prior to most, but not all, deliveries. Therefore every delivery room should have basic resuscitation equipment available at all times and the personnel attending the delivery must know the basic steps in newborn resuscitation. Approximately ten per cent of newborns with low Apgar scores will have demonstrated no evidence of foetal distress prior to delivery.¹

Newborn resuscitation will be considered in three sections: (1) resuscitation of the full term infant – the most common but easiest type of resuscitation, (2) resuscitation of the infant born through meconium, (3) the special requirements of the premature and/or growth retarded infant.

Resuscitation of the Full-Term Infant

The basic resuscitation equipment required for full-term neonates is listed in Table 1. The three stages of initial resuscitation of the newborn are summarized in Table 2. At delivery, all full-term infants should be placed on a well lighted, warm resuscitation area so that they may be observed carefully. The infant should be quickly dried with a warm towel and stimulated by rubbing the infant's back briskly. The mouth and nares should be gently suctioned. If the infant is not making active respiratory efforts 100 per cent oxygen should be administered through a face mask fitted snugly on the infant's face.

The delivery system for the oxygen should contain a reservoir bag. If there is no improvement in spontaneous ventilation after administration of oxygen for 10–15 seconds, assisted ventilation by bag and mask, at a rate of 15–20 breaths per minute, should be started (Resuscitation I). An assistant, most likely the delivery room nurse, should be asked to monitor the heart rate and stimulate the infant by briskly rubbing the back. The majority of full-term infants will respond to these simple

maneuvers if they are applied within the first 30–60 seconds following delivery.

If the infant has responded by initiating vigorous respirations and becoming pink, close observation should continue for five to ten minutes, during room air breathing, to ensure that the infant has completely recovered. During this time one- and five-minute Apgar² scores (Table 3) should be assigned and a brief physical examination should be done to confirm that the newborn is a full-term normal infant.

For the small number of full-term neonates who do not respond to the above procedures, the next step (Resuscitation II) is to gain complete control of the airway by laryngoscopy and tracheal intubation with a size 3.0 or 3.5 mm tracheal tube. One hundred per cent oxygen should be delivered by controlled ventilation at a rate of 20–30 breaths per minute and an inflating pressure of 20–30 cm H₂O. At this point, one should assume that resuscitation may be difficult and/or prolonged and expert assistance – preferably a neonatologist – should be called. During this time, monitoring of the neonatal heart rate should be continued by an assistant, and if the heart rate falls below 60 beats per minute, external cardiac massage should be started. In the newborn, cardiac massage is done by placing two fingers on the midpoint of the sternum and compressing halfway to the vertebral column (approximately 2–2.5 cm) at a rate of 100 compressions per minute.

Further resuscitation (Resuscitation III) requires the participation of an individual experienced in umbilical vein catheterization, for the administration of fluids and medications. The umbilical vein may be cannulated by using a sterile feeding tube (#3 or #5 French) or a #18 gauge I.V. plastic cannula.

From the Section of Obstetrical Anesthesia, Department of Anesthesia, St. Boniface General Hospital and University of Manitoba.

TABLE I Equipment Required for Newborn Resuscitation

<i>Proper Resuscitation Area</i>	<i>Airway Management Equipment</i>
<ul style="list-style-type: none"> - source of radiant heat - proper lighting - flat surface for observation - suction catheters, #5 & #8 Fr. - appropriate suction outlet, or portable suction apparatus 	<ul style="list-style-type: none"> - oxygen source (wall outlet or cylinder) with appropriate delivery tubing - neonatal face masks - Reservoir bag for delivery of 100% oxygen, e.g. Jackson-Rees, Laerdal[®], Hope[®], or Penlon[®]. - Laryngoscope with neonatal blade, e.g. #0, 1 Miller - Endotracheal tubes: Size 2.5, 3.0, 3.5 mm I.D. - Stylet for endotracheal tube - Tape, sutures
<i>Administration of IV Fluids</i>	<i>Intravenous Solutions & Medications</i>
(a) Sterile packaging of - infant feeding tubes, #3, 5 French Two small haemostats Scalpel, suture material Sterile towel Syringes, stopcocks 2 × 2 cotton gauze (b) Antiseptic solution (c) Sterile gloves	<ul style="list-style-type: none"> - 10% D/W (5 cc/kg); 5% D/0.45 N/S (5 cc/kg) - Salt poor albumen (2 cc/kg) - NaHCO₃: 1 mEq/cc (1-2 mEq/kg) - Epinephrine 1:10,000 dilution (0.1 cc) - Ca Gluconate 4 mEq/cc (4 mEq/kg) - Atropine 0.4 mg/cc (0.08 mg/kg) - Isoproterenol 1 mg/cc in 250 cc (titrate) - Naloxone 0.2 mg/cc (0.05 mg/kg) [Doses indicated in ()]

TABLE II Sequence for Resuscitation of the Newborn

<i>Resuscitation I</i>
1. 100% Oxygen by face mask 2. Assisted ventilation 3. Monitor heart rate, colour and tone IF NO RESPONSE AFTER 30 SECONDS
<i>Resuscitation II</i>
1. Intubation, 3.0 mm endotracheal tube 2. Ventilate 20-30 breaths per minute 100% oxygen 3. Check air entry, heart rate 4. Call for assistance IF NO RESPONSE AFTER 30 SECONDS
<i>Resuscitation III</i>
1. Continue IPPB with 100% oxygen 2. Begin external cardiac massage 3. Establish IV - umbilical vein 4. Give 5% D ₁ NS or 10% D/W 5-10 ml/kg 5. NaHCO ₃ , 1-2 mEq/kg, dilute 1:2 in D/W 6. Epinephrine 1:10,000, 0.1 ml IV repeat

Severely asphyxiated newborns are usually both hypovolemic and acidotic. Ten per cent dextrose in water or 5 per cent D₁/NS should be infused at a rate of 5-10 ml/kg, over five to ten minutes. These

fluids may also be used as a vehicle for administration of NaHCO₃, 1-2 mEq/kg diluted 1:2 in the IV fluid. Once fluids and bicarbonate have become necessary, monitoring of systemic blood pressure with a neonatal blood pressure cuff is required. This equipment, while not standard for every delivery room, should at least be available within the obstetrical unit for major resuscitations.

If bradycardia is present despite the above therapy, epinephrine, diluted to 1:10,000 should be given in incremental doses, beginning with 0.1 cc., to achieve a heart rate greater than 100 beats per minute. Other drugs which may be used to maintain heart rate and cardiac output are listed in Table I.

The neonate who has required such extensive resuscitation in the delivery room must then be transferred to an intensive care nursery, under the care of a neonatologist. Transfer is often difficult and should not be attempted until the infant is considered to be stable enough to tolerate moving. Experienced personnel, both a physician and nurse, should accompany the infant during transfer.

Resuscitation of the Infant Born Through Meconium

Infants born through meconium are often vigorous and usually full term. The special danger to these

TABLE III Apgar Scoring System

Score	Colour	Heart Rate	Reflex Irritability	Muscle Tone	Respiratory Effort
0	Blue, pale	Absent	No response	Limp	Absent
1	Body pink, Extremities blue	Below 100	Grimace	Some flexion of extremities	Slow, irregular
2	Completely pink	Over 100	Cough, sneeze or cry	Active motion	Good crying

infants is that in 6–12 hours they may develop severe respiratory distress, due to aspiration of meconium.³ The incidence of meconium staining during labour is highly variable from one obstetrical unit to the next. What is constant, however, is the fact that meconium pneumonitis, if it occurs, carries a mortality of 20–35 per cent. To prevent these tragedies, it is important at delivery to determine if there is meconium present in the trachea and, if so, to remove as much as possible by direct suctioning below the cords. The infant should be intubated with a 3.0 mm endotracheal tube immediately after birth. The endotracheal tube should be suctioned by applying oral suction (while wearing a mask!) and the endotracheal tube removed and inspected for meconium. If meconium is present in the tube, re-intubation with a clean tube should be performed and suctioning procedures repeated until no further meconium is obtained. During intubation and suctioning, the neonatal heart rate must be monitored by an assistant. After the trachea has been cleared, the stomach should also be aspirated to remove any meconium.

If the infant born through meconium is also depressed at birth, the procedure is to intubate and leave the tube in place. Suctioning with a catheter can then be alternated with administration of oxygen and assisted ventilation.

The use of the above techniques have been shown to markedly reduce the incidence of meconium pneumonitis with its attendant morbidity and mortality.³

The Special Requirements of the Premature and the Growth Retarded Infant

Premature delivery occurs in five to ten per cent of pregnancies and accounts for 80–90 per cent of perinatal mortality. The leading causes of death in

premature infants are intraventricular haemorrhage, respiratory failure and sepsis. The use of invasive monitoring and sophisticated respiratory and cardiovascular support in these infants have, however, improved the chances for a good outcome.⁴

At delivery, the premature infant should be assessed for gestational age. The criteria include overall appearance, presence of plantar creases, cartilage in the pinna of the ear, and breast tissue.⁵ If the neonate is less than 32 weeks gestation, the trachea should be intubated immediately and the infant ventilated with 100 per cent oxygen. As soon as possible, arterial blood gases should be drawn – preferably from the umbilical artery – to adjust the inspired oxygen to give arterial pO_2 of 60–90 torr with a pCO_2 of 30–35 and a pH of 7.40–7.45.

During immediate resuscitation the infant must be kept warm and a rapid physical examination should be done to detect congenital anomalies. An umbilical arterial catheter should be placed for monitoring of blood pressure, blood gases and administration of fluids and drugs. Once initial stabilization has been achieved, transfer of the infant to the intensive care nursery is necessary. The details of long-term management of the premature infant are beyond the scope of this discussion.

Growth retardation *in utero* (IUGR) may result from maternal disease (e.g., chronic hypertension, renal disease, infections) or foetal disease such as chromosomal defects, twin gestation, or the causative mechanism may be undetermined.⁶ IUGR may be suspected clinically and confirmed by serial ultrasound examinations. When IUGR is diagnosed, it must be remembered that these infants often do not tolerate labour well. They must be monitored closely, and emergency caesarean section may be necessary for foetal distress.

At delivery, these infants must be assessed

immediately, because they may be both premature and growth retarded. Respiratory support may be necessary. Next, a careful physical examination – looking for congenital defects and sepsis – is important. Intravenous fluids are often necessary because these infants frequently suffer from hypovolemia, hypoglycemia and hypocalcemia. A dextro-stix blood sugar determination should be done five to ten minutes after birth, and repeated hourly, until oral feedings or intravenous fluids are established.

These infants must be closely observed for several days following birth. In addition to the problems mentioned above, these infants are susceptible to hyperbilirubinemia and may feed poorly.

Conclusion

This has been a brief summary of some of the present concepts of neonatal resuscitation. All newborns deserve to be carefully assessed immediately following delivery. The vast majority of these infants will respond to simple procedures – stimulation, warmth, and oxygen. Immediate appropriate resuscitation often prevents later development of major problems, when treatment is much more difficult and complex.

References

- 1 Cohen SE. Evaluation of the Neonate, Chapt 25 in *Anesthesia for Obstetrics*, Shnider SM, Levinson G, Editors, Williams & Wilkin Co., Baltimore, 1979.
- 2 Aggar V. A proposal for a new method of evaluation of the newborn infant. *Anesth Analg* 1953; 32: 260.
- 3 Gregory GA, Gooding CA, Phibbs RH *et al*. Meconium aspiration in infants – a prospective study. *J Pediatr* 1974; 85: 848–53.
- 4 Hein H, Brown CJ. Neonatal Mortality Review, a basis for improving care. *Pediatrics* 1981; 68: 504–11.
- 5 Dubowitz IM, Dubowitz V, Goldberg C. Clinical assessment of gestational age in the newborn infant. *J Pediatr* 1970; 77: 1–7.
- 6 Kumen SP, Anday EK, Sack IM *et al*. Follow-up studies of very low birth weight infants born and treated within a perinatal centre. *Pediatrics* 1980; 66: 438–42.