

# Special REPORT

## Enhanced Direct Laryngoscopy: *Managing Routine and Difficult Airways Using the McGRATH MAC EDL*

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**F**or decades, direct laryngoscopy has been the most commonly used technique for tracheal intubation.<sup>1-3</sup> The introduction of video laryngoscopy in 2002 offered advantages over traditional direct laryngoscopy, including improved airway visualization; the ability to watch the endotracheal tube (ETT) pass through the vocal cords in real time; better coordination between laryngoscope operator/teacher and assistant through the use of an external monitor; and minimization of head or neck manipulation.<sup>4,5</sup> Most recently, enhanced direct laryngoscopy was introduced as a new approach that combines the familiarity of direct laryngoscopy with the advantages of video laryngoscopy for use in both routine and difficult airway management.

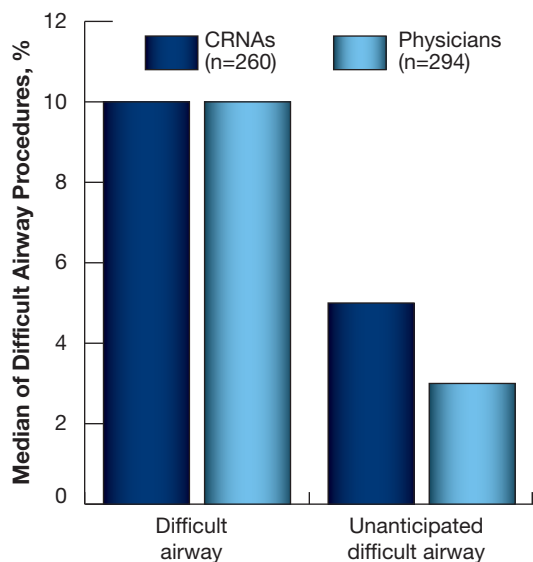
Although the American Society of Anesthesiologists (ASA) practice guidelines acknowledge that no standard definition of a “difficult airway” exists, there are a variety of factors that suggest its presence on a preoperative airway examination, including a prominent overbite, highly arched or narrow palate, a short thick neck with relatively limited range of motion, and lack of uvula visibility.<sup>6</sup> Data on the actual prevalence of a difficult airway in clinical practice are limited; however, a recent survey of 570 anesthesiologists and certified registered nurse anesthetists provides some context on the issue.<sup>7</sup> Overall, the median percentage of difficult laryngoscopic procedures reported in the survey was 10%, with approximately 4% classified as unanticipated difficult laryngoscopies (Figure 1).<sup>7</sup> With an estimated

21 million laryngoscopic procedures occurring annually in the United States, these results translate to approximately 2.1 million difficult and 840,000 unanticipated difficult laryngoscopies each year.<sup>7</sup> Enhanced direct laryngoscopy may be particularly useful in difficult airway cases. However, the McGRATH<sup>®</sup> MAC enhanced direct laryngoscope (EDL) is equally useful in all intubations.

### Benefits of Enhanced Direct Laryngoscopy With the McGRATH MAC EDL

In addition to facilitating endotracheal intubation via conventional direct laryngoscopy, enhanced direct laryngoscopy also provides a means for successful video laryngoscopy. According to the 2013 ASA practice guidelines for management of the difficult airway, video laryngoscopy is associated with an increased number of successful intubations, improved laryngeal views, and more successful first-attempt intubations than direct laryngoscopy among patients with predicted or simulated difficult airways.<sup>6</sup> Typical everyday intubation procedures, as well as predicted and unanticipated difficult laryngoscopic procedures, may be effectively performed with enhanced direct laryngoscopy without the need to switch back and forth between separate direct and video laryngoscopes during intubation.

Enhanced direct laryngoscopy with the McGRATH MAC EDL offers other advantages in the operating room (OR) setting beyond versatility in procedural approach and enhanced airway visualization, including portability, agility, durability, intuitiveness, training capability, and dental-friendly characteristics.<sup>4,8</sup>



**Figure 1.** Prevalence of difficult and unanticipated difficult airways.

CRNA, certified registered nurse anesthetist  
Based on reference 7.

The device is compact and cable-free, which allows for maximum portability between operating rooms if needed.<sup>8</sup> Additionally, the development of the slim X blade<sup>™</sup> increases the agility of laryngoscopy with the McGRATH MAC EDL by extending the range and clinical application of the device beyond routine and moderately difficult airways.<sup>9</sup> Its acute anterior curvature and slim blade profile may be of particular benefit in these challenging airways.<sup>9</sup>

The use of standard curved Macintosh blades also supports the intuitiveness of the McGRATH MAC EDL for the novice operator.<sup>8</sup> This feature, along with the external monitor, also is important when training other clinicians on a variety of intubation procedures—routine to difficult—in the OR.

Dental injuries during intubation procedures are not uncommon, particularly in patients with a difficult airway.<sup>10,11</sup> The McGRATH MAC EDL slim blade profile improves access and reduces dental contact.<sup>12</sup>

### Considerations for Disposable Versus Reusable Laryngoscope Blades

An issue of continued debate in clinical airway management is the use of disposable versus reusable laryngoscope blades. Considerations include risk for communicable diseases and cost concerns.<sup>13-15</sup> During intubation, laryngoscope blades may be exposed to potentially infectious material, which may result in cross-contamination.<sup>13,14</sup> The Healthcare Infection Control Practices Advisory Committee (HICPAC) of the Centers for Disease Control and Prevention (CDC) classifies laryngoscope blades as “semicritical” items.<sup>16</sup> As such,

**Table.** Cormack-Lehane Classification System

Grade	Description	Frequency, %	Likelihood of Difficult Airway, %
1	Full view of glottis	68	<1
2a	Partial view of glottis	24	4.3
2b	Only posterior extremity of glottis seen or only arytenoid cartilages	6.5	67.4
3	Only epiglottis seen, none of glottis seen	1.2	87.5
4	Neither glottis nor epiglottis seen	Very rare	Very likely

Adapted from reference 20.

laryngoscope blades must be sterilized or subjected to high-level disinfection before reuse per the Joint Commission.<sup>14,17</sup> Although the Joint Commission does not specifically recommend disposable over reusable laryngoscope blades, the American Association of Nurse Anesthetists (AANA) does recommend their use to prevent the spread of nosocomial infections whenever possible.<sup>18</sup>

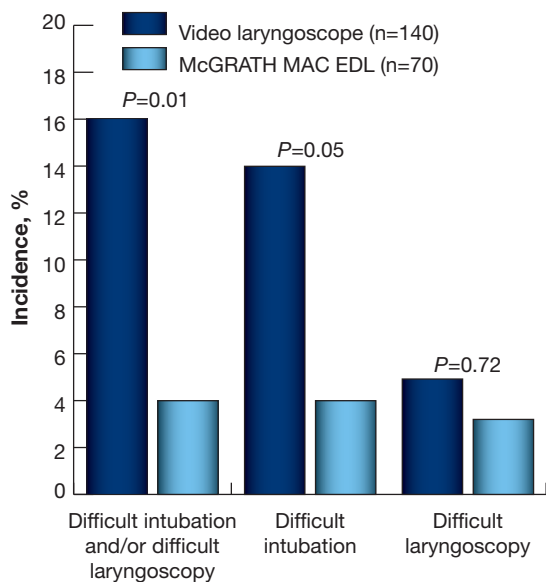
In a cost-conscious environment, there are additional concerns regarding the use of disposable versus reusable laryngoscope blades. These include cleaning, sterilization, and potential hospital-acquired infection costs.<sup>15</sup> Southeast Health, a regional health care services system based in Missouri, evaluated product quality and financial impact issues regarding reusable versus single-use laryngoscopes, and concluded that institution-wide implementation of disposable laryngoscopes offered improved patient care, a reduced risk for cross-contamination, increased intubation success rates, and fewer reprocessing expenses.<sup>15</sup> Southeast Health found that the reprocessing costs alone for reusable laryngoscopes were much higher than the cost of a disposable laryngoscope (\$17.12/intubation), and this cost increased significantly if only one hospital-acquired infection occurred to \$27.40 per intubation.<sup>15</sup>

Enhanced direct laryngoscopy with the McGrATH MAC EDL mitigates these issues by using sterile-packaged, single-patient/disposable blades that eliminate cross-contamination risk and potentially reduce intubation-related costs for institutions.<sup>8,15</sup> Additionally, the screen and handle of the McGrATH MAC EDL are fully immersible for high-level disinfection and compatible with current vaporized hydrogen peroxide sterilization systems.<sup>8</sup>

## Clinical Evidence Using the McGrATH MAC EDL

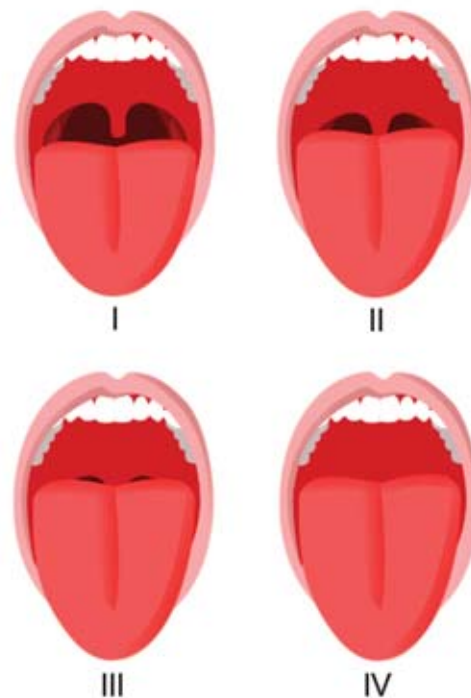
De Jong and colleagues recently compared the McGrATH MAC EDL with a standard Macintosh laryngoscope for intubation in critically ill patients.<sup>19</sup> This prospective, interventional, before-after, comparative study was conducted on 206 adult, non-pregnant patients in a single 16-bed medical-surgical intensive care unit (ICU) setting.<sup>19</sup> The study included both non-interventional and interventional phases separated by a 6-week training period.<sup>19</sup> In the non-interventional “before” phase, patients were intubated with a standard Macintosh laryngoscope (ie, the control group). Clinicians underwent 6 weeks of training on the use of the McGrATH MAC EDL with the aid of 2 manikins. After the training period, all intubations were performed using the McGrATH MAC EDL. The primary outcome was the incidence of difficult laryngoscopy (defined as a Cormack-Lehane grade 3 or 4; Table) and/or intubation (defined as  $\geq 3$  attempts).<sup>19,20</sup> Secondary outcomes included mild to moderate and severe, life-threatening intubation-related complications, the rate of difficult intubation in cases of predicted difficult intubation, the number of intubation attempts first-attempt success rate, glottis view, and difficult intubation and laryngoscopy.<sup>19</sup>

During the study, a total of 210 intubations were performed in 206 patients; 140 occurred during the non-interventional phase and 70 in the interventional phase with the McGrATH MAC EDL.<sup>19</sup> Baseline characteristics of patients and laryngoscope operators were generally comparable between the groups. At a planned interim analysis, the study was terminated

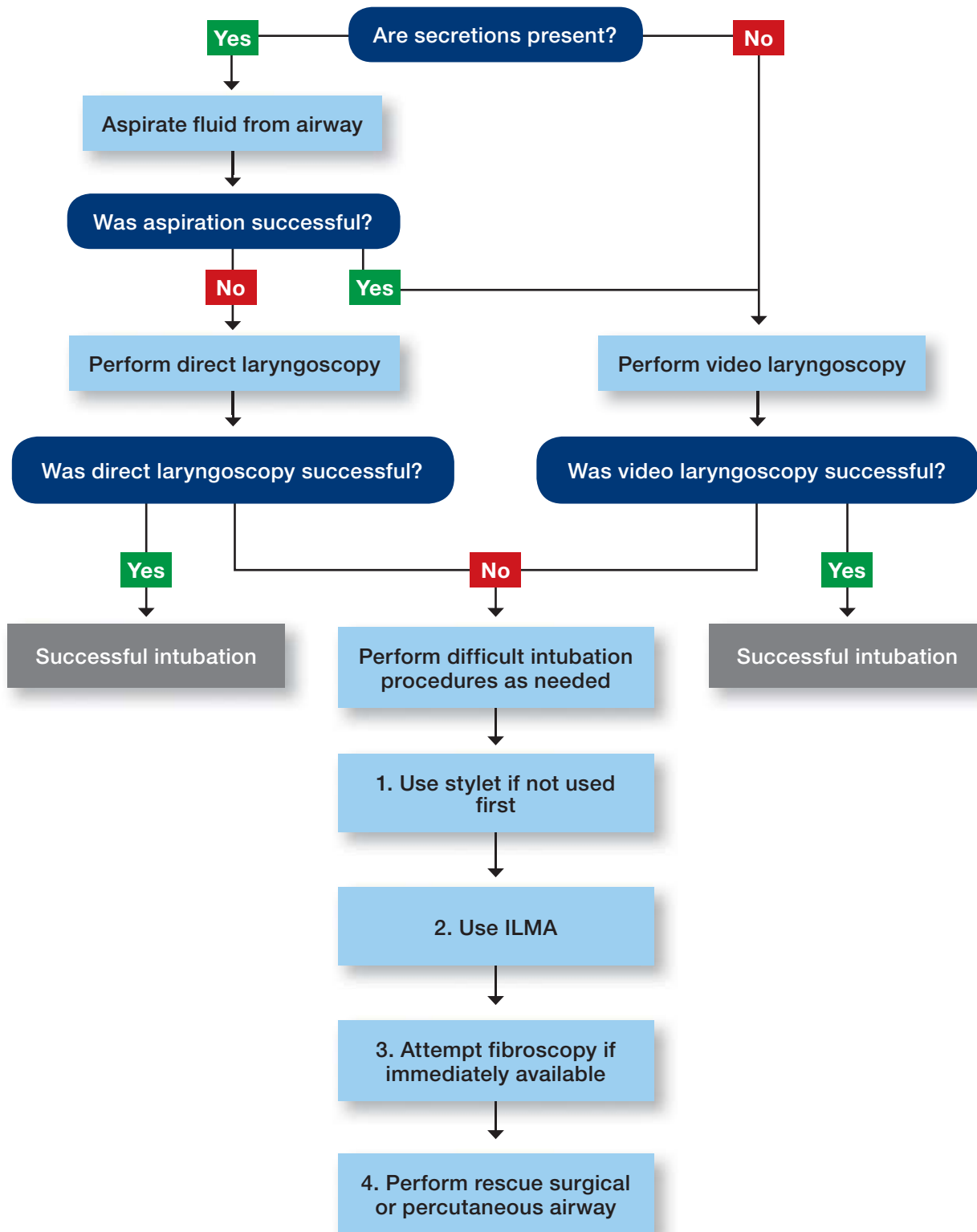


**Figure 2.** Incidence of difficult laryngoscopy and/or difficult intubation in the McGrATH MAC EDL and control groups.

Based on De Jong A, et al. Implementation of a combo videolaryngoscope for intubation in critically ill patients: a before-after comparative study. *Intensive Care Med.* 2013;39(12):2144-2152. Reprinted with permission.



**Figure 3.** Mallampati class scores.



**Figure 4.** Airway management algorithm using the McGRATH MAC EDL.

**ILMA**, intubating laryngeal mask airway  
Adapted from reference 19.

early because the McGRATH MAC EDL group had a significantly lower incidence of difficult laryngoscopy and/or intubation than the control group (4% vs 16%;  $P=0.01$ ; Figure 2).<sup>19</sup>

The rate of severe, life-threatening and mild to moderate intubation-related complications was similar between the groups and there were no reports of airway injury.<sup>19</sup> The groups also were comparable with regard to median number of intubation attempts (1 in each group;  $P=0.09$ ) and first-attempt success rate (69% in the Macintosh group vs 79% in the McGRATH MAC EDL group;  $P=0.13$ ).<sup>19</sup> Among the 32 patients with a predicted difficult intubation (ie, Mallampati score of class III, coma, hypoxemia, and operator not an anesthesiologist; Figure 3), actual difficult intubation occurred significantly more frequently in the standard Macintosh group than the McGRATH MAC EDL group (57% vs 0%;  $P<0.01$ ).<sup>19</sup> The McGRATH MAC EDL was used as a direct laryngoscope in 17 patients (24%) and as a video laryngoscope in 53 patients (76%).<sup>19</sup> Operators deemed to be “non-experts” with the McGRATH MAC EDL were more likely to use the device as a direct laryngoscope compared with expert operators, and no other intubation devices were required in the McGRATH MAC EDL group, whereas stylets and fiberoptic scopes were used in the Macintosh group.<sup>19</sup>

Based on these results, the authors concluded that enhanced direct laryngoscopy with the McGRATH MAC EDL was associated with a significant reduction in difficult laryngoscopy and/or difficult intubation.<sup>19</sup>

## Developing an Airway Management Strategy Using the McGRATH MAC EDL

According to the 2013 ASA guidelines, clinicians should complete an airway evaluation prior to an initial intubation attempt whenever possible.<sup>6</sup> The evaluation should include an airway history and a physical examination to identify a potentially difficult airway.<sup>6</sup> The ASA guidelines also recommend that clinicians should have a “preformulated” intubation strategy, particularly for patients with a difficult airway.<sup>6</sup> For patients without secretions, and those with secretions who are successfully aspirated, video laryngoscopy may be considered as the initial approach. If aspiration is unsuccessful for patients with secretions, then direct laryngoscopy may be considered (Figure 4).<sup>19</sup> Enhanced direct laryngoscopy with the McGRATH MAC EDL allows the clinician to perform either procedure without switching devices.

### Conclusion

Enhanced direct laryngoscopy with the McGRATH MAC EDL offers many advantages to clinicians, including direct and video laryngoscopy capabilities, as well as educational opportunities for training new clinicians. Additionally, the disposable nature of the McGRATH MAC EDL blades may decrease the risk for communicable diseases, improve intubation success rates, and reduce institutional costs associated with reusable blades.

## Case Study 1

### A 63-Year-Old Man With Known Cervical Myelopathy Scheduled for an Elective Multilevel Anterior Cervical Discectomy With Corpectomy and Fusion

**W. Bradley Worthington, MD**

**T**he patient’s medical history was significant for stable coronary artery disease, status post 3-vessel coronary artery bypass grafting, morbid obesity (BMI, 39), stable but long-standing insulin-dependent diabetes mellitus, stable essential hypertension, severe obstructive sleep apnea treated with continuous positive airway pressure (CPAP), and supraventricular tachycardia status post-ablation. Except for significant cervical myelopathy with upper- and lower-extremity objective weakness and urinary retention, the patient’s treating physicians determined his medical status to be stable.

The preoperative screening phone call revealed a past history of difficult intubation, resulting in the termination and abandonment of one elective surgical procedure requiring endotracheal intubation with a subsequent elective cardiac surgical procedure requiring awake fiber-optic nasal intubation. These records were requested for review, and per standard policy, the patient was scheduled for a preoperative evaluation several days prior to surgery. A preoperative airway exam revealed a normal upper incisor length, a slight overbite, an inter-incisor distance of approximately 4 cm, an inability to visualize the uvula with the mouth opened and the cervical spine neutral, a thyromental distance of less than 3 fingerbreadths, and a short and thick neck. A range-of-motion examination of the cervical spine was deferred.

The anesthetic plan included difficult airway precautions with our emergency airway cart available prior to induction

and immediate availability of a surgeon able to establish a surgical airway if needed. Additionally, the surgeon requested intraoperative neurophysiologic monitoring with testing prior to and post intubation. The patient was informed of the plan, and consent was obtained for the surgical procedure scheduled for 3 days after the preoperative visit. On the day of surgery, the patient was given standard multimodal preemptive analgesia and postoperative nausea and vomiting prophylaxis—as well as intranasal oxymetazoline. The patient was brought to the OR and transferred in a supine position with the cervical spine in a neutral position. Routine noninvasive blood pressure, electrocardiogram lead 2 and V5, pulse oximetry, and bispectral index (BIS) values were established while the patient was preoxygenated.

Anesthesia was induced with propofol, ketamine, and lidocaine. A 30-mm nasal trumpet with a proximal 8-mm adapter was inserted into the right nostril, and allowed manual positive pressure ventilation and adequate oxygenation. Baseline, pre-intubation, somatosensory, and cortical motor evoked potentials were acquired. Vecuronium bromide 0.6 mg/kg was administered while the patient was ventilated with 100% oxygen and 2% sevoflurane. The patient remained hemodynamically stable and ventilation was easy. When the BIS value reached 70 and neuromuscular junction monitoring showed a fade in train-of-four response to stimulation, the patient was prepared for intubation.



Using the McGRATH MAC EDL with a size 3 blade, the vocal cords were easily and rapidly visualized. A 7.5 internal diameter ETT with stylet was inserted easily past the vocal cords 3 cm, breath sounds were equal bilaterally, ETT position was confirmed with continuous ET<sub>CO</sub><sub>2</sub> waveform monitoring and secured. The patient underwent an uneventful 3-level anterior cervical discectomy with corpectomy with instrumented fusion. At completion of the operation, neuromuscular blockade was reversed with neostigmine and glycopyrrolate. After prompt return of spontaneous ventilation and a BIS value greater than 80, the patient was extubated, breathing spontaneously, neurologically intact, and following commands. After an uneventful recovery and 23-hour observation, the patient was discharged home.

## Case Commentary

This case shows that use of video laryngoscopy has proven to be beneficial and has decreased adverse airway events and morbidity. In addition to simplifying care for patients with a known difficult airway history, the technology has proven invaluable in patients with unpredicted difficult visualization after initial standard laryngoscopy. In these clinical situations, the immediate availability of the McGRATH MAC EDL at each anesthetizing location in my institution has allowed the anesthesia team to safely and quickly establish tracheal intubation and help decrease the significant complications that may arise from repeated attempts of standard laryngoscopy.

## Case Study 2

### A 29-Year-Old Morbidly Obese Woman With a Lost Airway and Acute Aspiration of Gastric Contents During Induction for Planned Arthroscopy

**Charese Pelham, MD**

**T**he patient's history showed a body mass index greater than 50 kg/m<sup>2</sup>. Her airway indicated a Mallampati score class III with a thyromental distance of less than 3 fingerbreadths (Figure 3). She denied having any comorbidities, such as gastroesophageal reflux disease and obstructive sleep apnea.

The anesthetic plan included general anesthesia with a laryngeal mask airway (LMA). Prior to transport to the OR, the patient was given midazolam 2 mg IV for anxiolysis and amnesia. The patient was placed in a supine position with a foam headrest, and was induced with fentanyl 100 mcg IV, lidocaine 100 mg IV, and propofol 150 mg IV. Immediately on induction, the patient vomited and aspirated green bilious gastric contents. Suction was applied quickly. The anesthesiologist attempted intubation with a Macintosh 3 laryngoscope with a grade 4 view (Table). The view was further obliterated by gastric contents in the oropharynx. The anesthesiologist switched to a video laryngoscope, but was unsuccessful in visualizing the cords or arytenoids. Attempts with an LMA and bag/valve/mask ventilation were unsuccessful. The patient's pulse oximetry was in the 50% range and dropping.

A second anesthesiologist arrived. Because the external auditory canal was far below the sternal notch, HELP (head elevated laryngoscopy position) was requested to further optimize the view. However, because of the dangerously low pulse oximetry, and despite a non-optimal position, another intubation attempt was made prior to HELP being established.

The oropharynx was suctioned, and a McGRATH MAC EDL with a size 4 disposable blade was used. This provided an immediate grade 1 view, with the lower half of the vocal cords and arytenoids noted (Table).<sup>20</sup> Intubation required only a slight clockwise rotation of the ETT, and was successful as evidenced by a positive ET<sub>CO</sub><sub>2</sub> in the 70% range, chest rise and fall, rise of pulse oximetry, and bilateral distant breath sounds. Ventilation was initially difficult, with large amounts of gastric contents in the ETT. Suction resulted in improved compliance, but it was still difficult to ventilate. Discussion ensued as to whether the tube was tracheal or esophageal. Oxygen saturation remained below the 90% range due to the

patient's aspiration of gastric contents in the upper bronchi.

The anesthesiologist of record requested a surgeon consult for tracheostomy. The second anesthesiologist and the surgeon resisted this procedure because the patient had a very disadvantageous body habitus for attempting a cricothyrotomy, and her oxygen saturation levels were returning closer to baseline. A third anesthesiologist arrived and confirmed that the tube was in the trachea, but slightly too deep.

The third anesthesiologist requested that the surgeon remove some air from the ETT cuff. This request was misunderstood and the entire cuff was torn off, necessitating a complete tube change. Because the patient was known to have a difficult airway, the decision was made to change the ETT using the "tube exchanger" technique. Accordingly, a tube exchanger was inserted into the ETT to remove the damaged tube and replace it with a new one. The new ETT was suctioned again. After multiple suctionings, the airway cleared, oxygen saturation levels returned to the 90s, and the patient finally was easily ventilated.

Initially, there was concern about the possibility of a hypoxic brain injury or patient awareness under anesthesia after successful intubation and reoxygenation. Accordingly, the patient received midazolam 2 mg IV for amnesic effect and a BIS<sup>TM</sup> monitor was applied. The monitor produced a reading in the low 60s, which correlates with a low probability of recall and unresponsiveness to verbal stimulus.<sup>21</sup> The patient's blood pressure and pulse were within normal limits. The patient was trying to "over-breathe" into the vent. The patient was allowed to awaken briefly to follow verbal commands, with the BIS value returning to the 90s, then immediately was sedated again with midazolam. The BIS value was taken down to below 60.

The patient remained intubated in the ICU for 24 hours with a pulmonologist managing the ventilator. Fortunately, the patient did not develop any signs of acute respiratory distress syndrome, and was safely extubated and discharged. The patient denied recall of intraoperative events, and did not display signs or symptoms of hypoxic brain injury at time of discharge. The patient rescheduled the knee arthroscopy for a later date.

## Case Study 3

### A 45-Year-Old Morbidly Obese Man With a Massive Rotator Cuff Tear

David Krhovsky, MD

The patient's height was 1.78 m and his weight was 166 kg. His medical history was significant for hypertension, asthma, and smoking. During the preanesthesia interview and assessment, the patient was asked about difficulties with previous anesthetics, including airway issues, which he denied. He was able to open his mouth widely, and appeared to have adequate neck extension. Despite the patient's morbid obesity, it appeared there would be no problems securing his airway. He did have a wet cough, but auscultation of his lungs revealed no wheezing. As a preventive measure, the patient was asked to self-administer 2 to 3 puffs from his inhaler before leaving the preoperative holding area.

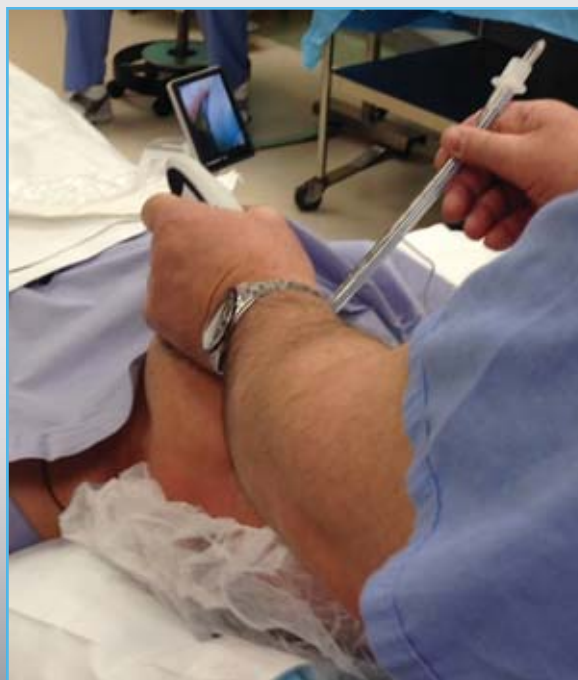
The patient agreed to an anesthetic plan consisting of general endotracheal anesthesia with a preoperative brachial plexus block for postoperative pain control. After successful placement of the block, the patient was transported to the OR and moved to the operating table. He was preoxygenated for several minutes, after which induction was carried out with fentanyl 150 mcg, propofol 200 mg, and succinylcholine 120 mg. The plan included spraying his trachea with lidocaine, using a laryngotracheal anesthesia (LTA) device.

After administering succinylcholine, laryngoscopy was performed using a McGRATH MAC EDL (Figure 5). It was possible to visualize the vocal cords without difficulty, but maneuvering the LTA device into the trachea proved challenging. Fortunately, the styletied ETT passed easily and was secured without incident. The remainder of the rotator cuff repair was uneventful, as was the anesthetic. The patient was allowed to breathe spontaneously after he had fully recovered from the muscle relaxants. At the conclusion of the operation, the patient was transported to the postanesthesia care unit (PACU) with his ETT in place. Because of his morbid obesity, he was not extubated until he was fully awake. Extubation was carried out eventually without incident, and the remainder of his stay in the PACU was similarly uneventful.

#### Case Commentary

The anesthetic induction and securing of the airway was carried out uneventfully, due in large part to the McGRATH MAC EDL. It is an effective laryngoscope for all intubations, regardless of the level of difficulty, for several reasons. First, it is user-friendly and allows one to become proficient quickly.

This is especially helpful when a truly difficult intubation is encountered. Second, it is a compact device that is transported easily. Third, having a screen attached to the handle is more ergonomic and intuitive than devices with separate screens. The screen produces a sharp, clear image that has the advantage of being visible not only to the operator, but also to others who are assisting, or to students and residents who are in training. In addition to its practicality, the McGRATH MAC EDL is cost-effective enough to be used for every intubation that takes place in the OR.



**Figure 5.** The McGRATH MAC EDL provides direct and indirect visualization using a single device that does not require a remote screen.

## An Anesthesiologist's Clinical Perspective

David Leggett, MD

Having been somewhat underwhelmed with the performance of the first-generation McGRATH video laryngoscope, it quickly became apparent that the McGRATH MAC EDL represented a substantial redesign.

Initially, I reserved the McGRATH MAC EDL for airways that

I assessed as being mildly to moderately difficult. These were patients whom I felt could likely be intubated with a standard laryngoscope, but necessitated a greater degree of provider proficiency. In fairly short order, I expanded the device's use to encompass any patient with significant anterior cosmetic

dental work, poor anterior dentition, and where documentation of limited cervical extension would be beneficial such as cervical disk herniation. This less-than-exclusive cohort resulted in more frequent use of the McGRATH MAC EDL.

With increased use, I became more aware of secondary ergonomic benefits. Being 6 ft 5 in tall and having worn corrective lenses for decades, my prescription has required the use of progressive bifocals to facilitate near vision when reading. Consequently, during intubation I must either bend forward or raise the operating table to substantial heights, and then decide “glasses on or off.” At times, it can be challenging to position my line of sight for optimal focus. The McGRATH MAC EDL eliminated this situation entirely. I intubate patients at roughly waist level while standing erect. Even with the relatively small screen, I have no difficulty viewing the image from this position.

This combination of ergonomics and improved first-pass intubations in mildly to moderately difficult airways has led me, over time, to adopt the McGRATH MAC EDL as my first-line choice for intubation. In my current practice, approximately 80% to 90% of intubations are done with this device. In a cursory review of

the literature showing several studies that consistently demonstrate advantages for video laryngoscopy versus standard direct laryngoscopy, I have found the general conclusions to be correct with regard to the McGRATH MAC EDL: The device is intuitive; the learning curve is small; it is durable; and most importantly, it is effective. My failure rate with the McGRATH MAC EDL is quite low, with only 2 instances of a failed intubation—one of these required fiberoptic intubation.

At my hospitals, all costs come under close scrutiny. The McGRATH MAC EDL is substantially less costly than the GlideScope device, as are the disposable blades.<sup>22</sup> As any administrator will tell you, costs are a valid and important concern; but as any physician will tell you, they are not the only concern. As more clinicians obtain hands-on experience, the usage will expand, and demand for video laryngoscopes will continue to increase. This technology can make intubation faster, smoother, and less traumatic—it is here to stay. The McGRATH MAC EDL is a well-designed and reliable implementation of the video laryngoscope concept, and I expect to use mine for years to come.

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Disclosures: Dr. Krhovsky reported that he is the chief medical officer for SunMed. Drs. Leggett, Pelham, and Worthington reported no relevant disclosures.

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