Recent advances in difficult airway prediction and management

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As the Closed Claims database analyses have revealed, loss of airway access is a contributing factor in a significant proportion of anesthesia claims. The development of the ASA Difficult Airway Algorithm was an attempt to provide evidence-based guidance on the management of a challenging airway. Although the Difficult Airway Algorithm recognizes the crucial role of bag-mask ventilation as a rescue technique, the volume of published literature regarding bag-mask ventilation stands in stark contrast. Our field has historically focused on difficult intubation (defined as difficult laryngoscopy and/or excessive attempts), resulting in hundreds of manuscripts attempting to create the optimal set of preoperative evaluation tools to predict difficult intubation.

The study of mask ventilation is far more limited. The first significant manuscript focused on mask ventilation was published in 2000, several decades after the first difficult laryngoscopy manuscript. Langeron et al prospectively examined the preoperative clinical features associated with difficult mask ventilation (defined as a SpO2 < 92%, gas flows ≥ 15 L, no perceptible chest movement, two-provider mask ventilation, or change of provider necessary). In a well conducted study, they enrolled 1,502 patients and observed a 5% incidence of difficult mask ventilation. More importantly, they derived the first difficult mask ventilation prediction scale and identified five independent predictors of difficult mask ventilation: presence of a beard, BMI ≥ 26, edentulous dentition, age ≥ 55 years, and a history of snoring.

Unfortunately, the study of mask ventilation is limited by the absence of a standardized, validated definition. Some questioned the relatively high incidence of difficult mask ventilation observed in the Langeron analysis. At the University of Michigan, we derived a 4-point scale for the assessment of mask ventilation that went beyond the three grades used by Langeron: easy, difficult, and impossible. The four grades of ventilation are: 1: ventilated without oral airway; 2: ventilated with oral airway/adjuvant; 3: difficult ventilation characterized as unstable, inadequate, or requiring 2 providers despite oral airway/adjuvant; 4: unable to ventilate despite multiple providers or adjuvants. Using this more discriminating scale, we observed a 1.4% incidence of grade 3 mask ventilation and a 0.16% incidence of grade 4 mask ventilation. More importantly, we were able to evaluate more preoperative predictors using a prospective database of 22,000 patients and found that six elements were independent predictors of grade 3 mask ventilation: BMI ≥ 30, presence of beard, Mallampati III or IV, age ≥ 57 years, severely limited jaw protrusion, and a history of snoring.

Finally, a truly “outcome” driven airway assessment focuses not only on mask ventilation or laryngoscopy, but both. Several studies have demonstrated that difficult intubation and mask ventilation are associated with one another. However, many patients that are difficult to mask may be easy to intubate, and vice versa. As a result, a combined airway outcome of difficult intubation (grade 3 or 4 view or more than three attempts) combined with difficult mask ventilation (grade 3 or 4 mask ventilation) is what truly creates a difficult airway situation. A review of 46,819 general anesthetic episodes with documentation of a mask ventilation attempt and laryngoscopy revealed that 176 cases (0.38%) of patients demonstrated the combined
outcome. We observed eight significant independent predictors: Mallampati III or IV, severely limited jaw protrusion, male sex, limited thyromental distance, presence of teeth, BMI $\geq 31$, presence of beard, and a history of sleep apnea. The model had a compelling c-statistic of 0.84.

Just as airway prediction has advanced with a more holistic definition of the difficult airway, the study of airway management has evolved as well. Although indirect videolaryngoscopy techniques such as the Glidescope have gained significant support, their systematic evaluation beyond a few expert sites and users has been limited. Recent literature has demonstrated that although videolaryngoscopes offer significant value as an airway rescue device, they may not be the definite airway control device for all difficult airway situations. However, the use of a videolaryngoscope in a predefined airway algorithm allows management of the vast majority of difficult airways not already diverted to awake fiberoptic intubation.

In summary, the study of the difficult airway and management of the difficult airway have been at odds historically. By incorporating difficult mask ventilation prediction into an airway evaluation, one can improve the safety of airway management. The only modifiable preoperative risk factor is the presence of a beard.

References

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