THE FIRST TWELVE MINUTES

VIRGINIA APGAR, M.D.

PROFESSOR OF ANESTHESIOLOGY
COLUMBIA UNIVERSITY
ATTENDING ANESTHESIOLOGIST
THE PRESBYTERIAN HOSPITAL
COLUMBIA-PRESBYTERIAN MEDICAL CENTER

NEW YORK, NEW YORK

I AM very honored to be invited to Portland. Until your turnpike was built, my main thoughts about Portland were that it was an easy place to get lost, and not until last night, under the gracious guidance of Mrs. McCann, was I able to appreciate the beauties of your fine city. I am also honored to be asked, bcause I come from New York, and seem to be the only one on the program south of the Boston and Maine Railroad.

The first ten or twelve minutes of a baby's life are, in our opinion, a very important time in his life. There are still plenty of dissenters from this opinion. Higgins, of Woking, Surrey, is one. He has written, in 1951, in the Journal of Obstetrics and Gynecology of the British Empire, that "No one has proven that resuscitation did a baby any good." How to prove or disprove this is difficult. He quotes the results of some 2,000 deliveries conducted or supervised by himself, and it is true that his death rates are no better or no worse than the average. His only treatment of the child is to shake it, and put it in a slightly head-down position, with one arm behind its back. The description of what happens in some cases is hair-raising. One child at 7 minutes had no apical impulse, but by the 14th minute was breathing well. Mr. Higgins must have strong coronary arteries.

The only way to prove his statement would be to make a completely random selection of every patient on the obstetrical floor, and do nothing to every other one, no matter how depressed the infant is, while treating every other infant as indicated. Mr. Higgins includes one paragraph which I think explains his success. In order to make the series more uniform, he has omitted from the series all forceps, breech, and section deliveries, all maternal diabetes and other illness, all prematures. He is probably right that normal, full-term infants do not need help.

There is growing evidence that if a baby survives the trauma of birth, brain deficiency is not likely to occur. Usden and Weil in Cincinnati examined all the children born in the Cincinnati General Hospital, in 1938, who were apneic at birth. Fifteen years later, some 80 or 90 of these children were followed at high school age. Psychological studies resulted in the startling fact that those who were apneic the longest were among the brightest! This fact just missed being statistically significant, fortunately. However, no mention is made of the treatment used for the apnea, and oxygen administration is not mentioned. Apnea treated with ventilation with oxygen is entirely different from untreated apnea. Several forward-looking studies are under way to follow well-documented infants at birth, and their results are awaited with interest.

Dr. Hallett has already mentioned the study carried out at Babies Hospital in New York. In 1947, The Rockefeller Foundation provided funds for a serial study of the heel capillary blood of infants at birth, and 404 unselected babies of ward patients were sampled 4 times during the first 2 hours. Gesell tests were given to some at 2 years of age, and Stanford Binet tests at 47 months. So far, we have found no relation at all to heel blood oxygen saturation at birth and later intelligence. The group is being re-examined at present with a battery of tests.

Since such a series represents considerable financial outlay, we tried to find a simple, clinical way to judge the condition of the infant. Five signs were chosen, and given a score of zero, 1 and 2, as shown in the following table. The signs are heart rate, respiratory effort, muscle tone, reflex irritability, and color. These are evaluated at 60 seconds after birth, and a total score given. This cannot exceed 10. The following 2 slides show the incidence of the total scores and the death rates in each group.

At present, we have over 16,000 infants so rated at birth; 32 of these scored 0 — not even a heart beat by auscultation. With prompt treatment, 22 of these recovered and went home. The follow-up of these and a sample of 4,000 in all, which will begin in 1960, should be most interesting.

The scoring system is used in several ways. In general, no treatment is needed for infants with scores of 5 or better other than indicated pharyngeal suction. If the score is 4 or under, we believe that artificial ventilation with oxygen-enriched air is indicated. A record of successive scores indicates how long depression is present,

and may be related to prognosis. An infant admitted to the nursery with an initial low score gets more prompt pediatric care and observation than one with a good score, since we know that the death rates are considerably higher with low-score babies.

Using scores as a criterion, we have found some differences in choice of anesthetic technique and the result to the baby. For example, in elective Caesarean sections, babies delivered under spinal anesthesia had an average score of 8.2, while those delivered under general anesthesia (cyclopropane) average 5.2. Since the death rate at score 5 is about five times that at score 8, we feel that spinal anesthesia is definitely superior to inhalation anesthesia for elective sections. Also, in a large group of full-term, vaginal vertex deliveries, babies delivered after regional anesthesia were significantly better, as judged by scores, than those following inhalation anesthesia. However, in breech deliveries, and in vaginal deliveries of premature infants with vertex presentation, we could detect no difference between regional and general anesthesia.

Dr. Hallett has asked me to give some prognosis as to the margin of safety following anoxia. That is a good question, and we are trying to find some answer to it. For a year or two we have been assembling a neonatal team, at present consisting of Drs. Stanley James and Irwin Weisbrot, pediatricians, and Dr. Edward Prince, a Macy Foundation Fellow in Obstetrics. We have a laboratory on the obstetrical floor, and wonderful cooperation from the obstetrical house staff and nurses to help us collect data during the perinatal period. Fetal electrocardiograms, blood pressures at birth, even before the cord is cut, weighing the amount of placental transfusion given in various positions, immediate collection of umbilical artery and vein samples as well as maternal arterial samples, and uterine vein samples in Caesarean sections are among our endeavors. After birth, catheterization of the umbilical vein is easily performed and blood samples, and pressure tracings are recorded from various parts of the circulatory system.

So far we are unable to tell you just why a baby breathes. It is not apparently related solely to oxygen tension or carbon dioxide tension. We are quite sure that depressed infants, those with low scores, have in addition to anoxia and hypercarbia, a considerable metabolic acidosis as determined from depression of buffer base. Dr. Duncan Holaday's laboratory has perfected the micromanometry necessary to study small blood samples. The rapidity of the de-

velopment of metabolic acidosis confirms our feeling that depressed infants should not be left to their own devices but should be treated promptly with ventilation to get rid of carbon dioxide, as well as to oxygenate their tissues.

We are quite sure that all babies undergo a period of asphyxia during delivery, whether from tonic contraction of the uterus, placental separation, or cord compression, or combinations of these factors. If this period is short, the infant should be in good condition. If intrauterine asphyxia is prolonged, a depressed baby with metabolic acidosis is often the result. It is imperative that we learn better how to diagnose intrauterine emergencies. The presence of meconium-stained amniotic fluid and appearance of fetal tachycardia or bradycardia are still excellent clinical guides.

Charles Steer and Arnold Fenton have just reviewed some 1,200 cases of fetal distress at the Sloane Hospital for Women, and have found that the death rate of infants born with meconium having been passed is twice that of those without this complication, while in those with pulse changes in addition, over 180 or under 110 beats a minute, the death rate rises to three times that of those without these complications. The work of Ed Sothern, here in Maine, and Hon and Hess, at Yale, on fetal electrocardiogram is of great importance.

During the usual vaginal delivery, the infant is delivered as expeditiously as possible. Intentional delay after delivery of the head, and suction of the mouth with a rubber bulb, has been widespread teaching in the past, apparently to allow the uterus to express as much placental blood to the baby as possible. It is questionable, especially in premature infants, whether this extra, high viscosity blood is desirable. Also, as the baby's pharynx and nares are stimulated with the rubber bulb manipulation, he is often seen attempting to respire. This is almost if not actually impossible, since the chest is held snugly in the pelvic girdle and the uterus is contracting tightly on the buttocks and feet, allowing no room for diaphragmatic expansion either. During and after delivery, the baby is held down at all times. The baby's first breath should be taken in the head-down position so that pharyngeal contents of vaginal mucus and blood will not be inspired with the first gasp. Gravity is the best prevention of this serious emergency. The child is placed head down in a bassinet, and the pharynx is gently and quickly suctioned with a two-holed rubber catheter (Rausch, No. 12, Davol) connected

to a DeLee trap. Prolonged suction will remove air (oxygen from the pharynx) as well as stimulating the pharyngeal plexus to cause bradycardia. After the pharynx is clear, the catheter is touched to the nostrils, which should cause the baby to sneeze or cough. Pharyngeal aspiration is repeated if the baby coughs up much material.

If the infant is not crying by this time, a brisk but gentle slap on the feet is adequate mechanical stimulation. After the cord is clamped or tied, the stomach is emptied with the same catheter, and its contents measured. Both atresia of the esophagus and upper intestinal obstruction can be diagnosed by this simple maneuver. Finally, the catheter is inserted into the rectum to rule out imperforate anus. Stethoscopic check of the chest will rule out diaphragmatic hernia, pneumothorax, and severe atelectasis.

The treatment of infants with scores of 4 or below is the same, with a few additions. After pharyngeal suction, if ventilation is inadequate or absent, the heart rate slow and the baby limp, respiration is assisted by inflating his lungs with oxygen-enriched air. There are many ways to do this, such as using a hand-operated inflator (such as the Kreiselman type), or mouth-to-mouth respiration, with oxygen in the operator's mouth. It is imperative to know that oxygen actually is reaching the lungs, not the stomach. If the chest is seen to rise or, better still, gas is heard to pass into the lungs, with a stethoscope, the treatment should be effective in a few seconds.

Often, the tongue falls back and completely obstructs the airway. This is treated by inserting an infant-size Berman plastic airway, and repeating the inflation of the lungs. If the heart rate does not speed up in a few seconds, direct laryngoscopy is indicated to rule out glottic obstruction or anomaly. Use suction if necessary. When the glottis and trachea are seen to be free, a No. 12 Cole infant endotracheal tube is inserted into the trachea, and one or two puffs blown into it. A simple, portable plastic device is being devised by Dr. Richard Day, which will prevent contamination of the baby by the operator's breath. Improvement in the heart rate should follow very shortly.

If one has the misfortune to have an apparent intrapartum death, and a speedy delivery is possible, the above form of management should be instituted at once. Endotracheal intubation and inflation of the lungs take about 3 seconds to perform if the equipment is at hand and in working order. If then the heart-beat cannot be

auscultated, cardiac massage should be attempted. There are two children living, without residual damage, following cardiac massage at birth, and endotracheal ventilation.

Dr. Abramson mentioned the occurrence of polyhydramnios in some cases of infant volvulus. This symptom should suggest to you a number of anomalies in the infant, some of which are operable. The best time to operate on a newborn infant is as soon as possible after birth. Some of the anomalies associated with polyhydramnios which can be corrected are bilateral choanal atresia, congenital goiter, tracheoesophageal fistula with atresia of esophagus, duodenal atresia, volvulus, obstruction from an annual pancreas, obstructed diaphragmatic hernia. Some which cannot be corrected are complete anencephaly, diffuse disease of the central nervous system, and so far, some cases of congenital cardiac anomaly. Polyhydramnios which accompanies diabetes and the second twin remain mysterious.

VIRGINIA APGAR, M.D.
COLUMBIA-PRESBYTERIAN MEDICAL CENTER
622 WEST 168TH STREET
NEW YORK 32, NEW YORK

DISCUSSION

QUESTION: Is pulmonary hypertension related to the formation of hyaline membrane?

DR. APGAR: Dr. McCann has asked that question, and he is probably correct that this is one of the factors, though it remains to be proven in humans. Catheterization of the pulmonary artery is not easy in the newborn, but Dr. Richard Rowe, in Toronto, has done it many times, and we are practicing the technique in stillbirths and abnormal infants.

Dr. McCann also inquired about the use of varidase in hyaline membrane disease. I have not had experience with this particular drug, but if it is an aerosol similar to alevaire, the value of its use has been disproven by Dr. William Silverman in the premature nursery at the Babies Hospital in New York City.

QUESTION: Compare cyclopropane with the other general anesthetic agents for routine use in delivery.

DR. APGAR: Cylopropane has the advantage of being able to be used both in light analgesic levels as well as surgical anesthetic levels, with adequate oxygen at all times. For analgesia alone, we prefer nitrous oxide and oxygen because of its nonexplosiveness, but if operative de-

livery of any type is considered, a quick change to cyclopropane is made. It has failed us on two occasions this year for relaxing a tightly constricted uterus. Chloroform was used successfully in both of these patients. All the inhalation anesthetics traverse the uterus quickly, so time of administration and depth should be kept to a minimum.

Dr. McSweeney has asked me if we use ether in normal deliveries. Ether is an excellent inhalation agent, and we use it if (1) there is no cyclopropane available; (2) if the personnel available to give anesthesia has had no experience with cyclopropane; and (3) if there is a mechanical defect in the anesthesia machine. All of these are very rare occurrences.

QUESTION: What are the criteria for determining the early stage of labor, Dr. Abramson?

DR. ABRAMSON: If the patient has regular rhythmic, painful contractions, and on rectal examination the cervix is taken up but not dilated, labor is still in the first phase of the first stage of labor, and the patient would be a very good candidate for Relaxin therapy.

QUESTION: Is rupture of membranes a contraindication to the use of Relaxin if the cervix is not dilated?

DR. ABRAMSON: It is not a contraindication. In fact, in our series of 40 patients presented today, 10 of them had ruptured membranes. Seven of these had an increase of as much as 7 weeks of gestational age and were delivered of live babies. Whether the patient comes in with ruptured membranes prior to the onset of labor, or simultaneously ruptures membranes with the onset of labor, as long as the cervix is not dilated, it is worth a trial.

QUESTION: Discuss the cost of Releasin.

DR. ABRAMSON: The cost of Releasin at the present time, to be sure, is high. Dr. Robert Kroc, who is here today representing the Warner Chilcott Company, has assured me that the cost of Relaxin is on the way down. I believe there has already been a 15% reduction this past month. We do not know what the oral preparations of Relaxin, now being used in other studies, will cost, but I am sure that it will be much less than the parenteral preparations now on the market.

QUESTION: Dr. Hallett, what do you mean by avoidance of the use of forceps?

DR. HALLETT: I don't feel that I'm really capable of discussing forceps at all. I probably should not have mentioned it in my remarks, and whatever I have mouthed is the written word that I have read, and I merely meant that forceps should be used as little as possible in the delivering of premature babies. I am sure that there are certain obstetrical indications for the use of forceps, but I would rather leave that decision up to you. I merely included it in my remarks for purposes of completion.

QUESTION: What about human breast milk for premature babies?

DR. HALLETT: There is a considerable amount of evidence that premature babies gain better on a high-protein cow's milk formula than they do on breast milk. However, although there is a great deal of evidence that they gain weight better on cow's milk, there is no evidence that this extra gain in weight is a good thing. I think that too much of our research on premature feeding is based on this weight gain, but at the present time they are investigating other aspects.

Just for one example, the absence of Vitamin B_6 in some cow's milk formulas has led to convulsions. Of course, Vitamin B_6 is present in breast milk. And this certainly may be true of other substances in breast milk as yet undiscovered. I would certainly tend to think (this is purely a matter of opinion, and there are many different opinions on the subject) that eventually breast milk will come into its own right and will be proven to be the best milk for premature feeding. It is rather difficult to obtain it in a community of this size. At least, we're not set up, from the administrative point of view, to get it. I have heard that in Detroit the Junior League of that city has made some kind of an organizational attempt and, as a consequence, can obtain the breast milk. I don't think it's from the Junior Leaguers themselves. (Laughter.) It is second-hand breast milk. They can obtain it for use in hospitals.

Dr. Apgar has passed on to me this question: How about the use of varidase in hyaline membrane disease? Well, she has certainly answered it in the same way that I would answer it, namely, that we don't either of us know anything about it. I think that our mistake in hyaline membrane disease has been to treat it in the wrong way, based on the wrong theory of the disease. Our theory in the past has been that we should remove the item which is causing the hyaline membrane, and we felt that this item was amniotic fluid. The strong evidence at the present time is that this item is pulmonary effusion, and therefore we should attack it from that point of view rather than from the point of view of the membrane itself. However, assuming that the membrane is present and we have been unable to prevent it, how can we then treat it? Perhaps varidase would be of some value, but one could liken the situation to removing a diphtheritic membrane without actually treating the disease diphtheria.

DR. APGAR: Dr. Abramson, I wonder if you would comment for us on your opinion of the type of delivery of premature babies. At the Sloan Hospital we have been brought up to do forceps in almost every case, with wide episiotomy. This sounds awful in view of Dr. Hallett's remark.

DR. ABRAMSON: That was the point in which I was going to disagree with Dr. Hallett, because we have been brought up to believe that the premature baby's best chance at the time of delivery is by the use of

forceps with a wide episiotomy. I think that is particularly true when the patient is a primipara with a good firm perineal body. I think there is a greater chance of damage to the infant, through probable intercranial hemorrhage caused by forceful uterine contraction, pounding the head against a firm perineum. With the proper use of forceps at full dilatation and a wide episiotomy, there is no pressure on the head and the baby is less anesthetized.