AEJ ANESTHESIA EJOURNAL
Volume 7- No. 5 2019

Verification of Ventilation before Neuromuscular Blocker Administration during Anesthetic Induction and Endotracheal Tube Insertion in the Non-Rapid Sequence Induction Setting

Skyler Murdock, BSN, RN, RRNA

Abstract

Anatomically, the upper airway consists of the cartilaginous and bony structures of the nose and mouth, followed by the soft tissue of the oropharynx and laryngopharynx, and ending in the rigid trachea.[1] The soft tissue of the pharynx is prone to collapse in the unconscious, or anesthetized, patient and may be further compromised by obesity, a large tongue, airway edema, large neck circumference, external compression, and many other factors.[1,4] In response to this collapse, anesthesia professionals who plan to place an endotracheal tube have historically been instructed to refrain from administering muscle relaxation until adequate mask ventilation in the anesthetized patient was confirmed in order to both avoid a critical hypoxemic event, and to ensure an attempt at an escape wake up. However, there is little published evidence to support this practice, and the administration of muscle relaxation before ensuring adequate BVM ventilation remains controversial.[1-8]

Verification of Ventilation prior to Neuromuscular Blocker Administration during Anesthetic Induction

Skyler Murdock, BSN, RN, RRNA

Introduction

- Anesthesia providers who plan to place an endotracheal tube have historically been trained to refrain from administering muscle relaxation until adequate mask ventilation in the anesthetized patient was confirmed in order to both avoid a critical hypoxemic event, and to ensure an attempt at an escape wake up.
- Mask ventilation is an important skill and can be lifesaving in cases of difficult intubation.
- Just as positioning maneuvers, chin lifts, or airway devices can help overcome collapsed pharyngeal tissue, knowing when to administer an NMB can make the difference between a failed and a successful oxygenation attempt.
- There is little published evidence to support the practice of ensuring adequate mask ventilation before NMB adminstration.[1-8]

Case Summary

- A 67-year-old, 125 kg, 1.78 m, male presented adequately fasted for robotic prostatectomy.
- The patient's medical history included prostate cancer, hypertension, obesity (with a BMI of 39.5), chronic obstructive pulmonary disease (COPD), current smoker with a 28-pack year smoking history, obstructive sleep apnea (OSA), diabetes mellitus type 2, using a CPAP machine at night with a 2L oxygen (O_2) bleed in, 2 pillow orthopnea, and dyspnea on exertion with ~ 5 measure of exercise tolerance (METS).
- Mallampati class 3, 2 fingers breadth thyromental distance (TMD), upper lip bite test Class II, large and short neck, and decreased lung sounds. The patient was unable to lay supine and required 2L nasal cannula.
- Following anesthetic induction with fentanyl 100 mcg IV, lidocaine 100 mg IV, and propofol 200 mg IV., the initial bag valve mask (BVM) attempt in ramp position was unsuccessful. Oral airway insertion, APL adjustment, and two provider BVM ventilation resulted in a tidal volume of 100 mL and a SpO2 of 88%.
- Succinylcholine 200 mg was then administered and two provider BVM continued. After 30 seconds, the patient's tidal volume increased to 350 mL and the oxygen saturation returned to 98%.

Table 3. Techniques for Difficult Airway Management

Techniques for Difficult Intubation	Techniques for Difficult Ventilation
Alternative laryngoscope blades	Esophageal tracheal Combitube
Awake intubation	Intratracheal jet stylet
Blind intubation (oral or nasal)	Laryngeal mask airway
Fiberoptic intubation	Oral and nasopharyngeal airways
Intubating stylet or tube changer	Rigid ventilating bronchoscope
Laryngeal mask airway as an intubating conduit	Invasive airway access
Light wand	Transtracheal jet ventilation
Retrograde intubation	Two-person mask ventilation
Invasive airway access	

This table displays commonly cited techniques. It is not a comprehensive list. The order of presentation is alphabetical and does not imply preference for a given technique or sequence of use. Combinations of techniques may be employed. The techniques chosen by the practitioner in a particular case will depend upon specific needs, preferences, skills, and clinical constraints.

Professional Opinion

•When given an emergency scenario of a difficult BVM attempt, 89% of survey respondents reported that they would administer a NMB in order to improve ventilation efforts.[3]

- Anesthesia professionals who verify ventilation before administering a NMB are establishing relevant, but not instrumental, anesthetic induction information.[3]
- Use of this relevant, but not instrumental, information may have benefit postoperatively.
  - May provide evidence of the support needed after a deep extubation, or during recovery in the post anesthesia care unit.
  - However, post intubation laryngeal edema may occur in up to 30% of patients, resulting in a postsurgical airway that is different from the presurgical airway.[12]

•National audit Project of the Royal College of Anaesthetists and the Difficult Airway Society:

- "Where facemask or laryngeal mask anaesthesia is complicated by failed ventilation and increasing hypoxia the anaesthetist should consider early administration of further anaesthetic agent and/or a muscle relaxant to exclude and treat laryngospasm…..no anaesthetist should allow airway obstruction and hypoxia to develop to the stage where an emergency surgical airway is necessary without having administered a muscle relaxant." [9]

Controlled Trial

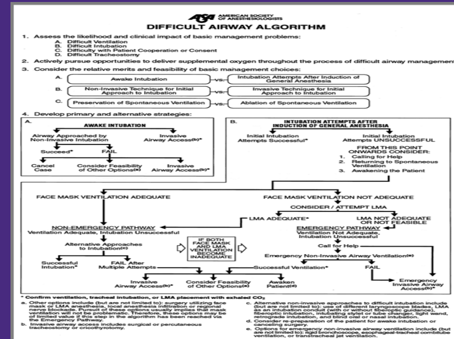
•Ventilation was performed 30 seconds after the patient became nonresponsive to eyelash stimulation.[5] A non-blinded anesthesia professional then administered either rocuronium 0.6 mg/kg or 0.9% saline, and repeat ventilation was performed 2 minutes later.[5]

- BVM ventilation scores were significantly better in the group that received rocuronium.[5]
- Amongst patients who had initially difficult BVM ventilation scores, the improvement in BVM ventilation was even more pronounced.[5]

Propofol

•Anesthetic induction dose of propofol will have respiratory depression effects that last 8-11 minutes.[10, 16]

- Adequate preoxygenation in patients of normal weight resulted in a < 90% SpO2 desaturation time of 6.06 minutes, and obese patients desaturated in 2.72 minutes.[11]
- As such, the likelihood of returning to adequate spontaneous ventilation before a decrease in SpO2, in a patient under the influence of an induction dose of propofol, is small.[1,4,6]



Paralytics and Suggamadex

•Testing BVM adequacy before NMB administration may aid the anesthesia provider in deciding which NMB agent to use for an intubation attempt if suggamadex is not readily available.

•Even though no publications exist to support this type of scenario, it is possible that NMB administration will not improve BVM attempts and create a much more serious situation of cannot intubate cannot ventilate.

•Succinylcholine has a duration of action similar to propofol, of 5-10 minutes depending on the dose used.[10, 14, 16]

- Succinylcholine is metabolized by pseudocholinesterase, and it is estimated that an atypical pseudocholinesterase phenotype may occur as often as 1 in 480 (heterozygous phenotype) to 1 in 3,200 (homozygous phenotype) people.[15]
- An unknown atypical phenotype may result in a can't intubate can't ventilate (CICV) scenario in a patient who does not have the ability to recover from the paralytic before a hypoxic event occurs.

•Suggamadex 16 mg/kg reliably reverses the paralytic effect of a 1.2 mg/kg dose of rocuronium in about 4.5 minutes, faster than the typical offset of the neuromuscular blocking effects of a standard dose of succinylcholine.[16]

- While Suggamadex will rapidly and reliably reverse the effects or rocuronium or vecuronium, the choice and timing of anesthetic induction agent may preclude return of adequate spontaneous ventilation.[16]
- Neuromuscular reversal in the setting of a collapsed airway may result in negative pressure pulmonary edema, and worsen patient outcomes.[16]

Difficult Airway Algorithm

•The algorithm does not address the timing of NMB administration.

•In a case of difficult BVM, excessive BVM ventilation attempts, which may occur while following the difficult airway algorithm, may waste valuable functional residual capacity (FRC) or result in increased intragastric pressure predisposing the patient to an aspiration event.

- Early NMB administration has potential to prevent increases in intragastric pressure and may preserve FRC for an intubation attempt.

•Incidence of laryngospasm is 0.78-5%. [17]

- Administering an NMB medication from the start of induction would rule out a potential laryngospasm and may allow faster diagnoses of other airway complications in a more timely manner.

Conclusion

- No anesthetic airway plan is assured to work every time, but a review of available evidence demonstrates that NMB administration is often part of the solution to a difficult BVM oxygenation attempt.[4,6]
- The immediate goal after delivering a non-RSI anesthetic induction should be to optimize oxygenation.[4] Optimization of oxygenation may include the use of BVM, endotracheal tube or laryngeal mask placement; all of which have been demonstrated to be made easier by NMB administration.[4]
- If verification of ventilation before NMB administration was essential to patient safety, then all patients needing a rapid sequence induction would require an awake fiberoptic intubation.[6]
- The difficult airway algorithm advises that an airway exam should be performed in all patients.[13] This alone is one of the best indicators of a difficult airway, and along with any history of a difficult airway, should serve as the basis for selection of induction and airway management technique.

Recommendations

- Administering an NMB during induction, with the proper reversal agent readily available, should not theoretically alter an escape wake up plan.
- While assessing bag mask ventilation prior to administering a neuromuscular blocker may provide information relevant to the entire perioperative airway management event, additional research is needed to further delineate in exactly which situations it is most appropriate to assess ventilation versus proceeding immediately with neuromuscular blockade.

References

1. Saddawi-Konefka DS, Hung SL, Kacmarek RM, Jiang, Y. Optimizing mask ventilation: literature review and development of a conceptual framework. *Respiratory care*. 2015;60(12):1834-1840.
2. Joffe AM, Ramaiah R, Donahue E, Galgon RE, Thilen SR, Spiekerman CF, Bhananker SM. Ventilation by mask before and after the administration of neuromuscular blockade: a pragmatic non-inferiority trial. *BMC anesthesiol*. 2015;15:134. PMID 26444853.
3. Broomhead RH, Marks RJ, Ayton MP. Confirmations of the ability to ventilate by facemask before administration of neuromuscular blocker: a non-instrumental piece of information? *British Journal of Anaesthesia*. 2010;104(3):313-317
4. Patel A. Facemask ventilation before or after neuromuscular blocking drugs: where are we now? *Anaesthesia*. 2014;69:801-815.
5. Warters RD, Szabo TA, Spinale FG, DeSantis SM, Reves JG. The effect of neuromuscular blockade on mask ventilation. *Anaesthesia*. 2011;66:163-167.
6. Priebe H. Ventilation before paralysis. *Anesthesiology*. 2013;4(118):992-993.
7. Patel A, Pearce A. Progress in management of the obstructed airway. *Anaesthesia* 2011;66:93-100.
8. Calder I, Yentis SM. Could 'safe practice' be compromising safe practice? Should anaesthetists have to demonstrate that face mask ventilation is possible before giving a neuromuscular blocker? *Anaesthesia*. 2008; 63:113-5
9. Frerk C, Pearce A. Induction and maintenance of anaesthesia. In: Cook T, Woodall N, Frerk C, eds. 4th National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Major Complications of Airway Management in the United Kingdom. London: RCoA, 2011: 55–61.
10. 10. Thomas BF, Parks LJ. Propofol. *Statpearls*. 2018. https://www.ncbi.nlm.nih.gov/books/NBK430884/
11. Jense HG, Dubin SA, Silverstein PI, O'Leary-Escolas U. Effect of obesity on safe duration of apnoea in anesthetized humans. *Anesth Analg* 1991; 72: 89–93
12. Wittekamp BH, VanMook WN, Tjan DH, Zwaveling JH, Bergmans DC. Clinical review: post-extubation laryngeal edema and extubation failure in critically ill adult paitents. *Crit Care*. 2009;13(6):233.
13. Apfelbaum, JL, Hagberg CA, Caplan RA, Blitt CD, et al. Practice guidelines for management of the difficult airway: an updated report by the American society of anesthesiologists task force on management of difficult airway. *Anesthesiology*. 2013;118:251-270.
14. Kpman AF, Zhaku B, Lai KS. The "intubating dose" of succinylcholine: the effect of decreasing doses on recovery time. *Anesthesiology*. 2003;99(5):1050-1054.
15. Pseudocholinesterase deficiency. U.S. National Library of Medicine. Genetic home reference. https://ghr.nlm.nih.gov/condition/pseudocholinesterase-deficiency#statistics
16. Naguib M, Brewer L, LaPierre C, Kopman AF, Johnson KB. The myth of rescue reversal in "can't intubate, can't ventilate" scenarios. *Anesth Analg*. 2016;123(1):82-92.
17. Mevorach DL. The management and treatment of recurrent postoperative laryngospasm. *Anaesth Analg* 1996;83:1110-1111.