The Simulation-derived Algorithm

A Better Method to Achieve a Performance Consensus

IN this issue of ANESTHESIOLOGY, Balki *et al.* introduce an algorithm for the unanticipated difficult airway in obstetric patients.[1] Their study methodology and results highlight how simulation can be used to develop a prospective expert consensus for managing events such as the unanticipated difficult maternal airway during caesarian delivery. The anesthesiologist and obstetric team must rapidly develop a plan to assure a successful outcome for mother and child when a difficult parturient airway is encountered during operative delivery. In their study, Balki *et al.* gather recommendations from a variety of sources to establish a consensus and develop a set of algorithms for managing the unanticipated difficult obstetric airway. In order to evaluate the algorithms, four scenarios were developed that recreated the clinical settings that would require anesthesiologists to apply the appropriate airway algorithm. The scenarios included not only the variations of "cannot intubate, cannot ventilate," but also the differences in maternal and fetal urgency that are often encountered in the difficult obstetric airway setting. These conditions included maternal and fetal emergencies such as prolapsed cord, placental abruption, and vasa previa, and a failed airway during an elective cesarian section. The scores obtained from 16 senior residents who manage each of the scenarios were analyzed to assess the quality of the scenarios and provide a measure of resident ability.

The study indicates how a simulation methodology can be used to develop and refine a set of algorithms that could be applied to advance safe anesthesia practice. Once a scenario is designed, subject matter experts must agree about how anesthesiologists should manage the scenario. This expert consensus establishes a prospective performance expectation for complex clinical events. Often this consensus demonstrates either the unanimity of expert opinion or the breadth of differences about how an anesthesiologist or healthcare professional should manage a critical condition. This approach assures that the scenario and the scenario score reflect management expectations for practice. From a learner's perspective, the advantages of this consensus are that the expectations for managing each scenario are relatively well defined with concise learning objectives.

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This expert consensus approach has been particularly useful in developing effective learning strategies for psychomotor skills (endoscopy, laparoscopy, central venous access, and ultrasound-guided procedures).[2,3] To develop a performance framework for training, experts divide the requisite skills into readily measured tasks. Content experts develop a skill acquisition paradigm that includes (1) the requisite preparation and processes needed to successfully perform a procedure; (2) the necessary (and unnecessary) steps; (3) a consensus about the timing, sequence, and details of each step; (4) the definitions for successful completion of each milestone; and (5) the types of errors and remedial steps in order to reduce the errors.

The ability to apply prospective expert opinion in determining how to manage complex critical events is perhaps one of the most essential advantages of simulation. This approach overcomes the hindsight bias introduced by the usual retrospective approach to developing management recommendations.[4]

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A simulation-based method can be used to identify the sequence of diagnostic, therapeutic, communication, and teamwork steps that are considered essential by the experts. When algorithms are based primarily on hindsight biases from retrospective processes (morbidity and mortality conferences, patient incident reporting systems, or malpractice reporting systems), the resulting management algorithm often trades the current exigent complication for other equally serious potential pitfalls in management.[4–6] One of the additional advantages of this prospective simulation approach is that the recommendations can be developed with attention to timing and sequence of each step in a real-time simulation environment. Finally, if experts are required to participate in managing the algorithm often, their inordinately high performance expectations can be modulated based on what an expert actually does rather than what the expert expects to observe in managing a crisis or indicates based on a retrospective review of the management decision.

What are the risks of such an approach? This approach works well when expectations are primarily related to performance of the individual in developing expertise in psychomotor skills or the initial recognition, diagnosis, and management of critical conditions. One of the concerns is that all of the nuances of teamwork may not be considered in the algorithm and the recommended path becomes fixed rather than a dynamic pathway. In the algorithms, Balki *et al.* include consultation with team members, but the importance of this "shared mental model" is potentially underestimated when following the algorithm.[7] Although expert anesthesia skills are required to manage the unanticipated difficult airway, team input from obstetric, neonatal, and nursing members is essential to effectively manage the associated risk to the infant and mother from the failed airway. The considerable variation in the severity of fetal risk from a prolapsed cord and maternal-fetal risk from placental abruption and vasa previa are important dynamic considerations that are key to the teamwork required in these situations. Simulation has been helpful in numerous other obstetric settings where this "shared mental model" of management is essential such as uterine rupture, placental accreta, uterine inversion, and shoulder dystocia.[8] There are a number of algorithms that could be developed to formulate realistic expectations that would be helpful in education and clinical care, and that more importantly could have a lasting impact on the safe care of patients. This important contribution by Balki *et al.* provides a methodological framework for using simulation in designing these algorithms for care.

David J. Murray, M.D., Howard and Joyce Wood Simulation Center and Department of Anesthesiology, Washington University School of Medicine, St. Louis, Missouri. murrayd@wustl.edu

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