

Infant Resuscitation

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APPROXIMATELY 6 per cent of the infants born at Sloane Hospital for Women in New York have severe respiratory depression at birth. To treat these babies successfully, everyone in the delivery room should be familiar with sound principles of resuscitation. "Everyone" includes the obstetrician, the anesthesiologist, the pediatrician, the medical students and the obstetric nurses, both graduate and undergraduate. The task of resuscitation should not be assigned to one of these persons or groups. The infant does not "belong" to the obstetrician, the pediatrician or the anesthesiologist. The most experienced available person should manage the severe depression promptly; nowhere is the success of teamwork more evident than in the delivery room.

1. Free Airway

At the moment of birth, consideration is given to maintaining a free airway. The in-

fant's head always should be lower than the trunk during delivery and until the pharynx has been examined and aspirated.¹ Gravity is a more important aid than any mechanical device. After prompt division of the cord between clamps, the infant, still in the head-down position, is placed in a bassinet with the head lowered. If the first inspiration consists of pharyngeal material rather than air, a strong basis is laid for development of secondary atelectasis, pneumonia and death in the first 48 hours. Mouth suction or electric suction (with a rubber catheter and trap) is used to empty the pharynx as long as any material remains in it. Prolonged suctioning is harmful both because of the marked bradycardia produced and because of removal of oxygen from the pharynx. After the pharynx is empty, almost all infants can be made to cough or sneeze (inspire deeply as well) by placing the end of the catheter just inside the nostril. After such a cough or sneeze the pharynx should be suctioned briefly again.

Amniotic fluid and its contents normally fill the tracheobronchial tree before birth, and al-

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though the fluid is easily absorbed by the pulmonary circulation, and the foreign debris moved upward by ciliary action, the volume which the infant must handle is less if he can expel some by coughing.

Usually, infants do not require further attention. One group² believes that leaving the stomach empty has a favorable effect in preventing the later development of pulmonary complications, but we have not found such a relation as yet.

If artificial ventilation is necessary because of persistent apnea, it is essential to keep the tongue from acting as an obstruction in the pharynx. The tongue of a limp child lying on his back falls backward against the bodies of the cervical spine and obstructs the passage of air from either the nose or mouth. A small plastic pharyngeal airway placed between the tongue and palate corrects this obstruction immediately and always should be inserted if some type of positive pressure breathing is planned. If the infant has enough tone to keep his tongue forward in his mouth, he does not need the artificial ventilation.

When inflation of the lungs does not produce a slight rise of the upper chest, some obstruction still is present. One should rule out choanal atresia by slipping the catheter into the nasopharynx; this rare anomaly necessitates tracheostomy. More often the obstruction is at the larynx, and direct laryngoscopy is immediately indicated if efforts at ventilation do not improve the child's condition after two to three breaths. We have encountered both blood clots and vernix caseosa as the cause of obstruction, and these were removed easily by direct suctioning. If a complete laryngeal web is seen, immediate tracheostomy is indicated.

2. Ventilation

The best ventilation is accomplished by the infant himself, and very few babies need any mechanical assistance. After making sure the pharynx is empty, a brisk slap on the soles of the feet will bring about sharp inspiration and precipitate crying. Obviously, a child deeply depressed and in shock is not so stimulated. If respirations are very inadequate or absent,

some type of IPPB (intermittent positive pressure breathing) should be applied. Numerous mechanical devices are available for this purpose, or mouth-to-mouth inflation is always available and does not get out of order. The principle of application is a short, sharp "puff." Better results and less lung damage are produced by one or two such puffs than by a low pressure application of several seconds' duration.

The best gas to use is oxygen-enriched air. We know that excessive exposure to 100 per cent oxygen produces secondary atelectasis, pulmonary hemorrhage and retrolental fibroplasia in premature infants. It is doubtful whether a few seconds' use of 100 per cent oxygen in the delivery room will be followed by such complications, but this procedure will be discontinued when a practical method of applying positive pressure with a mixture of air and oxygen has been developed.

If application of positive pressure using a face mask does not bring improvement in two to three breaths, direct laryngoscopy and insertion of a flanged endotracheal tube are indicated. The flange prevents the tube from being inserted below the carina and allows a snug fit at the cords. The endotracheal route is the most efficient and direct in ventilating lungs, and the entire delivery room personnel should take all opportunities to practice intubation in warm, dead infants.

3. Position

The head-down position from the moment of birth already has been stressed. There is much current discussion of the proper position of the infant in relation to the placenta before the cord is clamped. Since no competent valves function in the umbilical cord, blood volume easily can be shifted to the infant or to the placenta. In the case of a sensitized Rh infant it is recommended that the baby be held above the level of the placenta for 5 to 10 seconds before clamping the cord, thus lessening the likelihood of hypervolemia after exchange transfusion. We feel strongly that premature infants should *not* be held below the level of the placenta, for a large increase in blood volume will result. We believe

TABLE 1
EVALUATION OF THE NEWBORN INFANT; METHOD OF SCORING

SIGN	0	1	2
Heart rate	Absent	Slow	Over 100
Respiratory effort	Absent	Slow Irregular	Good Crying
Muscle tone	Limp	Some flexion of extremities	Active motion
Response to catheter in nostril (tested after oropharynx is clear)	No response	Grimace	Cough or sneeze
Color	Blue Pale	Body pink Extremities blue	Completely pink

at present that this hypervolemia is related to the high incidence of hyaline membrane in premature infants. The best "routine" position is level with the placenta. The cord should be clamped promptly to allow immediate attention to the airway. After respiration is established, a head-up position will provide a larger thoracic cage for the expanding lungs, since the weight of the viscera lowers the diaphragm. At present, we feel this position is desirable.

4. Temperature

The time-honored habit of keeping babies warm at all times is undergoing investigation. Cooler temperatures reduce tissue metabolism considerably, and warm ones raise it. Theoretically, cooling would be of aid to small, sick infants with respiratory insufficiency. There are few data regarding the normal behavior of the temperature after birth. The full-term infant's temperature drops 2 to 3° F., whereas the premature infant's may drop 4 to 8° F. and remain at that level for one or two weeks, apparently without detriment. A controlled experiment is under way at the Babies Hospital to study the survival of premature infants at different environmental temperatures. Our present practice is to omit hot water bottles, warmed blankets and other undue covering.

5. Humidity

Controlled experiments do not provide evidence that excessive humidity or vaporization of various wetting agents improves survival in the newborn period.

6. Use of Drugs

Rarely are agents other than oxygen indicated in the delivery room. If maternal depression exists, and if it is likely that it was caused by an opiate, intravenous injection of 0.25 mg. of *N*-allylnormorphine into the umbilical vein is worth a trial. If this is done and the diagnosis is in error, moderate sedation is produced in the infant.

Antibiotics always should be used after difficult resuscitation, and digitalis frequently is of help in severe cardiac problems.

7. Scoring

Every infant is evaluated 60 seconds after birth according to a simple, objective scale, reproduced in table 1.

8. Gastric Aspiration

After respiration is well established, every infant's stomach is aspirated by introducing a soft rubber catheter and aspirating the contents. The main purpose is to rule out esophageal atresia, the second purpose being to measure the gastric contents. If the tip of the catheter is not seen in the left half of the abdomen, a stethoscope is placed over the abdomen and a short puff of air is blown into the catheter. No noise indicates atresia.

9. Immediate Neonatal Diagnosis of Operable Anomalies

I already have mentioned esophageal atresia. If more than 50 cc. is aspirated from the infant's stomach, the abdomen should be x-rayed

within the hour to rule out duodenal or jejunal atresia. Absence of gas below the pylorus indicates atresia and immediate operation.

The chest should be auscultated in the first few minutes. A shift in loudest cardiac sounds and absent breath sounds in one side of the chest suggest diaphragmatic hernia, another operable emergency.

Imperforate anus should be treated by operation immediately. The newborn infant is most resistant to surgical assault and anesthesia in the first 24 hours after birth. Every delay in diagnosis of an operable anomaly jeopardizes his chances for survival.

10. Maternal Polyhydramnion

A history of maternal polyhydramnion

should lead to an especially thorough search for anomalies, most of which are operable. We have found the following anomalies to be directly associated with polyhydramnion: anencephalia, hydrocephalus, tracheo-esophageal fistula with esophageal atresia, diaphragmatic hernia, congenital cardiac disease, duodenal and upper jejunal atresia, volvulus, and perforated stomach. Rapid diagnosis in the delivery room is one of the most hopeful means of reducing neonatal mortality.

REFERENCES

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2. FREEMAN, L. C. and SCOTT, R. B.: Gastric suction in infants delivered by cesarean section. *Am. J. Dis. Child.* 87:570 (May) 1954.