Use of a Positive Pressure Endoscopic Mask to Assist With Positive Pressure Ventilation in a Morbidly Obese Patient During Fiberoptic Intubation: A Case Report

Dewi De Jarnett, CRNA

Airway management in the morbidly obese, anesthetized patient can be especially challenging. Difficulties in fiberoptic intubation (FOI) can be experienced due to alterations in airway anatomy associated with morbid obesity and the effects of anesthesia. The loss of upper airway muscle tone that occurs during anesthesia compromises the structure of the pharynx, causing a tendency toward airway collapse. This collapsibility can prevent the identification of anatomical structures during FOI, making this advanced airway technique difficult or impossible. The application of positive pressure via endoscopic mask ventilation during FOI can help to stent open collapsible airways and reestablish airway anatomy in morbidly obese patients. Although drawbacks exist, the endoscopic mask may be most effective at accomplishing this goal.

Keywords: Airway stenting, endoscopic mask, fiberoptic intubation, morbid obesity, positive pressure ventilation.

Obesity is defined as a more than 20% increase above ideal body weight, and a corresponding body mass index (BMI) of 28 for men, and 27 for women. Obesity is a worldwide epidemic. Doubling since 1980, current rates reflect 1.5 billion adults and 43 million children. The prevalence of morbid obesity (BMI > 40) is rising faster than obesity with an estimated 1 in 20 Americans being affected. Morbid obesity carries a greater risk of comorbidities, having negative effects on the respiratory, cardiovascular, and metabolic systems. The incidence of morbidity with anesthesia is high in the morbidly obese population, partly because associated syndromes such as obstructive sleep apnea (OSA) introduce significant challenges in airway management for the anesthesia practitioner during the pre- and postoperative period when the airway is most vulnerable to anesthetics. Alterations in upper airway anatomy, and possibly neural control, cause a susceptibility to airway collapse during anesthesia. This collapsibility can make anatomical structures difficult to identify during fiberoptic intubation, removing the key prerequisite for successful intubation when using this advanced airway technique. Over the years, aides to fiberoptic intubation (FOI) have been developed that have significantly improved successful use of this technique. Airway adjuncts, such as the intubating oral airway, have gained popularity and a permanent residence on many difficult-airway carts. Other less popular aides are underutilized, likely because of equipment unfamiliarity. Mastery of airway management is an expectation of the anesthesia practitioner. The utilization of alternative intubation techniques and devices is mandatory, especially during FOI when other alternatives have been exhausted.

This case report spotlights the use of the Patil-Syracuse endoscopic mask as an aide to FOI that helped to reestablish an adequate view of the airway anatomy in a morbidly obese patient using positive pressure ventilation (PPV).

Case Summary
A 48-year-old 111 kg, morbidly obese female with a BMI of 42 presented for laparoscopic gastric bypass surgery under general anesthesia. Comorbidities included hypertension, hyperlipidemia, depression, and OSA. The patient reported occasional use of a continuous positive airway pressure (CPAP) mask at night. There was no history of heartburn or reflux disease. Current medications included metoprolol, oxcarbazepine, fluoxetine, valsartan, aspirin and simvastatin. The first three medications were taken on the day of surgery. Extensive cosmetic dental work was discovered during assessment of the airway, with caps noted to the upper front teeth. Other concerning airway findings were very large breasts and a large tongue. Only the soft palate and the base of the uvula were visualized, meriting a Mallampati 3 classification. The thyromental distance, neck range of motion, and mouth opening were all within normal limits. After review of previous anesthesia records that described prior intubations to be “easy” with a Cormack and Lehane laryngeal view of grade 1, asleep fiberoptic intubation was ultimately elected. (The Cormack and Lehane is a broad description of laryngeal views during direct laryngoscopy. The vocal cords are visible in class I.)
The patient was transported to the operating room after the administration of midazolam 2 mg IV in the holding room. Preinduction vital signs included oxygen saturation of 99%. Preoxygenation and denitrogenation with an \( \text{FiO}_2 \) of 1.0 occurred for a full 5 minutes prior to induction. A smooth intravenous induction was performed with fentanyl 100 µg, lidocaine 100 mg, propofol 200 mg, and succinylcholine 100 mg for optimal intubating conditions. Easy mask ventilation was established using an intubating oral airway prior to administration of a neuromuscular relaxant. A lubricated flexible fiberoptic bronchoscope (FOB) was inserted orally, and the identification of pertinent anatomical airway structures was not possible. A second attempt, incorporating a jaw lift to optimize view, was met with similar difficulty. Oxygen saturation remained 100% throughout both attempts. The patient was manually ventilated by face mask with an \( \text{FiO}_2 \) of 1.0 for approximately 1 minute until the face mask could be exchanged for the endoscopic mask. Easy mask ventilation was established with the endoscopic mask; oxygen saturation remained stable at 100%. A lubricated flexible FOB was inserted through the sealed diaphragm of the mask and directed orally into the pharynx. PPV was delivered manually with tidal volumes between 450-550 cc, and peak airway pressures between 15-20 cm H\(_2\)O. The FOB was placed into the trachea where airway anatomy was easily identified during PPV. The airway anatomy became unidentifiable during expiration as the structure of the pharynx collapsed. Upon timed visualization of vocal cords corresponding with the delivery of breath, a 7.0 mm cuffed oral endotracheal tube (ETT) was advanced using the FOB as a guide. Confirmation of correct placement was confirmed using bilateral chest rise, positive end-tidal CO\(_2\), condensation present in the ETT, and auscultation of bilateral, equal breath sounds. The ETT was then secured in place.

**Discussion**

The upper airway framework is bone, cartilage, and soft tissue making it dynamic and subject to collapse when exposed to anesthesia.\(^5\) The soft tissue of the pharynx is not supported by bone or cartilage and is prone to collapse during anesthesia, creating the potential for difficulties in airway maintenance for the anesthetist. Inhibition of cortical responses causes depression of the chemoreceptor response and mechanoreceptor input during anesthesia, contributing to decreased upper airway muscle tone and neural activity.\(^5,6\) The effect of anesthesia on the upper airway is more pronounced in the obese patient, who has a higher propensity for airway collapse due to an already narrow pharyngeal lumen.\(^5\) Narrow airways are more prone to collapse due in part to Laplace’s law, which requires a greater expanding force to oppose collapse within a small radius.\(^5\) PPV can serve as this expanding force, stenting open collapsible airways during anesthesia. Intubating conditions were improved for this morbidly obese patient with OSA after the application of PPV via the endoscopic mask, revealing airway anatomy essential for FOI.

The stenting effect of CPAP on collapsible airways in the morbidly obese patient with OSA is well-known; however, research examining the benefits of CPAP or PPV during FOI is limited. CPAP is the most effective treatment for OSA, delivering positive pressure to maintain upper airway patency during repeated occlusion during sleep.\(^7\) Practice guidelines set forth by the American Society of Anesthesiologists (ASA) task force for the management of patients with OSA recommend “postoperative use of continuous positive airway pressure to patients who were using it preoperatively, unless contraindicated by the surgical procedure.”\(^8\) Meier et al.\(^9\) investigated the effect of CPAP on the size of the glottic opening and stridor score when combined with chin lift and jaw thrust in children. An airway endoscopic mask and a partially closed adjustable pressure release valve were used to deliver CPAP of 10 cm H\(_2\)O. Fiberoptic visualization revealed that the use of CPAP worked as a pneumatic splint, “stiffening the pharynx and making it less susceptible to collapse.”\(^5\) The splinting effects achieved with PPV may be as useful to FOI as CPAP can be for the OSA patient. To further investigate the benefits of PPV, FOI was performed on a randomly chosen, consenting adult patient. Although this patient, with a BMI of 26 and no history of OSA, differed from the original case study patient, PPV appeared to optimize FOI conditions when compared to images recorded without the application of PPV. As in the original case report patient, an increase in airway diameter during the application of PPV was demonstrated. The visibility of airway structures improved with each delivered tidal volume. The splinting effect of PPV during FOI improved visibility of airway anatomy in both patients, illustrating its potential value during airway collapse.

There are several devices capable of delivering PPV during FOI, some more effective than others. Aoyama et al.\(^10\) utilized PPV during FOI in healthy adults to compare the laryngeal mask airway (LMA) and the intubating laryngeal mask airway (ILMA) with endoscopy mask techniques. They concluded that the ability to deliver PPV during FOI with the endoscopic mask was superior to that with the LMA or LMA. Delivery of tidal volume was greatest with the endoscopic mask due to the sealed diaphragm that permits introduction of an FOB into the airway without a loss of seal.\(^10\) Lower tidal volumes were delivered through the LMA and ILMA during FOI due to lack of seal between the endotracheal tube and the laryngeal mask. PPV was easily established during FOI utilizing the endoscopic mask in this case report patient, demonstrating the efficient seal that is characteristic to
the mask. Rogers and Benumof found that the Patil-Syracuse endoscopic mask allowed for effective, uninterrupted PPV during FOI in 25 adult patients who either had a history of difficult intubation or were determined to be difficult based on preoperative assessment. 

Although the benefits of PPV during FOI seem promising, legitimate drawbacks of the endoscopic mask exist. The potential for gastric insufflation of air during the delivery of PPV may place patients at increased risk for vomiting and aspiration. Not only complicates FOI, but also can be detrimental to patient outcome. Caution in patient selection should be exercised to minimize this risk; this technique may not be appropriate for all patients. Published reports dating back to the 1980s identify incidents of foreign body aspiration while using the endoscopic mask. A 1986 case described the discovery of mask parts found in the pharynx of a patient intubated fiberoptically using the mask. Another case from 1991 warned about the potential for foreign body aspiration with this apparatus. The diaphragm covering the port that accepts the FOB was found to be the source in both cases, leaving behind diaphragm fragments in the airway. Instructions for the care and maintenance of the mask specify careful inspection of the silicone diaphragm, as this material is prone to break down. The manufacturer of the Patil-Syracuse mask suggests that the diaphragm be cleaned separately with soap and water to maintain its integrity and prevent the breakdown of the silicone material. Adverse events such as these have damaged the mask’s reputation, leaving practitioners questioning its usefulness and many others unaware of its existence.

Practice guidelines set forth by the ASA task force for management of the difficult airway are intended to reduce adverse outcomes during intubation. Although not named in the difficult airway algorithm, the Patil-Syracuse endoscopic mask may prove to be effective in a can ventilate, cannot intubate situation where FOB fails. The ability to identify anatomical landmarks is essential for successful FOI. Because of the stenting effect on the collapsible upper airway provided by PPV using the endoscopic mask, airway anatomy was reestablished and FOI was successful in this morbidly obese patient. As rates of morbid obesity and OSA occur with increasing prevalence, the potential for difficult airway emergencies during anesthesia also increases. The stenting effects of PPV when applied to collapsible airways may make all of the difference in visibility when seconds matter and difficult airway algorithm options have been exhausted. PPV during FOI may serve as a worthy topic of discussion, or perhaps one for further research.

REFERENCES


AUTHOR

Dewi De Jarnett, CRNA, was a student at Midwestern University College of Health Sciences in Glendale, Arizona, obtaining student registered nurse anesthetist clinical training at Tampa General Hospital when this case report was written. Email: dewidrop@yahoo.com.

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