

Relevance and Applicability of the Apgar Score in Current Clinical Practice

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Abstract

Birth asphyxia is the failure to initiate and sustain breathing at birth and is estimated to be the third most common cause of neonatal deaths. The Apgar score has been used for more than 50 years to assess the state of the neonate at birth. The main advantages of this score is that it is simple, cost effective and easy to use by all health personnel in all settings, without any interventional procedures. Recently, questions have been raised as to its usefulness, reliability and limitations in assessing the wellbeing of the neonate at birth. We sought to review current available evidence to see how these concerns have been addressed and whether the Apgar score still stands the test for adequately assessing the wellbeing of the neonate at birth.

This review demonstrates that the Apgar score is still a reliable and cost effective tool for assessing the wellbeing of the neonate at birth if well taken, but its limitations should be considered and caution should be taken on its interpretation.

Keywords: *Apgar Score; Clinical Practice*

Introduction

The World Health Organization (WHO) defines birth asphyxia as failure to initiate and sustain breathing at birth [1]. It is estimated to be the third most common cause of neonatal deaths, contributing for 23%, after preterm birth (28%) and severe infections (26%) [2]. About 40% of all under five deaths occurred in the neonatal period in 2008; in the same period asphyxia was the cause of 9% of all under five deaths [3]. There is considerable variation of incidence with values as low as 1 per 1000 live births in industrialized countries [4]; and as high as 26 to 40 per 1000 live births in developing countries [5].

This difference could be due to improvements in primary and obstetric care in industrialized countries and hence adequate perinatal care [5]. Birth asphyxia may affect almost all organs, but hypoxic-ischemic encephalopathy (HIE) is a complication that can give rise to deleterious sequelae [4]. Among important statements for standard definitions of intrapartum hypoxic-ischemic events, features Apgar score which is a reliable clinical assessment [6]. In effect the American Academy of Pediatrics and the American College of Obstetrics and Gynecology, consider profound metabolic acidosis in umbilical artery blood, Apgar score ≤ 3 for more than 5 minutes, neonatal encephalopathy and multi organ dysfunction as indicative of intrapartum hypoxic-ischemic events [7]. Even though some definitions take into consideration sophisticated assessments such as cerebral imaging not always available, Apgar score if well used may be an indicator to hypoxic-ischemic insults [6]. Apgar score is an accepted and convenient method for assessing the status of the newborn infant immediately after birth and the response to resuscitation if need be [8]. It was discovered by Dr Virginia Apgar in 1952 as a scale which may provide valuable speculations on neonatal and postnatal adverse outcomes in term infants without distinction of race nor ethnicity [9]. Its main

attribute was to serve as a standardized assessment for newborn infants enabling recording of fetal-to-neonatal transition and hence adaptation to extra uterine life [9]. Over the years, some discussions have been raised about the pertinence of Apgar score, as a number of misuses have been noticed in the daily practice of perinatology. For example, using Apgar score alone to predict neurologic outcomes in term infants [8] and its disproportionate use as diagnostic criterion for birth asphyxia [10]. Subsequently a number of questions arose with significant studies carried out and committee meetings to reposition the Apgar score as a tool for assessing neonates. Today, there is evidence that a number of neonatal, obstetrical and environmental factors can affect the scoring [11]. More than sixty years after its adoption, various updates and recent findings, necessitate a reminder on Apgar score interpretation, utility, limits and amendments to rationalize its present use.

Historical background

The Apgar score was developed by Virginia Apgar, an American Professor of Anesthesiology born in 1909 in New Jersey, USA [9]. She had noted that while infant mortality trends had been declining over decades, neonatal deaths within the first 24 hours of birth had not [9]. She made careful tabulations of relevant objective observations of newborns with imminent or actual distress. She realized that five organ systems were frequently affected in such neonates: mucocutaneous, cardiovascular, respiratory, neurological and musculoskeletal [9]. Corresponding signs reflecting affectation of these organ systems were: skin color, heart rate, respiratory efforts, reflex response and muscle tone [9]. An equivalent acronym was then adapted as: Appearance, Pulse, Grimace, Activity and Respiration (APGAR). Each item was graded on a continuous scale of 0, 1 or 2 with the grades being inversely proportional to the degree of deviation from the normal state as a general principle [8]. In such a scale, the maximum possible score would be 10 and the minimum 0.

The scale was presented to the medical community in 1952 and published some months later. There were some opposition expressed pertaining to the newness of the scale, its simplicity compared to the complex notion of “newborn wellbeing” [9]. Between 1952 and 1958 the Apgar score was tested on thousands of newborns with satisfying results [9]. By 1960 most hospitals worldwide had adopted the scale. Further research in the 1950s brought the realization that this scale initially meant for evaluation of newborns at the 1st minute of life was pertinent for a second evaluation at the 5th minute [9,12].

In 1959, the National Collaborative Perinatal Project reported a 7 year study from 1959 to 1966 that involved 17.000 children followed from birth [9]. The study revealed that Apgar score is an important tool for identifying babies at risk of death or significant disability necessitating intervention at birth [9]. However, no linear correlation between 5 minute score and longer term disability was found. Following these findings, new issues and debates relative to the significance, interpretation and range of reliability of Apgar score came up prompting further research [9]. This led to further progress in understanding its application in clinical practice.

Scoring and interpretation of the Apgar score

The conventional Apgar score [12] is a 5-item scoring system with each criteria graded 0, 1 or 2, depending on the observed condition (see table 1 below). The first evaluation gives an indication of the newborn’s tolerance of the birth process, while the 5th minute evaluation provides information about the neonate adaptation to immediate extra-uterine life.

Component	0	1	2
Heart rate (beats/minute)	Absent	< 100 bpm	> 100 bpm
Respiratory effort	Absent	Slow (irregular)	Good crying
Muscle Tone	Limp	Some flexion of extremities	Active motion
Reflex irritability	No response	Grimace	Cough or sneeze
Color	Blue, pale	Pink body, blue extremities	All pink

Table 1: Apgar score [7].

The American Academy of Pediatrics in 2011, recommended scoring at the 1st and 5th minutes for all infants and at 5 minutes intervals thereafter until 20 minutes for infants with scores less than 7 points [13]. The maximum possible score of 10 points denotes excellent clinical condition of the neonate while the minimum score of zero may be suggestive of death [8]. In practice, the extreme scores are not often reached [9]. The American College of Obstetricians and Gynecologists in collaboration with the American Academy of Pediatrics define a 5th minute Apgar score of 7 to 10 as reassuring, a score of 4 to 6 as being moderately abnormal and a score of 0 to 3 as low in term infants and late preterm [14]. The same report qualifies an Apgar score of 0 to 3 at the 5th minute or more as a non-specific sign of illness which could be indicative of encephalopathy, with one of the major etiologies being intrapartum asphyxia [14]. Some degree of predictions may be done based on the score at a particular time or over a given range of minutes. First minute Apgar score between 0 and 3 would difficultly predict any individual infant outcome [15] while a 5-minute score of 0 to 3 could correlate with neonatal mortality as reported in large populations [15] but has less chances predicting neurologic dysfunction. It is believed that most infants with low Apgar scores are not susceptible to developing cerebral palsy [16]; even though a low 5-minute score was reported as likely to increase the risk of cerebral palsy by 20 to 100 folds over that of infants with a 5-minute Apgar of 7 to 10 [17,18]. Although individual risk varies, the risk of poor neurologic outcome seems to increase when Apgar score is 3 or less by the 10th, 15th and 20th minutes [18]. Nevertheless, it was concluded that a persistently low Apgar score is not absolutely a specific indicator for intrapartum compromise [13]. Thus scores at 5 or less at 5th minutes should prompt umbilical arterial and placenta sampling for complementary examinations such as blood gases, lactate and pathological analysis [13].

Utility of the Apgar score

The Apgar score was designed to be convenient, simple to understand and apply [9]. It does not require special skills nor long term experience and can be performed by any health personnel. The score permits an early, rapid appreciation of the newborn's status, indicating the necessity for immediate interventions such as resuscitation or delayed management of underlying causes [14]. Apgar assessment is equally required for the evaluation of the efficacy of interventions few seconds or minutes after. An Apgar score that remains at 0 beyond 10 minutes of age may be useful to determine the need for continuous resuscitation maneuvers given the poor prognosis often associated with such scores [16]. The severity of the score may help forecast or make predictions to a certain extent as far as prognosis or outcome is concerned [16]. Monitoring of neonates with low Apgar scores may help identify the need for focused, adapted and individualized management. Poor Apgar scores could help improve perinatal care in a service, as it may raise an alarm to question some practices or interventions. Best practice of Apgar scoring could be a guide to prompt and vital interventions within the first minute of life, also known as the "Golden Minute" [16].

A five-minute Apgar score < 7 has been shown to be highly associated with neurological impairment and with low cognitive function in early adulthood [19-21]. Thus, even a minor degree of physiological dysfunction soon after birth, reflected in the Apgar score, may indicate a slightly higher risk for developmental vulnerability in later childhood [20].

Limitation of the Apgar score

Since its introduction in 1952 a number of limitations to the use of the Apgar score have emerged over time and were summarized by the American Academy of Pediatrics in 2015 [22]. Some of these confounding factors may lead to false interpretations and misuses. In effect the scale comprises some elements of subjectivity in three of its items [9]: tone, color, reflex irritability. These characteristics cannot be quantified, making appreciation or scoring subjective and observer-dependent, thereby giving rise to erroneous interpretations or discordances between noted values and the state of the newborn. More so the reliability of Apgar score might be reduced when hazardous aggregated scoring is done by untrained personnel, without considering detailed item scoring [12].

The Apgar score [9,12] may be altered by transitional physiological changes of newborns. The scale seems to be more of an aid to diagnosis than a diagnostic tool as it gives no etiologic orientation. It is therefore limited in diagnostic value and hence may not serve for therapy.

The score is meant to be performed as from the first minute after birth [12] and would not be useful in case of necessity for immediate resuscitation after delivery. In such cases scoring may be omitted because of the need for rapid intervention, which suggests the Apgar scoring may be time wasting under critical circumstances.

Some studies [8,14] revealed that factors like newborn immaturity, maternal sedation by anesthesia, congenital malformations, infections, hypoxia and trauma may have influence on the Apgar score [14]. This is consistent with findings in support of the unreliability of Apgar scoring in case of prematurity and low birth weight characterized by physiologic immaturity and altered responsiveness to stimuli [23]. In effect among the components of the Apgar score, respiratory effort, muscle tone and reflex activity correlate well with one another and are considered as major determinants of decreasing Apgar score with declining gestational age, while heart rate and color correlate the least [24,25]. This confirms the limited use of the Apgar score in preterm infants and demonstrating different responses of the Apgar score's components [24]. Considering these various cases, restricting Apgar scoring to birth asphyxia may be misleading as some other conditions may alter newborn status. More over biochemical disturbances must be significant enough to impact the Apgar score [13]. As such, metabolic disturbances being primordial or concomitant to birth asphyxia renders the Apgar score alone insufficient for the diagnosis and explanation of anoxo-ischemic encephalopathy [13]. Complementary analysis such as blood gases and P^b from umbilical arterial sampling should be considered [13]. This may justify why predicting neurological outcomes based on low Apgar scores alone is not recommended [14]. Even though some studies showed evidence of relationship between Apgar score, morbidity and mortality in infants [23], other proven independent determining factors should be taken into consideration when predicting outcomes.

Propositions for improvements

The accuracy of the Apgar score can be preserved or even enhanced by taking into account a number of important recommendations in its use. The most essential of these recommendations were elaborated by the American Academy of Pediatrics in 2015 [22] and may be summarized as a strict restriction of the use of Apgar score to its initial purpose in neonatology practice, that is reporting the status of newborn infants after birth, instead of its exclusive use for neurologic predictions [13,14].

However, an Apgar score assigned during a resuscitation is not equivalent to a score assigned to a spontaneously breathing infant. There is no accepted standard for reporting an Apgar score in infants undergoing resuscitation after birth because many of the elements contributing to the score are altered by resuscitation. The concept of an assisted score that accounts for resuscitative interventions has been suggested, but the predictive reliability has not been studied. In order to correctly describe such infants and provide accurate documentation and data collection, an expanded Apgar score report form is encouraged. This expanded Apgar score also may prove to be useful in the setting of delayed cord clamping, where the time of birth (complete delivery of the infant), the time of cord clamping and the time of initiation of resuscitation all can be recorded in the comments box [25].

The use of expanded Apgar score (Figure 1), which entails reporting concurrent resuscitation interventions, is encouraged for consistency in assigning scores during resuscitation [14].

Complementary analysis such as blood gases and lactates from umbilical artery sampling, just as pathologic examination of the placenta is recommended in newborns with Apgar score of 5 or less, at 5 minutes to make diagnosis of birth asphyxia plausible [13]. The reliability of the score can be considerably increased by detailed item scoring before global scoring, rather than careless and aleatoric attribution of global scores. Predicting individual mortality or neurologic outcome in infants based on the Apgar score alone is discouraged [13,14]. Interpretation should take into consideration confounding and influencing factors with possible corrections made.

Conclusion

Despite the fact that the Apgar score has been adopted as a tool for standardized assessment of the newborn for more than sixty years now, some limitations to its use have been noted in recent years. The most important is the need to avoid making long term predictions

Apgar Score				Gestational age _____ weeks				
Sign	0	1	2	1 minute	5 minute	10 minute	15 minute	20 minute
Color	Blue or Pale	Acrocyanotic	Completely Pink					
Heart rate	Absent	<100 minute	>100 minute					
Reflex irritability	No Response	Grimace	Cry or Active Withdrawal					
Muscle tone	Limp	Some Flexion	Active Motion					
Respiration	Absent	Weak Cry; Hypoventilation	Good, Crying					
Total								

Comments:	Resuscitation					
	Minutes	1	5	10	15	20
	Oxygen					
	PPV/NCPAP					
	ETT					
	Chest Compressions					
	Epinephrine					

Figure 1: Expanded Apgar score form. Record the score in the appropriate place at specific time intervals. The additional resuscitative measures (if appropriate) are recorded at the same time that the score is reported using a check mark in the appropriate box. Use the comment box to list other factors including maternal medications and/or the response to resuscitation between the recorded times of scoring. PPV/NCPAP indicates positive-pressure ventilation/nasal continuous positive airway pressure; ETT: Endotracheal Tube [8].

on neurologic outcome but rather restrict the application of the score to assessment of the infant in the immediate post-partum period. A number of relevant recommendations have been elaborated and need to be taken into consideration to improve its accuracy for an optimal use.

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