Resuscitating neonates: 65 years after Virginia Apgar

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It is more than half a century ago that Virginia Apgar proposed 'A new method of evaluation of the newborn infant'.[1] In her influential paper, she noticed that 'Resuscitation of infants at birth has been the subject of many articles,' and stated, 'Seldom have there been such imaginative ideas, enthusiasm, and dislikes, and such unscientific observations and study about one clinical picture. There are outstanding exceptions to these statements, but the poor quality and lack of precise data of the majority of papers concerned with infant resuscitation are interesting.'[1] Although neonatal resuscitation remained an important topic of textbooks and guidelines, it took almost 50 years that several international research groups started to question the evidence on which recommendations on neonatal resuscitation are based.

O'Donnell and co-workers showed the poor validity of Virginia Apgar's score, which has become standard to evaluate the condition of each infant, and of other parameters used to describe infant's condition. Using video recordings, they described large interobserver and intraobserver variations of how infant's condition is scored.[2] The data have been subsequently replicated and motivated other researchers to question several other aspects of neonatal resuscitation guidelines. Stuart Hooper and his group provided excellent animal data on the physiology of neonatal adaptation,[3] which subsequently helped to develop an appropriate approach of supporting neonatal transition after birth. Finally, various groups performed animal and clinical studies to test efficacy of various interventions used during neonatal resuscitation. Nevertheless, it is amazing to see how many recommendations are still based on little or no evidence.

O'Donnell and co-workers helped to close another knowledge gap and performed a randomised crossover simulation study to provide data on the best device to intubate very preterm infants. Whereas intubation has been an essential part of neonatal resuscitation in the past, philosophy has changed and most of the infants do not require any 'resuscitation' after delivery but need only some support of transition—as reflected not only in the title of the current European Resuscitation Council guidelines.[4] Nevertheless, intubation skills are crucial for neonatologists, and thus, the current study is of great importance for two reasons. First, O'Donnell and co-workers provide important data regarding laryngoscope blades made by different manufacturers, which allow a better decision making in the clinical routine. Second, the data suggest that success of intubation could be improved by 'a simulated intubation performed immediately before a clinical intubation'. A recent analysis of video recordings of real-life delivery room management of very low birthweight infants revealed that time needed for intubation varied between 20 and 120s with a median of 1.5 attempts per infant.[5] Thus, it would be worthwhile to use video monitoring in the delivery room to determine the time needed for intubation in the individual institution and to study whether intubation success can be really improved by a 'just in time' training, as suggested. O'Donnell and co-workers add a new piece of evidence to the puzzle of successfully supporting neonatal transition and suggest a new opportunity to improve management in the delivery room that, however, requires a careful evaluation prior to being introduced into clinical routine.

The work of O'Donnell *et al* shows that, almost 65 years after Virginia Apgar influential work, researchers still have 'imaginative ideas and enthusiasm' on that topic. As a consequence, the amount of 'precise data' has substantially increased over the years and delivery room management has become 'evidence-based' science in the past decade.

Even Virginia Apgar's score has been modified and adapted to meet the demands of modern neonatal care. Based on the large interobserver variability of the Apgar score that has been described by O'Donnell and other authors, it was already asked whether the Apgar score is 'ready for retirement'. The

Table 1 Combined Apgar describing infant's condition and the interventions needed to achieve that condition

Administered interventions	Infant's condition
Cpap	Appearance
Oxygen	Pulse
Mask and Bag Ventilation	Grimace
Intubation	Activity
Neonatal Chest Compression	Respiration
Exogenous Surfactant	*Sum: intervention*
Drug	*Sum: condition*

Administered intervention: no=1, yes=0. Infant's condition: scored according to Virginia Apgar but independent of intervention required to achieve the condition and according to gestational age.

major reason for large variations was a lack of consensus on how to score preterms or infants receiving any interventions. As a consequence, an infant with respiratory support was either scored 0—since it requires support, 1—since it had a disturbed respiration or 2—since it had sufficient respiration due to the ventilator support. Surprisingly, despite the missing agreement, the Apgar score was (and is still) used in most industrialised countries every day to describe infant's condition in a clinical context and for research purposes. To overcome the limitations, the score has been adapted to meet requirements of modern delivery room management. The resulting Combined Apgar specifies the five well-known items of the original score to described infant's condition as a result of the interventions (table 1). It further adds 7 points for interventions that are required to achieve the described condition.[6] Finally, the Combined Apgar has been tested and proven to be useful in two clinical trials in preterm and term infants.[6 7] As a consequence, there is no need for retirement of Apgar's 'imaginative idea' but for an integration of her score into the modern concept of supporting neonatal transition.

It took more than half a century to base the key part of neonatologist's work—management of the newborn infant in the delivery room—from an eminence-based to evidence-based science and to correct its concept from 'resuscitation' to 'support of transition'. As a consequence, the score to describe infant's condition and the philosophy of delivery room management and many of the subsequent recommendations are nowadays based on 'precise data' and sound evidence.

If an intervention is given, it is scored as 0, and if no intervention is administered, it is scored 1, resulting in a total between 0 points (all interventions are given) and 7 points (if no intervention is given). Infant's condition is scored independent of the intervention; for example, if infant's colour is pink, it is scored 2, even if oxygen is administered or if heart rate is above 100/min it is scored 2 and even if infant is receiving cardiac compression or drug administration. The Combined Apgar is given for instance as 7/10 (no intervention/excellent condition) or 0/10 (all intervention/excellent response).

REFERENCES

1. Apgar V. A Proposal for a new method of evaluation of the newborn infant. *Anesthesia & Analgesia* 1953;32:250–9.
2. O'Donnell CP, Kamlin CO, Davis PG, *et al*. Interobserver variability of the 5-minute Apgar score. *J Pediatr* 2006;149:486–9.
3. Lang JA, Pearson JT, Binder-Heschl C, *et al*. Increase in pulmonary blood flow at birth: role of oxygen and lung aeration. *J Physiol* 2016;594:1389–98.
4. Wyllie J, Bruinenberg J, Roehr CC, *et al*. European resuscitation council guidelines for resuscitation 2015: section 7. Resuscitation and support of transition of babies at birth. *Resuscitation* 2015;95:249–63.
5. Konstantelos D, Dinger J, Ifflaender S, *et al*. Analyzing video recorded support of postnatal transition in preterm infants following a c-section. *BMC Pregnancy Childbirth* 2016;16:246.
6. Rüdiger M, Braun N, Aranda J, *et al*. Neonatal assessment in the delivery room--Trial to Evaluate a Specified Type of Apgar (TEST-Apgar). *BMC Pediatr* 2015;15:18.
7. Dalili H, Sheikh M, Hardani AK, *et al*. Comparison of the combined versus conventional Apgar scores in predicting adverse neonatal outcomes. *PLoS One* 2016;11:e0149464–11.