Adding Science to the Decision to Extubate Children

David J. Murray, M.D.

Practitioners develop expertise in deciding when to extubate children through experience. The clinical acumen to make this decision is difficult to learn and is a skill that many consider more art than science. In this issue of Anesthesiology, Templeton *et al.* report the relationship between a number of clinical signs frequently used by practitioners to make a decision to extubate children and how these signs correlate with "success."[1] One of the most important contributions of the study is that by applying the signs selected for extubation "readiness," the less experienced practitioner could acquire the expertise in deciding when to extubate more quickly and with a lower frequency of, as this study reports, either the need for a "major" or "minor" airway intervention after extubation.[1] A second important finding of Templeton *et al.*'s study is that children who exhibited more of the selected clinical signs used to guide extubation had a greater likelihood of successful extubation, suggesting the utility of the cues selected by the authors to include in their study design. Finally, the study identified additional signs (elevated end-tidal carbon dioxide) and perioperative factors (upper respiratory infection and midazolam premedication) that, when present, impact extubation success.[1]

"[E]xpert judgments are challenging to study [objectively] because most decisions are based on an expert's ability to integrate their knowledge and experience in a timely manner."

Similar to the findings in many other clinical studies, there are numerous caveats that need to be considered when interpreting the study results and, more importantly, when applying the approach to clinical practice. The first and foremost is that the findings apply only to those children who were emerging from inhalation anesthesia and judged to be ready for extubaton. The study excluded children for whom the plan was to extubate deep before their emergence from anesthesia. The study also excluded children who received intravenous anesthetic techniques or a dose of Propofol in the period before emergence. The study is observational, and the perioperative anesthetic management was left to the discretion of the anesthesiologist. This led to variation in the use of midazolam premedication and the type, timing, and dose of narcotic administered during the procedure. The study also was limited to children who were less than 7 yr old, and a large proportion of those children were infants less than 1 yr of age (more than 30%). Despite these many study qualifications that could limit the application of the findings, infants and young children most commonly receive primarily volatile anesthesia and in this younger age group the decision to extubate is often based on clinical signs rather than the child's ability to respond to verbal stimuli.

More than 92% of the children met the author's definition of extubation success. These children required brief airway support (continuous positive airway pressure less than 30 s) and maintained an oxygen saturation greater than 92%. In a study that directed practitioner's attention to clinical signs of emergence, this extubation success rate might be better than that observed in practice settings when practitioners might not assess clinical criteria as thoroughly before extubation or be as attentive to apnea, breath-holding, and desaturation as this study required after extubation. The finding that 44 of the 600 children (7%) required an experienced practitioner to recognize and manage either apnea or breath-holding for an extended time period after extubation is not surprising. The study confirms that skill in airway management and vigilance are required in managing emergence.[2] The results reaffirm the need for advanced airway training for recovery room personnel, if extubation is to be deferred to postanesthesia care unit settings.[3]

The study design included nine signs that were evaluated before extubation. The clinical signs selected in the

Image: S. Suresh, Lurie Children's Hospital.

This editorial accompanies the article on p. 801.

Accepted for publication July 9, 2019. From the Division of Pediatric Anesthesiology, Department of Anesthesiology, Washington University School of Medicine, St. Louis, Missouri.

 Anesthesiology 2019; 131:769–70. DOI: 10.1097/ALN.0000000000002921

<zdoi;. DOI: 10.1097/ALN.0000000000002921>

study are time honored, and pediatric anesthesia practitioners around the world use similar signs or variants of these signs to determine extubation readiness. In general, the results indicate that the more signs that were present, the greater likelihood of success. Some signs often used in older children and adults, such as eye opening and purposeful movement, although predictive of success, were often not present at the time the decision was made to extubate. The relationship between many of the central nervous system events surrounding recovery from anesthesia, such as movement, purposeful movement, and eye opening, are being investigated using a combination of brain function monitoring, neuroimaging, and neural network research.[4] As this research continues to provide additional insight about the return of consciousness after anesthesia and the relationship of these clinical signs to consciousness, the potential exists to add considerably more scientific rigor to this decision-making process in the future.[4]

The authors are to be commended for studying one of the many judgments that practitioners are required to make during daily practice. These expert judgments are challenging to study because most decisions are based on an expert's ability to integrate their knowledge and experience in a timely manner. The article not only provides a more objective approach to this decision, but the findings provide insight into how many of these clinical signs sequentially return during anesthesia emergence. Although the study has numerous limitations, the results highlight the frequency and magnitude of the airway intervention that is often required after extubation and also suggest a safer path for determining the timing of pediatric extubation.

Competing Interests

The author is not supported by, nor maintains any financial interest in, any commercial activity that may be associated with the topic of this article.

Correspondence

Address correspondence to Dr. Murray: murrayd@wustl.edu

References

1. Templeton TW, Goenaga-Díaz EJ, Downard MG, McLouth CJ, Smith TE, Templeton LB, Pecorella SH, Hammon DE, O'Brien JJ, McLaughlin DH, Lawrence AE, Tennant PR, Ririe DG. Assessment of common criteria for awake extubation in infants and young children. Anesthesiology 2019; 131:801–8
2. Adler AC, Chandrakantan A: Nursing initiated tracheal extubation in PACU, the risk of delegating critical anesthesiology tasks in the interest of speed. Paediatr Anaesth 2017; 27:1165–6
3. Kako H, Corridore M, Seo S, Elmaraghy C, Lind M, Tobias JD: Tracheal extubation practices following adenotonsillectomy in children: Effects on operating room efficiency between two institutions. Paediatr Anaesth 2017; 27:591–5
4. Ranft A, Golkowski D, Kiel T, Riedl V, Kohl P, Rohrer G, Pientka J, Berger S, Thul A, Maurer M, Preibisch C, Zimmer C, Mashour GA, Kochs EF, Jordan D, Ilg R: Neural correlates of sevoflurane-induced unconsciousness identified by simultaneous functional magnetic resonance imaging and electroencephalography. Anesthesiology 2016; 125:861–72