Preoperative Endoscopic Airway Examination (PEAE) Provides Superior Airway Information and May Reduce the Use of Unnecessary Awake Intubation

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BACKGROUND: Development of a perioperative plan for management of patients with airway pathology is a challenge for the anesthesiologist. Lack of comprehensive information regarding the architecture of airway lesions often leads the clinician to consider techniques of awake intubation (AI) to avoid catastrophic outcomes in this population. In one uncontrolled trial, endoscopic visualization of the airway lesion was included in the preoperative anesthetic assessment for planning of airway management. We sought to determine whether visual inspection of airway pathology would change the anesthesiologist's approach to the management of these patients.

METHODS: Patients presenting for elective diagnostic or therapeutic airway procedures were included in the study. After a standard examination of the airway, a management plan was recorded. Before entering the operating room, and after brief preparation of the nares with a vasoconstrictor and local anesthetic, the patients underwent a preoperative endoscopic airway examination (PEAE) and a final airway management plan was recorded and implemented. Four or more months after the procedure, video recordings of the PEAE were reviewed without other patient identifiers and a remote PEAE plan was recorded, to test for operator bias.

RESULTS: One hundred thirty-eight patients were studied. Although AI was initially planned in 44 patients, only 16 of these patients underwent preinduction airway control after PEAE ($P > 0.05$). Additionally, of the 94 patients for whom the initial plan was airway control after the induction of anesthesia, 8 patients were found to have unexpectedly severe airway pathology on PEAE, and also underwent AI. There was no significant difference between the post-PEAE airway management plan and the remote plan recorded 4 or more months later.

CONCLUSIONS: In 26% of the patients studied, PEAE affected the planned airway management. We believe that PEAE can be an essential component of the preoperative assessment of patients with airway pathology; airway visualization reduces the number of unnecessary AIs while providing superior information about the airway architecture. PEAE could be applied to other populations of patients at risk for airway control failure with the induction of anesthesia. (Anesth Analg 2010;X:●●●–●●●)

Patients with known or suspected upper airway pathology who present for elective diagnostic or therapeutic procedures may pose a particular challenge to the anesthesiologist. The potential for lesions of the base of tongue, epiglottis, glottic aperture, or larynx to interfere with tracheal intubation or facemask ventilation may not be fully appreciated during standard airway examination. These anatomic structures are not typically visualized during a preoperative examination, and clinical signs and symptoms may be unreliable indicators of the significance of these lesions.[1] Conversely, some patients may have undergone prior surgical procedures or radiation therapy that renders their routine airway examination consistent with difficult direct laryngoscopy (DL), yet they may not have intra-airway lesions that prevent safe facemask or other manner of supraglottic ventilation, and subsequent intubation with an alternative technique. The anesthesiologist responsible for the care of these patients may lack sufficient information to choose the safest sequence of anesthetic induction and airway management, or the appropriate instrumentation to avoid airway failure. The American Society of Anesthesiologists' Task Force on the Difficult Airway encourages the use of awake intubation (AI) when the anesthesiologist determines that there is a significant risk for loss of control of the airway during the anesthetic induction.[2] When sufficient information regarding the potential for airway obstruction is not available, AI may be the safest management choice.[3] However, unnecessary or overuse of AI can be time- and resource-consuming compared with tracheal intubation after routine anesthetic induction.[4]

Moorthy et al.[1] described a 10-year experience with upper airway endoscopic examination of patients with laryngeal tumors presenting for general anesthesia. Nearly 50% of their 801 patients underwent AI based on the combined findings of medical history and standard physical and endoscopic examinations. Because this study was not controlled, it cannot be determined whether preoperative endoscopy itself changed clinician behavior or increased patient safety.

We hypothesized that in patients with upper airway pathology, visualization of the airway anatomy by preoperative endoscopic airway evaluation (PEAE) would affect

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Accepted for publication August 31, 2010.

Disclosure: The authors report no conflicts of interest.

Reprints will not be available from the author.

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DOI: 10.1213/ANE.0b013e3181fdfc1c

Table 1. Inclusion Criteria, History, and Standard Airway Examination

Inclusion criteria
ASA classification I–IV
Age ≥18 y
Procedure: elective direct laryngoscopy and/or biopsy with/without other airway procedure
Exclusion criteria
Disease of the bilateral nasal passages
Coagulopathy
At risk of gastric contents aspiration
Recorded history
Age
Gender
Height and weight
History of snoring
History of gastroesophageal reflux
History of airway surgery or radiation
History of airway management events
Standard physical examination
Thyromental distance
Sternomental distance
Interincisor gap
Cervical range of motion
Oropharyngeal view
Temporomandibular joint translation
Dental condition

anesthesiologists' management by facilitating the decision to proceed with routine anesthetic induction or AI. This finding would be particularly important in a population of same-day surgery patients undergoing brief laryngoscopy and biopsy procedures in which the unnecessary use of AI could delay a demanding operating room (OR) schedule.

METHODS

Patients were enrolled in the study in accordance with the protocol approved by the Yale-New Haven Hospital Human Investigation Committee. Informed, written consent was obtained on the day of surgery. One hundred forty patients, ASA physical status I to IV were enrolled. Recruited patients were those presenting for elective surgery of the upper airway, including patients scheduled for DL for therapeutic or diagnostic purposes. Exclusion criteria included age younger than 18 years, pathology of the bilateral nasal passages (e.g., chronic epistaxis, bilateral congenital or acquired obstruction not relieved by decongestants), coagulation disorders, or a significant risk for aspiration of gastric contents (Table 1).

Information regarding the patient's age, gender, height, weight, history of snoring, gastroesophageal reflux symptoms, as well as previous airway pathology and/or airway management events (e.g., difficult intubation, if known) and postintubation symptoms consistent with a prior episode of difficult airway management (e.g., postoperative jaw soreness, dental trauma, soft tissue injury) were collected from the medical records and patient interview. A standard examination of the airway was performed and recorded, which included the thyromental distance, sternomental distance, interincisor gap, degree of maximal neck/occipital extension, Samsoon and Young oropharyngeal view, ability to prognath the mandible, and the condition of incisor dentition[2,5] (Table 1).

After collecting the above information, the attending anesthesiologist recorded a clinically derived airway management plan (Clinical decision-Awake or Clinical decision-Induced). The clinician also recorded the device to be used during tracheal intubation. For the purposes of the study, the choice of devices was limited to either a rigid DL or video laryngoscope (DL/VL), or a flexible fiberoptic intubating bronchoscope (FOB).

If the patient had previously undergone flexible nasopharyngoscopy by an otolaryngologist, he or she was asked to rate the discomfort experienced during the most recent examination using a numeric scale of 0 (no discomfort) to 10 (extreme discomfort). Subjects received nasal oxymetazoline (1 spray each nostril) in the OR holding area. Topical anesthesia was accomplished using 100 mg of 5% lidocaine ointment applied to 2 swabs that were inserted into the nares. The swabs were advanced to the nasopharynx gradually over 3 minutes.

Before entering the OR, PEAE was performed. With the patient in a semirecumbent position (head of bed raised 15–30 degrees), a 65-cm-long, 3.7-mm-diameter FOB (Karl Storz Endovision, Culver City, CA) fitted with a camera was advanced into 1 naris. The FOB was advanced until the proximal tip of the epiglottis could be identified. The FOB was then maneuvered to visualize the vallecula and vocal cords. Rotation of the FOB was used to achieve images of the right and left pyriform sinuses. The patient was asked to vocalize during the true cord visualization. All PEAEs were video recorded and number coded. At the end of the PEAE, the patient was again asked to rate the examination discomfort.

All PEAEs were performed by the attending anesthesiologist assigned to the surgical procedure, who noted the presence or absence of the following findings: (1) a single-plane optical path to the laryngeal inlet, (2) a mass or other anatomic distortion that might prevent correct seating of a supraglottic airway (SGA) device, and (3) an anterior airway lesion that could be traumatized by DL/VL. After the endoscopy, the attending anesthesiologist recorded a PEAE airway management plan that included the patient's state of consciousness (PEAE-Awake or PEAE-Induced) and the device to be used during tracheal intubation (DL/VL or FOB). The patient was moved to the OR where the attending anesthesiologist applied the airway plan for tracheal intubation. Delayed OR entry (in minutes) was calculated based on the room-ready time recorded on the electronic patient-flow system (NaviCare; Hill-Rom, Batesville, IN). The success or failure of the airway management efforts was recorded.

At a later time, chosen to be at least 4 months after the presentation of any patient to the OR, the video record of the PEAE and the clinical information were reviewed without accessing other patient identifiers. The video record reviewer was blind to the Clinical decision plan or PEAE plan. Again, an airway plan was recorded.

The occurrence of a change in the airway management plan, influenced by PEAE, was the primary outcome measure of this study. Secondary outcome measures included patient comfort with PEAE (as compared with prior endoscopies) and OR delays caused by the examination.

Table 2. Anatomic Location (or Other Cause) of Surgical Interest

Location	No. of subjects
Vocal cord/subglottic larynx	48
Base of tongue	27
Supraglottic larynx (not epiglottis)	14
Floor of mouth	8
Epiglottis	8
Anterior tongue	5
Dysphagia	4
Tonsil	3
Mandible	3
Parapharyngeal	3
Other	15

All data were analyzed using SPSS for Windows, Version 15.0 (SPSS, Chicago, IL). χ^2 tests or Fisher exact tests were used to test for change in intubation plan and change in intubation plan by gender, location of anatomic lesion, hospital admission status (outpatient versus same-day admission), standard airway examination indexes, history of airway procedures, and head extension. The *t* tests were used to test for change in intubation plan by age, thyromental distance, interincisor gap, and Samsoon and Young score. Wilcoxon signed rank test (nonparametric paired *t* test) was used to test the difference in PEAE discomfort scores.

RESULTS

One hundred thirty-eight patients were included in the study analysis. Care of these patients was distributed among 7 anesthesiologists. Two patients were removed from analysis because of incomplete data. The mean age was 59 years (range, 38–79 years), the mean body mass index was 26.8 kg/m^2 (range, 14.8–36.3 kg/m^2), and 74% were males (n = 103). The indication for surgery included lesions of the larynx/vocal cords (35%), base of tongue (19%), supraglottis (10%), and other lesions (36%) (Table 2). Eighty-one patients (58%) had a history of radiation and/or surgery of the neck or airway. The surgical procedures undertaken included laryngoscopy and soft tissue neck dissection (14%), laryngoscopy with biopsy (52%), laryngeal surgery (12%), and/or tongue-base surgery (9%).

After reviewing the patient's history and completing a standard airway examination, the attending anesthesiologist indicated a Clinical decision-Awake intubation plan in 32% (n = 44), and a Clinical decision-Induced intubation plan in 68% (n = 94) of the cases. The device chosen to be used for intubation included DL/VL in 56% (n = 77) and FOB in 43% (n = 60) of cases. In 1 patient, severe airway distortion led to the Clinical decision-Awake intubation choice, with use of a minimally invasive surgical technique (retrograde wire-guided tracheal intubation).

After PEAE, the airway management plan was changed in 26% (n = 36, $P < 0.05$) of cases, either from Clinical decision-Awake to PEAE-Induced (n = 28) or from Clinical decision-Induced to PEAE-Awake (n = 8) (Figs. 1 and 2). There was no significant change in the intubation device chosen to be used. The remote and PEAE plan assignments differed in 2 of 138 patients (P = 0.416).

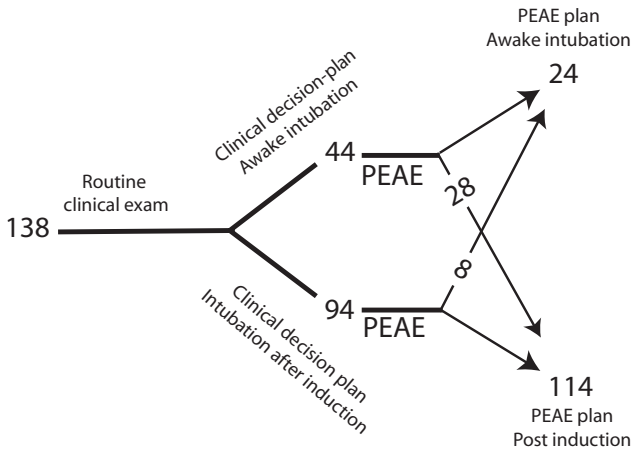

Figure 1. Of the 138 patients included in the analysis, standard airway examination resulted in a clinical decision to pursue awake intubation in 44 patients and induced airway management in 94 patients. After preoperative endoscopic airway evaluation (PEAE), 24 patients were managed with awake intubation and 114 patients were managed with anesthetic induction followed by tracheal intubation.

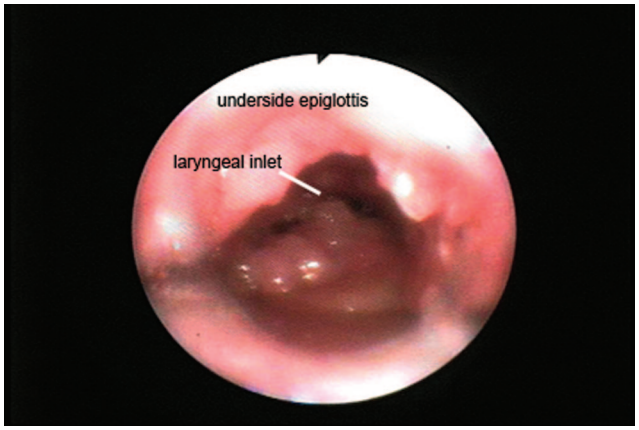

Figure 2. Still image from the preoperative endoscopic airway examination (PEAE) of patient 128. This patient with familial polyposis had no change in symptoms or standard airway examination when compared with prior presentations. On past presentations, the anesthetizing team reported no visual obstruction of the airway during direct laryngoscopy. After standard airway examination, a Clinical decision-Induced plan was recorded. This patient underwent awake intubation (PEAE-Awake plan recorded) after PEAE.

Table 3 lists the historical, symptomatic, and physical findings that were associated with the Clinical decision-Awake versus Clinical decision-Induced groups and those whose plan was changed after PEAE from Awake to Induced. No significant results are provided on those whose plan was changed after PEAE from Induced to Awake, because there were only 8 patients in this group. Regarding the Clinical decision, those with an Awake plan were more likely to have a history of major airway surgery, be scheduled for a same-day/in-house admission, be older, have a smaller thyromental distance and interincisor gap, a head extension of ≤35 degrees, and a higher Samsoon and Young score compared with those with a Clinical decision-Induced plan. Regarding the post-PEAE decision, those with an Awake plan were more likely to have a higher Samsoon and Young score compared with those with an

Table 3. Clinical and Historical Findings Associated with the Clinical Decision Plan Choice and Change in Plan Post-PEAE from Awake Intubation to Induced Management

	Clinical decision			
	Awake (n = 44)	**Induced (n = 94)**	**Results**	***P* value**
History major airway surgery	33 (75.0%)	48 (51.1%)	$\chi^2 = 7.083$	0.008
Admission				
Same day/in-house	30 (68.2%)	45 (47.9%)	$\chi^2 = 4.983$	0.026
Outpatients	14 (31.8%)	49 (52.1%)		
Age (y)	64.02 (10.8)	56.66 (10.9)	$t = 3.700$	<0.001
Thyromental distance (cm)	6.328 (1.3)	6.922 (1.5)	$t = -2.196$	0.030
Head extension (degrees)				
≤35	16 (38.1%)	18 (19.1%)	$\chi^2 = 5.558$	0.018
>35	26 (61.9%)	76 (80.9%)		
Interincisor gap (cm)	3.963 (1.4)	4.769 (0.9)	$t = -3.438$	<0.001
Samsoon and Young score	Higher grade		$t = 4.413$	<0.001
	Change in plan from Clinical decision-Awake to PEAE-Induced			
	Change in plan (n = 110)	**No change in plan (n = 28)**		
History major airway surgery	59 (53.6%)	22 (78.6%)	$\chi^2 = 5.724$	0.017
Admission				
Same day/in-house	54 (49.1%)	21 (75.0%)	$\chi^2 = 6.039$	0.014
Outpatient	56 (50.9%)	7 (25.0%)		
Age (y)	57.58 (10.7)	64.61 (12.3)	$t = -2.998$	0.003
Interincisor gap	4.615 (1.1)	4.111 (1.2)	$t = 2.029$	0.044
Samsoon and Young score	2.21 (0.8)	2.79 (0.8)	$t = -3.132$	0.002

Data are n (%) or mean (SD). The results of χ^2 analysis, Fisher exact test (P value), and t tests are given as appropriate.
PEAE = preoperative endoscopic airway examination.

Induced plan. Finally, those whose plan was changed from Clinical decision-Awake to PEAE-Induced were more likely to have a history of major airway surgery, be scheduled for same-day/in-house admission, be older, have a shorter interincisor gap, and have a higher Samsoon and Young score compared with those whose plan did not change from Clinical decision-Awake to PEAE-Induced.

The patients' discomfort scores during PEAE were decreased as compared with their previous office-based examination (2.5 vs 4.9, $P < 0.05$).

In 114 of 138 cases, the PEAE procedure was completed before the OR had been readied for the surgical procedure. In the remaining 24 cases, PEAE delayed room entry by no more than 3 minutes.

At no time during this study was an emergent airway situation encountered. All tracheal intubations were accomplished in accordance with the PEAE plan, without episodes of oxyhemoglobin desaturation or need to change the recorded airway device.

DISCUSSION

The search for anatomic correlates and causes of difficult tracheal intubation has historically focused on findings associated with the failure of DL. As techniques of glottic visualization evolve (e.g., with the incorporation of indirect imaging technology), traditional airway measures or indexes may become less important to airway management practice.[6] But despite the success of these newer instruments in situations in which DL has, or is predicted to fail, pathology in the "invisible" upper airway (i.e., at and below the level of the oral pharynx) may impede successful airway control with any instrument. Although many patients with known airway lesions will eventually be managed with routine anesthetic induction, the uncertain architecture of their airway anatomy, and therefore the potential for a catastrophic outcome, should infer an airway failure risk when they are initially evaluated.[3] According to the American Society for Anesthesiologists' Task Force on the Difficult Airway, AI should be considered in these cases.[2] Obviously, AI techniques in all patients who harbor an undefined risk for obstruction would unnecessarily draw on resources (equipment, personnel, and OR time), and cause discomfort in some patients. This would be especially disruptive in the ambulatory surgery setting, where a large number of patients may present for short diagnostic procedures of the upper airway.

Flexible nasal-endoscopy is a procedure frequently performed by otolaryngologists during a presurgical evaluation and may be accomplished with little or no patient preparation, monitoring, or discomfort.[7] Unfortunately, the report of the otolaryngologist's preoperative examination may be inadequate for use by the anesthesiologists: the presurgical evaluation may have occurred weeks before the OR visit, and a rapidly changing lesion may become a previously unappreciated obstacle. Additionally, the otolaryngologist might not consider the anesthesiologist's use of supraglottic ventilation, or DL and indirect laryngoscopy techniques of tracheal intubation.

Because flexible indirect laryngoscopic examination of the upper airway is a technique familiar to the anesthesiologist, and the equipment is widely available, we sought to evaluate the clinical impact of PEAE on airway management decisions in the otolaryngology patient.[1,4,7] When approached as a diagnostic (as opposed to a therapeutic) maneuver, airway endoscopy can be performed rapidly and requires little or no patient preparation.[7] Moorthy et al.[1] incorporated routine endoscopy into their examination of patients presenting with upper airway pathology over a

10-year period. Although these clinicians reviewed historical, physical examination, imaging, and other laboratory information, their airway management plan was also influenced by the PEAE. In the current study, we sought to determine whether PEAE would cause a change in the airway management plan that had been devised based on standard evaluation techniques alone. Although often available, pulmonary function tests and advanced radiological imaging were not used in our study design for 3 reasons. First, this information was not universally available at the time of our patients' presentations. Second, static imaging does not reflect changes in anatomic relationships with spontaneous ventilation, positive pressure ventilation, or the onset of anesthesia. Third, pulmonary function tests (that are obtained during spontaneous ventilation) may not reflect airway restriction caused by complex, fixed, and dynamic lesions when managed with positive pressure ventilation.

PEAE was performed to evaluate 3 anatomic findings that could not be assessed by standard airway examination. Although failure to find an optically straightforward access to the larynx does not exclude intubation success with a rigid or flexible device, it does discourage routine anesthetic induction; in the event of facemask or SGA ventilation failure, rapid tracheal tube placement cannot be relied on for airway salvage. Anatomic lesions that might interfere with SGA placement (e.g., posterior pharyngeal or upper esophageal masses) reduce the likelihood of success when using these devices in the event that other means of controlling the airway fail; in patients with preoperative findings consistent with difficult laryngeal visualization (e.g., significant standard airway examination findings, a history of upper airway surgery, or radiation), the additional identification of intra-airway lesions that cast doubt on successful SGA placement should discourage the induction of anesthesia before airway control, lest SGA salvage be needed. Lastly, vascular or friable lesions situated on the anterior surfaces of the upper airway may limit the use of devices that apply direct pressure (e.g., DL/VL) to these tissues, and therefore deter the inclusion of these instruments in a plan for rapid airway salvage after failed facemask or SGA ventilation.

In the current trial, PEAE led to a change in the airway management plan in one-quarter of the patients. The occurrence of a plan change was statistically significant when the Clinical decision plan called for AI, thereby reducing the use of awake techniques ($P < 0.05$). As noted, the site of airway pathology did not affect the post-PEAE change of plan. Additionally, 8 of 94 patients whose initial, clinically based plan called for tracheal intubation after the induction of anesthesia underwent AI after PEAE ($P < 0.05$). This group represents those whom PEAE served best: patients whose standard airway examination led the clinician to choose anesthetic induction before securing the airway, yet were discovered to have unexpectedly significant pathology on endoscopic examination. Clinical signs, symptoms, or standard airway examination findings did not make manifest the severity of their airway disease. It is speculated that had routine anesthetic induction been pursued, some of these patients' tracheas may have been both impossible to intubate and/or to ventilate by any means and might have required invasive airway rescue. No patients in the current study required emergency invasive airway management or were allowed to awaken because of airway management failure.

Conversely, 28 of the 44 patients for whom the standard airway examination resulted in an initial choice of AI underwent routine induction and intubation after PEAE. This included 2 distinct patient groups: those patients with unremarkable standard airway examinations, but with a history or symptoms that caused a suspicion of significant airway pathology, and those patients with clinical findings consistent with difficult laryngoscopy and/or difficult ventilation (e.g., history of radiation or surgery, small interincisor gap, higher Samsoon and Young score). After the attending anesthesiologist was reassured by PEAE that the "invisible" airway was not obstructed or included other pathology of concern, routine induction was pursued. This represented a 54% reduction in all AI events.

For the purposes of the study, the attending anesthesiologist was limited in the choice of tracheal intubation devices. Although the nonsurgical intubation armamentarium of the modern OR is vast compared with just a decade ago, it can be described by 2 basic device designs: sagittal plane line-of-sight devices (e.g., DL, VL, channeled laryngoscopes, optical stylets, blind intubation devices), or multiplane line-of-sight devices (e.g., flexible fiberoptic laryngoscopes, flexible digital scopes). In obstructive or complex lesions of the upper airway, devices that can be manipulated in more than a single plane may be able to follow a pathway to the larynx that has been distorted out of the simple sagittal plane. Because this is often the most significant change to affect access to the airway, we decided to limit the choice of intubation devices. In 1 patient, these options were too limiting for the attending anesthesiologist, who opted for a minimally invasive technique (i.e., retrograde wire-aided intubation) because of severe airway distortion. This patient's data remained in the analysis because, in the context of the current study, his airway represented an extreme form of nonsagittal plane airway distortion.

In our series of patients, clinical signs of airway compromise were not helpful, and at times were misleading in identifying those who were eventually managed with AI. Of 10 patients with voice changes or stridor who were judged on standard airway examination to require AI (Clinical decision-Awake), 5 were changed to the PEAE-Induced plan after endoscopy. Likewise, of the 8 Clinical decision-Induced patients who were changed to PEAE-Awake management after endoscopy, 5 had no clinical signs of airway compromise. Whereas patients who were moved from the Clinical decision-Awake to the PEAE-Induced group represent a reduction in unnecessary AIs, these latter patients underscore the diagnostic advantage of endoscopic evaluation: patients without manifest signs of airway compromise, yet harboring potentially obstructive lesions, were identified only through PEAE.

In each case in which AI was chosen based on the PEAE findings, the outcome, had intubation after induction been pursued clinically, is unknown. Determining which PEAE findings mandate AI would have necessitated blinding the attending anesthesiologist to the results of the endoscopy,

which the authors believed was ethically unfeasible. Another limiting aspect of this protocol was that the same clinician was responsible for determining both the Clinical decision plan and PEAE plan. An attempt to mitigate this potential bias was made with the remote reevaluation of the PEAE recordings; the clinical history and video records were reviewed ≥4 months after the first data collection. The remote PEAE plans did not differ significantly from the original, PEAE plans result.

Although our data suggest that PEAE may efficiently provide the practitioner with superior information to be used in managing the patient with a difficult airway, the potential for bias can not be fully eliminated without the performance of a randomized controlled trial. A true randomized controlled trial could not only verify whether PEAE reduces the use of AI, but also weigh the benefits of performing PEAE in all patients versus the modest occurrence of unnecessary AI in some.

PEAE is a noninvasive technique that may be completed without OR delay. Unlike AI, only the nasal cavity need be gently anesthetized, if at all. PEAE was performed during the OR turnover period, and rarely introduced even a minor delay. Our subjects found the examination to be less uncomfortable than the one performed by the otolaryngologist during the preoperative visit (often done without anesthetic preparation). We attribute this to our progressive preparation of the nasal cavity as the patient moved from the admitting to the holding areas, and to the OR. No IV premedication (i.e., benzodiazepines) was necessary to perform the PEAE, hence precluding the risk of oversedation in patients with a difficult-to-manage airway.

Skill in the use of AI techniques is critical for the anesthesiologist. When properly applied, AI can be performed efficiently and be comfortable for both the patient and staff. In this study, PEAE not only eliminated several unnecessary AI events, but also identified patients who may have experienced catastrophic outcomes had routine anesthetic induction been chosen. The goal of this study was not to eliminate the use of AI, but rather to validate an evaluation tool that can aid in identifying appropriate candidates for AI.

CONCLUSION

Among patients who present for intra-airway procedures, standard physical evaluation and the reliance on airway signs and symptoms do not consistently identify all those at risk for airway management failure who present for intra-airway procedures. Endoscopic airway examination in this population reduces the number of unnecessary AI procedures, and may increase patient safety by providing the clinician with superior anatomic information. PEAE can be done with minimal or no schedule delay or patient discomfort, and we believe it increases the clinician's confidence in the airway plan. Because PEAE reduced the number of unneeded AIs and identified high-risk patients who had otherwise been considered for routine anesthesia induction, we believe that it has a place in the evaluation of patients with airway pathology who present for intra-airway surgery. Additionally, PEAE may have a role in the evaluation of patients presenting for surgery remote from the airway, yet harbor chronic airway changes that increase their risk for airway failure (e.g., morbid obesity, obstructive sleep apnea, lingual tonsil hyperplasia, and recent food ingestion). ■

AUTHOR CONTRIBUTIONS

WR and WS helped design and conduct the study, analyze the data, and write the manuscript. AII helped conduct the study, analyze the data, and write the manuscript. AF helped design the study, analyze the data, and write the manuscript. CS helped design and conduct the study and write the manuscript. All authors have seen the original study data, reviewed the analysis of the data, and approved the final manuscript. WR is the author responsible for archiving the study files.

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