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How Is the Baby?: The Apgar Score Revisited

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"Learn of the Muse, and may thy Pains succeed,
Don't, 'till 'tis born, defer thy Pious care;
Begin betime, and for its Birth prepare."
Paedotrophia, Scevole De St. Marthe, 1579

THIS year, 1972, marks the 20th anniversary of Virginia Apgar's presentation to the 27th Annual Congress of Anesthetists of a new method for newborn evaluation. Before then, the usual approaches to evaluating an infant's condition at birth were the observations of a competent pediatrician, and noting the time interval from birth to the first breath or to the first cry.

Historically, descriptions of newborns dealt mostly with the presence of severe malformation or with serious morbid events, as indicated by the following quotation attributed to William Heberden in 1807: "It sometimes happens, that immediately after birth the face and neck put on a black or livid appearance, the lips become purple, and the breathing short. These symptoms, if they do not soon go off, usually terminate in a speedy death." Care in the delivery area was given over to cultural or religious dicta extolling the benefits of swaddling, bathing, cord care and hygiene, as in the following quotation, again from St. Marthe's *Paedotrophia*:

"Then the kind nurse, with tender fingers clears
His mouth from filth and even his eyes and ears."

Virginia Apgar's scoring system was promptly accepted and has become the most universally used system for describing a newborn's condition at birth and for measuring the impact of perinatal events on that newborn. This system not only compel's physicians to quantitate those neonatal functions necessary to sustain life, but by so doing makes them direct much more of their attention to the newborn. Another important consequence of the routine use of Apgar scores has been to provide a framework of familiarity upon which to establish the need for, and to evaluate the results of, resuscitative measures.

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Dr. Apgar's purpose in designing her score was to assess the status and follow the progress of the acutely asphyxiated and severely depressed newborn. Time has brought consistent confirmatory documentation, clinically and physiologically, of the accuracy of her design.[2, 3] As a consequence, therefore, the Apgar score has been and is still being widely applied as the sole yardstick for measuring a great number of perinatal factors which might affect the newborn, such as maternally administered drugs, obstetric maneuvers, and abnormal conditions in the mother.

The five variables scored (heart rate, color, tone, respiratory effort, irritability) are essentially vital signs. Yet few pediatricians would be content to judge an infant's status *only* from this basic information. The Apgar will miss subtle changes from intrauterine events, since an effect must be considerable to significantly lower the number. Furthermore, limiting the scoring period to the first 10 or 15 minutes after birth neglects a most critical time of life. Perinatal mortality figures indicate that it is the first 24 postnatal hours which are the most hazardous for any human being. In addition, adaptation to extrauterine existence must be established during this time. As Dr. Apgar herself said, "The Apgar score is no substitute for a careful physical examination and careful observations over the first few hours of life, nor will it predict neonatal death or survival in individual infants."[2] With infants of drug-addicted mothers, experience has demonstrated that life-threatening perinatal influences may not become manifest for hours or days after birth.[4] The Apgar score misses all delayed effects from intrauterine events.

The Apgar score has also been utilized as a predictive index for future neurologic normality. It has real importance in this regard as an initial, crude screening tool. However, when data from the Collaborative Study[5, 6] are critically evaluated, a limited predictive value for the Apgar score is apparent. Infants of low birth weight, or otherwise at risk, who have a low (0–5) five-minute score, do have a significantly decreased chance for neurologic normality at one year of age. Birth asphyxia and other neonatal morbidity are syn-

ergistic, each contributing to an unfortunate outcome. Similarly, the incidence of neurologic deficits is fourfold greater in full-term normal birth weight infants with low five-minute Apgars than in similar full-term "normal Apgar" infants weighing 2.5 kg or more. This last observation has been the basis for general pessimism regarding the outcome of all infants with low Apgar scores. From actual data, however, only 4.3 per cent of these term, low five-minute Apgar score babies will be abnormal at one year of age; *95.7 per cent will not.*

The prediction of more subtle effects on outcome in the higher range of the Apgar score is suggested by Lewis *et al.*[7] These investigators studied visual attentiveness in 40 babies at three, nine, and 12 months of age. Twenty of these infants had five-minute Apgars of 10 and the other 20 had scores ranging from 7 to 9. The capacity of the "perfect 10" Apgar baby's response to complex visual stimuli was consistently and significantly greater than this same ability in infants who had scored between 7 and 9. These data are not to be interpreted that the Apgar score is a sensitive or precise measure of behavioral capacity. Borgstedt and Rosen[8] were not able to demonstrate a correlation between Apgar scores and electroencephalographic or behavioral changes caused by maternal obstetric sedation. Rather, Lewis's data support the concept that an Apgar score is exceedingly subjective. Most physicians will agree on a score of 10, that is, a perfectly pink, crying, active baby. But when a baby scores less than 10, unrecognized biases of an "interested" observer might raise some marginal score up to the 7–9 range, adding minimally depressed babies to Lewis's lower Apgar group.

This subjectivity of the Apgar score is at once an advantage and a handicap. Certainly one reason why the Apgar has become the standard for newborn evaluation is that it is simple, rapid, and requires no special equipment or extensive training to implement. Yet Dr. Apgar herself initially, and repeatedly, warned that to be valid, her score must *not* be performed by an observer who is involved in the care of either mother or infant.[1, 9] Comparative data, collected by Dr. Apgar, document this scoring variability. During ten years of study, the median score from Sloane Hospital in New York City was 8, from University Hospital in Puerto Rico it was 9, and from University Hospital in Helsinki, it was 10.[9] We have witnessed, all to often, the awarding of a casual, "eyeball" Apgar after only a cursory glance at the newborn. This misinformed score does more harm than good.

As previously mentioned, the Apgar score has been extensively used in clinical perinatal pharmacology.[10] The pediatrician must indeed be wary of statements that a maternally administered drug is "safe" or "shows no untoward effects" for the newborn from data which are based on Apgar scores alone. First of all, there is no historical precedent for using Apgar scores to study drug effects in the newborn. The infants in Dr. Apgar's original report were almost all delivered following some form of anesthesia or analgesia.[1] This lack of nonmedicated control is, in Dr. Apgar's words, regrettable, because it provides no master control group for any subsequent study. Considerable data now indicate that many obstetric drugs, previously thought to have no activity in the newborn, actually do have considerable effects when evaluated by other standards.

In perinatal pharmacology, a number of more recent studies have documented the effects of prenatal sedation[11, 12, 13] or regional or general anesthesia[14] upon the newborn in dosages once regarded as "safe." These studies rely to a great extent on newly developed behavioral tests. In none of these was the degree of newborn behavioral impairment reflected by unusually lowered Apgar scores.

The use of behavioral technics for assessing the effects of intrauterine events on the newborn is not really new. In 1957, Graham *et al.*[15] reported significant behavioral differences within a group of 60 newborns whose obstetric histories suggested anoxia, when compared with the behavior of 62 historically nonasphyxiated controls. More recently, investigators have attempted to combine behavioral testing with neurologic and electrophysiologic standards in order to increase diagnostic and prognostic sensitivity in the newborn period. These testing procedures, while shedding much light on the complexities of neonatal neurologic adaptation, are themselves complicated and frequently require expensive and/or cumbersome equipment. These restrictions limit their general clinical applicability.

What can the clinician use with his patient to complement the observations begun with the Apgar score? First of all, the initial physical examination of the newborn provides irreplaceable information about transition from intrauterine to extrauterine life. The physical,[16] neurologic,[17] and ponderal[18] criteria of maturity correlated with the estimated gestational age can be intelligently interpreted in light of any given obstetric history. Since the neurologic responses indicative of major and minor residual CNS damage are those related to tone, muscular excitability, or the absence of reflexes,[19] attention to recording specific abnormalities is mandatory. Repeated observations at regular intervals will give even more substantive information. One hallmark of a normal newborn is his ability to vary many responses to environmental stimuli. Brain damaged newborns will often have disorganized, depressed, obligatory, or stereotyped activity. An infant's ability to change his level of arousal (state) when stimulated,[20] his

ability to modify his response to repetitive stimulation (response decrement),[21,22] and the rapidity with which he recovers from the initial "shock of birth"[23,24] are all indicators of normality.

Finally, newer observational technics have begun to quantitate the early mother-infant interaction.[25] The traditional view of this interaction has been that the mother is the sole activist. This may not be true. Because of his small size, apparent helplessness, and distressing cry, the newborn can trigger mothering activities.[26] Thus, anything which changes the newborn's behavior (such as minimal asphyxia, subtle drug effects, etc.) might alter his ability to elicit an appropriate maternal reaction. The pediatrician has an invaluable opportunity to observe this pair at first hand. As Brazelton[21] points out, regular and repeated observations of interactional situations in the newborn provide irreplaceable predictive information for further behavioral assessment.

What we are suggesting, really, is the use of the pediatrician's stock in trade: careful, close, intelligent observation of the patient. These observations, and their interpretation, will serve to complement the more acute but less sensitive measurements of the Apgar score.

In summary, the Apgar score has stood the test of time as an index of acute, severe neonatal impairment at birth. More sensitive clinical measures, plus an understanding of the Apgar's limitations, will enable the clinician to better answer the question posed by our title.

Bibliography

1. Apgar, V.: A proposal for a new method of evaluation of the newborn infant. Anesth. Analg. (Cleve) 32: 260, 1953.
2. Apgar, V. and James, L. S.: Further observations on the newborn scoring system. Am. J. Dis. Child. 104: 419, 1962.
3. James, I. S.: Acidosis of the newborn and its relation to birth asphyxia. Acta Paediatr. [suppl. 122] 49: 16, 1960.
4. Zelson, C., Rubio, E. and Wasserman, E.: Neonatal narcotic addiction: 10-year observation. Pediatrics 48: 178, 1971.
5. Drage, J. S., Kennedy, C., Berendes, H., Schwarz, B. K. and Weiss, W.: The Apgar score as an index of infant morbidity. Dev. Med. Child Neurol. 8: 141, 1966.
6. Drage, J. S. and Berendes, H.: Apgar scores and outcome of the newborn. Pediatr. Clin. North Am. 13: 635, 1966.
7. Lewis, M., Bartels, B., Campbell, H. and Goldberg, S.: Individual differences in attention. Am. J. Dis. Child. 113: 461, 1967.
8. Borgstedt, A. D. and Rosen, M. G.: Medication during labor correlated with behavior and EEG of the newborn. Am. J. Dis. Child. 115: 21, 1968.
9. Apgar, V.: The newborn (Apgar) scoring system: reflections and advice. Pediatr. Clin. North Am. 13: 645, 1966.
10. Burt, R. A. P.: The foetal and maternal pharmacology of some of the drugs used for relief of pain in labor. Br. J. Anaesth. 43: 824, 1971.
11. Kron, R. E., Stein, M. S. and Goddard, K. E.: Newborn sucking behavior of the neonate. Am. J. Psychiatry 37: 1012, 1966.
12. Brazelton, T. B.: Effect of prenatal drugs on the behavior of the neonate. Am. J. Psychiatry 126: 1261, 1970.
13. Stechler, G.: Newborn attention as affected by medication during labor. Science 144: 315, 1964.
14. Bowes, W. A., Brackbill, Y., Conway, E. and Steinschneider, A.: The effects of obstetrical medication on fetus and infant. Monographs of the Soc. for Research in Child Devel. 35: 4, 1970.
15. Graham, F. K., Pennoyer, M. M., Caldwell, B. M. and Hartman, A. P.: Relationship between clinical status and behavior test performance in a newborn group with histories suggesting anoxia. J. Pediatr. 50: 177, 1957.
16. Usher, R., McClean, F. and Scott, K. E.: Judgment of fetal age: II. Clinical significance of gestational age and objective method for its assessment. Pediatr. Clin. North Am. 13: 823, 1966.
17. Kenigsberger, M. R.: Judgment of fetal age: I. Neurologic evaluation. Pediatr. Clin. North Am. 13: 823, 1966.
18. Miller, H. C.: Fetal growth and neonatal morbidity. Pediatrics 49: 392, 1972.
19. Parmalee, A. H. and Michnelis, R.: Neurological Examination of the Newborn Exceptional Infant, Vol. II. New York, Brunner/Mazel, Inc., 1971.
20. Prechtl, H. and Beintema, O.: The Neurological Examination of the Full-term Newborn Infant. London, William Heineman, 1971.
21. Scanlon, J. W., Brown, W. U. and Alper, M. H.: Neurobehavioral responses of newborn infants after maternal epidural anesthesia. Abstracts of Scientific Papers, Amer. Soc. of Anesthesiologists, 1971, p. 107.
22. Brazelton, T. B.: Assessment of the infant at risk. Clin. Obstet. Gynecol., in press.
23. Desmond, M. M., Franklin, R. R., Valbona, C., Hill, R. M., Plumb, R., Arnold, H. and Watts, T.: The clinical behavior of the newly born. J. Pediatr. 62: 307, 1963.
24. Escardo, F. and de Coriat, I. F.: Development of postural and tonic patterns in the newborn infant. Pediatr. Clin. North Am. 7: 511, 1960.
25. Klaus, M. H., Jerauld, R., Kreger, N. C., McAlpine, W., Steffa, M. and Kennell, J. H.: Maternal attachment, importance of the first postpartum days. N. Engl. J. Med. 286: 460, 1972.
26. Moss, H. A.: Methodological issues in studying mother-infant interaction. Am. J. Orthopsychiatry 35: 482, 1965.