The Bougie and Airway Management
Revisiting an Old Friend

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T he role of the endotracheal tube introducer has been revered for five decades and is recognized as a valuable intubation adjunct.

Introduction
The endotracheal tube introducer (ETI), commonly referred to as a “bougie” or “gum elastic bougie,” is a useful intubation adjunct. It has been described as not made of gum, not elastic and not really a bougie (see callout).1-4

Perhaps our urological colleagues would argue that the bougie, useful for urethral dilatation purposes, rose to prominence within their specialty. Sir Robert R. Macintosh described the use of this catheter as an introducing adjunct for difficult intubations in 1949.2 Many years passed until Venn designed the currently used Eschmann introducer in the early 1970s, with alterations in its construction material to provide more stiffness while maintaining flexibility, lengthening it to 60 cm and adding the curved tip (35-degree coudé tip) to improve maneuverability.3 These changes contributed to the success of the ETI as an airway adjunct.

Not Really a ‘Gum-Elastic Bougie’
Your correspondent (Toyoyama et al. Anaesthesia 2002;57:932) seeks information about the development of the ‘gum-elastic bougie’. I have researched this subject for a chapter ‘Intubation techniques for unanticipated difficult direct laryngoscopy: Stylets and introducers’ in a forthcoming book ‘Derschwierige Atemweg, ed. Paschen and Dörges’, to be published by Springer. There is a historical explanation for the inaccurate and confusing terminology relating to the ‘bougie’. The ‘gum-elastic bougie’ used so widely in the UK is not made of gum-elastic, and is not used by anaesthetists as a bougie (a device for serial dilation of strictures). The so-called ‘bougie’ is an introducer and the product used in the UK is described by the manufacturers as an introducer.

Adopting the Seldinger-based placement of an introducer into the trachea to facilitate tracheal intubation is widespread and is a mainstay in all the major airway management guidelines.\textsuperscript{4-11} The development of the gum elastic bougie was reviewed historically by Henderson in a piece written in 2003, a portion of which is quoted in the callout (page 67).\textsuperscript{4}

The role of the ETI has been revered for five decades and is recognized as a valuable intubation adjunct. Its simple design, lack of moving parts, easy transportability, absence of batteries to fail, quick learning curve, and adaptability to assist with other airway-related tasks favor its continued presence in any airway manager’s arsenal.

Depending on the grade of the laryngeal view, the ETI has accumulated an excellent success rate, in the range of 80% to 90% for the first attempt and rising to 94% to 100% by the second attempt in a difficult airway situation.\textsuperscript{12-20} The success rate for the most restricted laryngeal views (IIIA, IIIB) is lower due to greater difficulty maneuvering the ETI tip underneath or around the epiglottis. Its pairing with conventional direct laryngoscopy (DL) and video-assisted laryngoscopy (VAL, with conventional blade design) provides support for its worthiness for inclusion in the difficult airway cart (DAC) or portable airway bag/suitcase, as well as in the OR, emergency department and ICU (including non-OR anesthesia [NORA] settings).\textsuperscript{12-22} Relatively high success rates have been duplicated by the novice and non-anesthesia personnel, such as first responders.\textsuperscript{16,17,22,23} Its routine elective use to assist with DL or VAL (with a non-hyperangled blade) has shown promise by improving first-pass success in the emergency department.\textsuperscript{21,25}

There are a variety of ETI designs available to the airway manager. The reusable Eschmann tracheal tube introducer is considered the original and the gold standard. Multiple other manufacturers offer polyvinyl chloride/plastic designs, most with similar characteristics, feel and length (50-70 cm) and a 14 Fr to 15 Fr diameter that affords use with a variety of endotracheal tube (ETT) sizes (5.5-9.0 mm).

Each model has its own variable intrinsic bending or shaping memory. This is important to appreciate since it may affect how one stores, cares for and transports the catheter (in the emergency airway bag) as well as its adaptability for use with DL and VAL devices (Figure 1). Most are single use and disposable to hasten cleanup and reduce the potential for cross-contamination. However, the less expensive, disposable ETI seem to perform less impressively in comparison to the Eschmann design (author’s view), and this is not an isolated opinion.\textsuperscript{26-28} The Frova introducer (Cook Medical), which is an alternative available in two sizes (8 Fr and 35-cm length or 14 Fr and 70-cm length), has a hollow design with an optional metal stiffening cannula (rod) for the proximal two-thirds of the catheter. Moreover, a 15-mm adapter or luer lock connector is offered for optional oxygen delivery via the catheter. Whether to deploy reusable equipment (e.g., Eschmann) or disposable, single-use adjuncts is a question best handled at the local and institutional level based on economic factors and infection concerns.

If reusable ETI equipment is provided, strict enforcement of its care and maintenance are important. An ineffective quality control program could allow reprocessing and redistribution of damaged or misshaped ETIs, or lack of disposal if they are past the recommended life span. There is further concern that the disposable models are stiffer and may have increased propensity for tracheal or bronchial injury, mucosal or otherwise.\textsuperscript{29-34} Injury may occur with an uneventful ETI insertion, eliciting a “click” or “hang up,” or while railroading the ETT over the ETI.

Recently, a steerable ETI (with a directional tip) has been introduced (Flexible Tip Bougie, Sharn Anesthesia), which affords improved maneuverability by offering anterior flexion of the ETI tip that may be particularly helpful in navigating the restricted or difficult airway (i.e., grades IIIa, IIIb), especially when utilizing a hyperangled VAL blade.\textsuperscript{35} Some clinicians have adapted an alternative to assist ETT maneuvering with the hyperangled VAL, given the relative lack of a good bougie alternative—that is, combining the VAL with flexible fiber-optic bronchoscopy (FOB). The bronchoscope becomes a maneuverable bougie with the added advantage of FOB visualization combined with VAL-assisted visualization. This technique does require at least two experienced airway managers for best results.

**Figure 1.**

Single-use disposable ETIs stored in a STAT airway bag for NORA encounters (left) displaying a variety of unintended curves due to storage conditions versus the same ETIs and the Cook model Frova ETI (right) stored in the anesthesia supply room.

ETI, endotracheal tube introducer; NORA, non-OR anesthesia

All photos courtesy of the author.

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Indications

Classically, the ETI has been considered a valuable adjunct for intubation when the epiglottic edge is visible along with a glimpse of the arytenoid/corniculate complex (grade IIb) or when the glottic opening cannot be viewed (modified Cormack-Lehane and Cook Lentis grades IIIa or IIIb, Figure 2). The coudé tipped catheter can be advanced across the underside of the epiglottis in a grade IIb view with a high certainty of success, and in many cases visualization with conventional DL or VAL assistance allows the operator to confirm the ETI is placed within the glottis. Conversely, when the glottis is completely hidden (either grade IIa, Cook “restricted” or grade IIIb, Cook “difficult”), manipulation of the ETI is more challenging.36 Grade IIIa is typically handled reasonably well with either a styledet ETI with the appropriate angle or, better yet, the ETI which affords navigation under or around the epiglottis. Managing the grade IIIb (Cook “difficult”, Figure 2) is certainly more challenging and has a higher rate of failure and mistaken esophageal placement of the ETI, ETT or both.36

Maintaining the angled tip anteriorly is best to assist with the ETI’s blind advancement and maneuvering. ETI manipulation (gentle turning, twisting) may provide tactile feedback, especially to the experienced ETI user, of the coudé tip’s location with regard to the glottic opening. The ETI can be combined with DL, VAL (conventional blade angle) or FOB. Conversely, incorporating the ETI is valuable when the operator achieves a complete view of the laryngeal inlet (grades I and Ia, or Cook “easy”) or a partial view of the glottis but certainly as restricted as a grade IIa (or grade IIb, Cook “restricted” view). Passage of the ETI should be fairly easy and be accomplished with high accuracy. This describes the theory of Driver et al who proposed elective ETI use for every intubation to improve first-pass success.25

Despite achieving a good to excellent view of the glottic inlet, accurate and timely ETT advancement into the trachea may be difficult. For example, in the obese patient with excessive, redundant pharyngeal tissue and a crowded hypopharynx, one may obtain a full or partial view of the glottis, yet the pathway to the glottis may be narrow or confined. Advancement of the ETT essentially blocks the line of sight, leading to a difficult intubation. Blocking the operator’s line of sight may occur in an otherwise straightforward airway. The blocked line of sight may lead to ETT tip deflection laterally or posteriorly, leading to failure, or the ETT may be placed into the esophagus. The slender contour of the ETI may be more easily maneuvered into the trachea in these situations.

The Hames group studied the success rates for tracheal intubation of 64 healthy patients during simulated grade III laryngoscopy after induction of general anesthesia.28 They compared the single-use ETI and FOB, both in conjunction with conventional Macintosh DL. Patients underwent simulated grade IIIa or grade IIIb laryngoscopy randomly and were intubated using one of the two devices. Success rates for FOB-based intubation were 16 of 16 grade IIIa and eight of 16 grade IIIb views compared with ETI results of eight of 16 grade IIIa and one of 16 grade IIIb views. These findings reinforce Cook’s designations of “restricted” and “difficult” views (i.e., grades IIIa and IIIb).36

Practitioners often reserve the ETI as a rescue device after failed intubation or when confronted by a “restricted” or “difficult” laryngeal view. The elective role of the ETI was recently investigated. Reports suggested that elective, routine use of an ETI increases first-pass success rates for both DL and VAL (Karl Storz C-Mac blade or GlideScope [Verathon] titanium MAC blade, excluding the hyperangled model VAL blade). The investigating group used the SunMed ETI (15 Fr, 70-cm length, single use). Driver et al reported that first-pass intubation success was higher in the elective ETI use group, at 98% versus 87%. In specific airway circumstances, such as in the obese patient, the presence of a hard cervical collar, a restricted laryngeal view with laryngoscopy or patients with a predicted difficult airway; the differences were more profound, suggesting elective ETI may improve patient safety by increasing the efficiency for first-pass success.25

In either laryngoscopic choice (DL or VAL), the operator’s temporary loss of laryngeal viewing (line of sight) from the advancing ETT may reduce accurate and timely ETT advancement into the trachea. Routine ETI placement typically does not interfere with the operator’s line of sight due to the ETI’s slender design, cuff-free contour and color vibrancy (blue or yellowish-orange vs.

**Figure 2.**
Modified Lehane-Cormack Lentis Cook Laryngeal Grading System.36
Drawing courtesy of A. Mort and M.E. Mort.
Combining the ETI with VAL will vary by the type of VAL device: Factors include channeled or nonchanneled, and blade angulation (more conventional angle: 25 to 35 degrees vs. hyperangulated: 65 to 70 degrees). A channeled VAL allows the ETI to be placed within the ETT to assist with tracheal intubation. Models such as the Airtraq (Prodol Meditec; Figure 3), King Vision (Ambu), Pentax AWS, and CoPilot VL+ (Dilon Technologies) work well when combined with the ETI. Freehand advancement of the ETI with conventionally angled VAL models can be utilized with or without video-assisted viewing. Use of the ETI with a hyperangled VAL model, such as the GlideScope (Verathon) or D-Blade (Karl Storz), may be more challenging due to the 65- to 70-degree angle that the ETI needs to navigate.

The Hartford Hospital NORA management database had 12 encounters on record that combined a single-use, disposable ETI with the hyperangled GlideScope VAL. Each ETI attempt failed due to the inability to maintain a consistent angulation to allow accurate and timely maneuvering around the 65-degree VAL blade. Some ETI models, depending on the introducer’s composite materials, may allow the operator to bend or angle the ETI to provide the proper curvature to ease advancement and maneuverability around the VAL blade.

Other models have little or no intrinsic shape memory when angled/shaped as they return to their native stored shape. For example, in the author’s hands, utilizing a single-use ETI that has been stored to maintain its factory-provided straight shape, then attempting to induce an appropriate curve for use with the GlideScope, is rarely successful (Figure 1). The ETI only retains a curve momentarily. However, if the ETI is carried in an airway travel bag and placed around the periphery of the travel bag, maintaining it in a semicircular fashion, when removed for use the curve will likely remain intact, even despite efforts to straighten it. Conversely, if the ETI is stored folded over or angled, it may retain such a shape and be rendered useless to the airway team at the time it is deployed.

It was once unofficially recommended to me by a colleague that to ensure a proper bougie curve, one could pass and carry the ETI within the drawstring waist compartment of one’s scrubs. Other ETI models do perform better regarding intrinsic shape memory. It is best to review several ETI models before committing to a brand that does not meet your needs, particularly if you plan to use it with both DL and hyperangulated VAL devices.

Alternatively, using a steerable ETI may assist advancement not only with conventional angle blades but also when combined with the hyperangled VAL blades. One model, the Flexible Tip Bougie is adaptable to both DL and VAL. The ETI has a slider on the proximal end of the device that allows manipulation by the operator’s thumb and forefinger to adjust the anterior or posterior tip angle. This innovative design does require some practice to master so that the operator may easily flex, straighten or retroflex the tip to assist with transglottic placement.

**ETI Advancement**

Use of the ETI should best be performed as a two-person procedure, at minimum. Typically, the ETI is being used as a rescue adjunct with DL due to a restricted laryngeal view. The operator will pass the ETI into the trachea, followed by passage or railroading of the ETT over the ETI. It is imperative to maintain the laryngoscope in place to keep the pathway open to ease ETT advancement and allow the bougie to retain a straighter line and thus facilitate intubation.

Secondly, it is equally important that the assistant firmly holds the proximal end of the ETI in position while the ETT is advanced/railroaded into the airway. The vector of force of ETT advancement will very likely advance an unheld ETI distally, and this could injure the tracheobronchial tree. It is a reasonable expectation that the team members openly communicate with each other to assign their roles in the airway management schema. Commonly, the operator who places the...
ETI would maintain the laryngoscope with their left hand. While maintaining the ETI at the decided depth, the assistant places a lubricated ETT on the ETI and advances it while they or a second assistant secures the ETI in position. Then, while maintaining the ETI at its prescribed depth, the operator advances the ETT.

While advancing the ETT, one has two choices of how to proceed:

• Simply advance the ETT forward down the ETI. If resistance is encountered, stop ETT advancement, withdrawal the ETT 1-2 cm, turn the ETT 90 degrees counterclockwise and then re-advance the ETT, or

• The operator could pre-emptively twist/turn the ETT 90 degrees counterclockwise as the ETT is advanced.38

Tip impingement is common due to the right-side location of the bevel on the standard ETT. The typical position of the ETI is the “posterior chink,” as presented in Figure 4. It will be held up by the glottic chink, the arytenoid/corniculate cartilage or the vocal cord, typically on the right (Figures 5 and 6). Other factors that influence the ease of ETT advancement are maintaining the presence of the laryngoscope to allow the pathway to remain open, minimizing the gap between the ETI and the ETT and lubrication.

Alternatively, one may pre-insert the ETI within the tracheal tube so the distal ETI tip is protruding (5-8 cm) from the ETT tip. The ETI–ETT unit is then used together for tracheal intubation. The preformed curve of the new ETT may add the needed curvature to the ETI to improve its navigation into the glottic opening.

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**Figure 5.**

Depiction of ETT encountering tip/bevel impingement on the right lower posterior portion of the glottis during its advancement over the ETI (left image).

Corrective action is to halt advancement and retract the ETT 1-2 cm to allow the tip to clear the glottic tissue then turn the ETT 90 degrees counterclockwise (middle image).

Note that following the 90-degree counterclockwise rotation, the bevel is anterior. The ETT can then be re-advanced and likely will pass freely into the trachea (right image).

**ETI,** endotracheal tube introducer; **ETT,** endotracheal tube

Drawing courtesy of M.E. Mort.

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**Figure 6.**

Posterior glottic structures: Nearly 97% of observed AEC plus ETI lie against the posterior hypopharyngeal wall buried in the mucosa. The anterior angle taken by the AEC/ETI to traverse the glottis explains why 95% of AEC/ETI lie in the posterior glottic chink. Mannequin (left) and human (right).

**AEC,** airway exchange catheter; **ETI,** endotracheal tube introducer
Tactile Feedback

Many advocate the importance of the tactile feedback to the operator’s fingers when using the ETI. The first feedback, via the tracheal clicks, may provide a reassuring sign of tracheal placement. The tactile feedback will be appreciated by both the operator handling the ETI and the assistant providing the so-called BURP (backward, upward, rightward pressure) maneuver, or cricoid pressure, or optimal external laryngeal manipulation.

The angled coudé tip should be maintained in an anterior direction to improve the chance of encountering the tracheal rings (Figure 7). Depending on the angle of advancement, the straight or curved shape of the ETI and the coudé tip direction, tracheal clicks may or may not be appreciated. Too much dependence on the presence or absence of tracheal clicks should be discouraged. It should be taught to the novice operator as an interesting and potentially helpful clinical observation, rather than as an all-or-none test.

I have observed, on numerous occasions, a lack of clicks followed by the more reliable distal tip carinal/bronchial hang up or “stop sign,” confirming correct ETI placement in the trachea, particularly in the emergency setting. The elective use of the ETI in the OR with a previously unintubated “virgin trachea” seems more likely to produce the clicks compared with an emergency NORA patient. I have less commonly appreciated the clicks under emergency circumstances, particularly in the patient who has recently undergone airway manipulation (previous intubation, self-extubation, volume resuscitation, tracheobronchitis, pneumonia, etc.).

The second tactile sign that may suggest correct tracheal placement is encountering insertion resistance from the carina and distal bronchopulmonary anatomy. Depending on the adult patient’s height and tracheobronchial tree dimensions, gentle ETI advancement to between 22 and 40 cm from the gum-dentition line may meet resistance by the distal ETI tip getting hung up on the carina or the secondary bronchi. This should distinguish itself from smooth unobstructed ETI advancement within the esophagus, barring any esophageal pathology or anatomic alterations. This is referred to as the “hang-up,” “stop sign,” “hard stop,” or a positive Cheney sign.

Conversely, if the ETI is placed within the esophagus, the clicks should not be appreciated, and the ETI should advance unopposed through the esophagus and into the stomach (depth >35-45 cm). It is imperative to gently advance the ETI in search of the hang-up sign to reduce the potential for injury. Following its detection, the depth of the ETI should be noted and the ETI should be retracted by 3 to 6 cm, depending on its depth and the patient’s height. The proximal end of the ETI must be secured and held in position by an assistant during ETT advancement (railroading). This is important to perform to reduce tip-induced damage to the tracheobronchial tree. The vector of force of the advancing ETT may push the unsecured ETI more distally, leading to tip impingement and possible mucosal or cartilaginous injury.

It is well known that airway trauma may occur with laryngoscopy and placement of the ETT. Various factors influence its occurrence and degree of injury:
• the patient’s head/neck anatomy,
• ETT size and construction characteristics,
• force vectors applied,
• operator (in)experience,
• stylet used, and
• ease or difficulties encountered, and coagulation status, among other factors.

Serious intubation injury is uncommon but real. Now, the addition of the use of an ETI on top of all this is another source of potential injury.

Proceed Gently

While there are numerous case reports of ETI-related injuries, some quite serious and life-threatening, the exact numerator and denominator to determine the true incidence are not known. If the ETI is utilized properly and gently, injury should be rare, but it has had some devastating consequences. Reports of injury were nearly nonexistent prior to the marketing of the disposable ETI models. Does this mean the reusable Eschmann is kinder and gentler (than the disposables) or is it the operator holding it? Has the relatively unregulated market of disposables ushered in a new wave of introducer-related injuries?

There appears to be distinguishing differences among ETI tip and shaft stiffness of the various models available. Excessive force applied to any instrument is
typically frowned upon, especially in the airway. The ETI in general should not be forced or advanced excessively. However, we need to separate ETI placement alone versus performing confirmatory tests to assist the airway team in determining its location (trachea vs. esophagus) prior to ETT advancement. The forces generated during attempts to prompt the hang-up sign and those needed to cause perforation are likely very different.

This is the reason gentle advancement permeates this writing. The disposable models appear to be more likely to injure or perforate than the Eschmann introducer, based on tip design and stiffness. So it falls back on the operator and their willingness and ability to either avoid the hang-up sign altogether or apply it with the utmost gentleness.

As a potential compromise, the ETI may be accompanied by a laryngeal view that affords visualization of its position within the trachea (grades I, IIa and IIb). So, is there a need to perform the hang-up test in these clinical situations? It is most applicable when the ETI is passed blindly into the trachea (grades IIIa and IIIb). The hang-up sign has a reported nearly universal success in differentiating the trachea from the esophagus. It is absolutely fair and reasonable to always apply gentleness to the airway. If you have to apply excessive force during intubation, something is likely wrong. Trying harder could increase the potential for injury. It would be best to change your approach or technique.

Should we abandon the hang-up sign due to the small but real chance of injury? We do not know the true incidence of injury related to ETI use. Should the hang-up test be reserved for only grade IIb and IIIa views? Since the rate of failed intubation with the Cook “difficult” grade IIb is significant, even with using the ETI as an adjunct, should the ETI not even be utilized in grade IIb?

When one deals with a grade IIIa or, more specifically, a grade IIib laryngeal view, there is significant risk for blindly advancing the ETI into the esophagus. If this occurs in the elective surgical procedure in an NPO patient without aspiration risk, accidental esophageal intubation has a low risk for life-threatening consequences. However, the emergency NORA intubation in the ICU, emergency department, radiology or the ward is a much higher risk environment.

If we continue to deploy the ETI but abandon the confirmatory testing due to fear of an uncommon though possible consequence, patient injury from airway and hemodynamic complications related to ETI misplacement followed by esophageal intubation will likely arise. Reviewing the Hartford Hospital NORA management database, ETI-assisted intubation in grades IIIa and IIIb cases are the most likely to cause patient harm due to a misguided ETI with subsequent esophageal intubation. Despite timely recognition of ETT misplacement with end-tidal carbon dioxide (EtCO₂) monitoring and other tests, esophageal intubation has an increased risk for life-threatening hypoxemia, bradycardia, regurgitation, aspiration, multiple intubation attempts and cardiac arrest. Should we advocate that a gentle hang-up test be pursued, at least in patients with grades IIIa and IIIb laryngeal views, particularly in the emergency or critical care setting?

**Tips and Caveats**

Any NORA management procedure is best handled by the team approach with at least one knowledgeable or teachable assistant at the bedside. If you must deliver care as the sole practitioner, it will be best to recruit help at the bedside and provide point-of-care teaching and instructions to optimize patient care. In either case, announcing the role of each team member is key to minimize duplication of steps/actions by different team members who then may neglect another important step.

There are several jobs: the “scoper,” the loader, the holder and the passer. Some team members may perform more than one task, but clear communication announcing each assigned role should reduce confusion. The jobs include the need to maintain the laryngoscope in position (the scoper); placement of the ETT on the ETI (the loader); maintaining control of the proximal ETI so it remains at the same depth during ETT advancement (the holder); and advancement of the ETT (the passer).

Easing ETT advancement over any conduit by applying lubricant on the ETI and the inner and outer edges of the ETT tip is highly recommended. In the rush to secure the airway, particularly if the ETI is utilized as a rescue measure, lubricant may be forgotten. This is particularly important in the patient with dry mucosal membranes. Pushing an unlubricated ETT over a dry ETI that is advancing past dry mucosal structures may be difficult or impossible, and securing the airway will thus be delayed. Moreover, advancing a dry or inadequately lubricated ETT over the ETI will increase the vector force applied to the ETI and potentially advance it more distally, even if held securely by the “holder.”

Maintaining ETI position by an assistant (the holder) is imperative to avoid proximal ETI retraction or more distal ETI advancement. Furthermore, maintaining the presence of the laryngoscope blade in the oro-hypopharynx is quite helpful for assisting with ETT advancement as it keeps the pathway open. ETT advancement may be met with resistance along the length of the ETI. Many ETI models offer depth markings to assist the intubator in estimating the ETI’s position. Likewise, appreciation of the ETT depth markings may provide valuable feedback to the cause of resistance or advancement failure.

Resistance at a shallow depth of 10 to 13 cm may likely be redundant tissue or the epiglottis. Resistance felt at 16 to 17 cm (in a patient of average height) likely is the arytenoid/corniculate cartilage, posterior glottic chink or the vocal cord, typically on the right side. The standard ETT tip bevel is protruding on the right side of the ETI and tends to catch or lodge on the right side of the glottis.42-45
Once resistance is encountered, it is best to halt ETT advancement rather than to apply further force. Then withdraw the ETT 1 to 2 cm, turn the ETT 90 degrees counterclockwise, then re-advance the ETT. Cossham described this issue\(^38\) and proposed its solution in 1985, by commenting that when:

> “encountering resistance, one automatically tends to rotate it clockwise, as if inserting a bolt or screw, thus causing the tip of the tube to lie posterior to the bougie, protruding like a ploughshare lodging firmly behind the arytenoids. I suggest that, before the tube nears the larynx, it should be rotated a quarter-turn anti-clockwise. This manoeuvre will cause the tip of the tube to lie anterior to the bougie, and to be in close contact with the bougie, so that it does not catch on anything. The tube must previously have been lubricated inside and outside.”

His clever observation is applicable to a number of situations of Seldinger-based ETT advancement; namely, the ETI, bronchoscopic-assisted intubation and ETT exchange over an airway exchange catheter (AEC). The 90-degree counterclockwise turn is applicable also to nasal intubation, whether intubation is freehand or over a conduit. Applied cricoid pressure may increase impingement of the ETT tip on the glottic structures. Despite incorporating the 90-degree counterclockwise twist, release of cricoid pressure may allow successful passage of the ETT.\(^47\)

**Minimizing the Gap:** Another factor that has a significant impact on ETT passage is the principle of “minimizing the gap” as it applies to any Seldinger-based procedure. Placing a large-bore central venous line starts with attaining venous access via a small catheter/needle, passing a wire into the vein, “enlarging” the wire by passing an obturator sleeve over the wire, and then advancing the large-bore venous catheter. This principle also applies to passage of an ETT over an AEC, bronchoscope or ETI. Proper pairing of the two devices may reduce intubation attempts, decrease intubation failure and frustration, and improve the patient’s safety.

Minimizing the gap allows the ETT to pass with a firm trajectory, snugly over a well-matched conduit, and there will be fewer encounters of tip/bevel impingement on airway tissues, the vocal cord, arytenoid and corniculate cartilages, or the posterior “chink,” particular toward the right. Table 1 displays the external or outer diameter of the common ETI and AEC models as well as the cross-sectional area. Passing the larger 9.0 ETT over a 14-Fr ETI would allow excessive ETT wobble and increase its tip impingement as it traversed the airway. Pairing them to minimize the gap will afford smooth and timely advancement and reduce the chance of bevel/tip injury from engaging the posterior chink and the arytenoid–corniculate complex, particularly on the right portion of the glottis (Figures 4-6).\(^42-45\)

An alternative ETT choice is the Parker Flex-Tip (Parker Medical), which is equipped with an anteriorly directed bevel combined with a flexible, tapered tip to reduce hang up (Figure 8). Its design reduces

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**Table 1. Mind the Gap: Comparison of Outer Diameter and Cross-Sectional Area**

<table>
<thead>
<tr>
<th>Device: Outer Diameter (description)</th>
<th>Cross-Sectional Area (~mm(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Fr: 3.7 mm (small Cook AEC)</td>
<td>11</td>
</tr>
<tr>
<td>14 Fr: 4.7 mm (medium Cook AEC, bougie)</td>
<td>17</td>
</tr>
<tr>
<td>15 Fr: 5.0 mm (bougie)</td>
<td>19.6</td>
</tr>
<tr>
<td>19 Fr: 6.3 mm (large Cook AEC)</td>
<td>31</td>
</tr>
<tr>
<td>ETT</td>
<td></td>
</tr>
<tr>
<td>6.0 mm OD</td>
<td>28</td>
</tr>
<tr>
<td>6.5 mm OD</td>
<td>33</td>
</tr>
<tr>
<td>7.0 mm ID, 9.5 mm OD, Evac: 10.4 mm OD</td>
<td>38</td>
</tr>
<tr>
<td>8.0 mm ID, 10.8 mm OD, Evac: 11.8 mm OD</td>
<td>50</td>
</tr>
<tr>
<td>9.0 mm ID, 11.9 mm OD, Evac: 13.1 mm OD</td>
<td>64</td>
</tr>
</tbody>
</table>

\(^a\) Commonly used ETTs in a NORA management situation are equipped with subglottic suction capabilities (Evac), which increases the outer diameter by approximately 0.9 to 1.0 cm: for example, standard 7.0 mm I.D., 9.5 mm OD versus subglottic Evac model, 10.4 mm OD.

AEC, airway exchange catheter; ETT, endotracheal tube; ID, inner diameter; OD, outer diameter

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**Figure 8.**

Minimizing the ETI-ETT gap is important to ease advancement through the glottic opening. The Parker Flex-Tip ETT (left), with its distinctive “bird beak” tip, provides the Cossham twist with a centered bevel positioned anteriorly combined with a flexible, tapered tip to reduce hang up. Note the tip hugging the ETI to assist with minimizing the gap (right).

ETI, endotracheal tube introducer; ETT, endotracheal tube
tip impingement without having to employ the coun-
terclockwise (“Cossham”) twist, though twisting may
assist with advancement. Use of this ETT model is
fine for the OR and short-term use, but it has been
poorly accepted as a longer term (>24 hours) ETT
in an ICU setting due to it potential for leaking, high
cuff pressures and lack of the subglottic suction role
(author’s opinion). Once placed in the NORA patient
who requires extended mechanical ventilation, the
ETT’s limitations, as noted above, most often require
the patient to undergo a high-risk ETT exchange after
24 to 48 hours in the ICU.

Another factor to consider is the bevel/tip burden-
that is upsized by using the specialty ETT with sub-
glottic suction capabilities (Evac, Shiley). The external
diameter is approximately 1 cm larger than a standard
ETT. This upsizing may impact ETT advancement
despite one’s efforts to “minimize the gap.” The “min-
imizing the gap” principle is supported by data from
Hartford Hospital’s NORA management database on
AEC-assisted ETT exchange, which clearly demon-
strates the influence of minimizing the gap on first-
pass success. For example, in over 800 AEC-assisted
ETT exchanges involving passing a new 8.0 ETT over
an AEC, the first-pass success rate varied widely: 11 Fr,
43%; 14 Fr, 79%; and 19 Fr, 91%. There is a strong rela-
tionship between minimizing the gap and improved
patient safety (increased first-pass success, decreased
hypoxemia of any level, decreased severe hypox-
emia [saturation <80%] and decreased bradycardia,
by nearly 70% [comparing 11 Fr and 14 Fr and 19 Fr]).

Figure 9.
6.0 ETT over 15-Fr ETI. Left: The bevel toward the right displays minimal impingement on glottic structures due to the small
gap between the ETI and ETT. Right: The 90-degree Cossham twist turns the bevel upward (note the Murphy eye), allowing
smooth advancement.

Figure 10.
7.0 ETT via ETI. Left: With the bevel toward the right, note the impingement of the ETT tip on the arytenoid and posterior
chink. Right: The 90-degree Cossham twist frees the bevel/tip to improve passage through the glottis.

ETI, endotracheal tube introducer; ETT, endotracheal tube
Figure 11.
8.0 ETT via 15-Fr ETI. Left: Note significant overlap of bevel/tip of ETT posteriorly due to widening gap between ETI and ETT. Right: The 90-degree Cossham twist (likely 120-degree turn) centers the ETT and reduces tip impingement.
ETI, endotracheal tube introducer; ETT, endotracheal tube

Figure 12.
9.0 ETT via 15-Fr ETI. Left: Note significant tip/bevel impingement in the posterior-rightward direction with the ETT load in the standard position on the ETI. Right: The 90-degree Cossham twist affords improved navigation through the glottis despite the sizable gap between the ETI and ETT.
ETI, endotracheal tube introducer; ETT, endotracheal tube

Figure 13.
ETI passed into a plastic trachea model (not part of a mannequin head/neck). This allows a more direct approach for the ETI to take without it bending around the mouth-oral cavity-opharynx-hypopharynx passage, which leads to it arching and being buried into the posterior pharyngeal wall. Its subsequent anterior vector to enter the glottic opening nearly assures its position in close proximity to the posterior glottic structures, enhancing the chance for ETT tip impingement. Conversely, when the ETI is not arched around the passage, it tends to lie in the middle of the glottic opening (left), thus offering nearly unopposed ETT advancement (right), even with a larger caliber ETT.
ETI, endotracheal tube introducer; ETT, endotracheal tube
When traversing the curvature from the mouth opening down to the glottic opening, the ETI, similar to the FOB insertion cord or shaft of the AEC, has a tendency to arch against the posterior portion of the oro-hypopharynx. As the shaft angles slightly anterior to rise from the posterior wall to enter the trachea, it comes to rest in the most posterior portion of the glottic opening, surrounded by the posterior portion of the vocal cords, the arytenoid and corniculate cartilages, and the posterior chink. The posterior position hampers ETT advancement by promoting impingement, especially with a larger ETT (8.0-9.0 mm) coupled with a smaller ETI.

This principle is influential in choosing the optimal FOB, AEC or ETI to minimize the gap as it relates to the desired ETT caliber. Patient safety is improved by minimizing the gap. This principle is influential in the marriage of the smaller caliber “anesthesia” FOB (typically 3.5-4.2 mm in size) with the Aintree intubating catheter (AIC). The highly touted “FOB plus AIC plus SGA” (supraglottic airway) rescue combination allows the delivery of a larger-bore ETI introducer through an SGA so the airway team may more accurately pass a standard 7.0- to 9.0-mm ETT into the trachea via the AIC.47,48 Table 2 summarizes tips and caveats of note.

### Additional Airway Tasks

**Tracheostomy exchange/reintubation/recannulation:** In both the elective setting and urgent/emergent circumstances, the ETI is a valuable airway adjunct. Elective upsizing/downsizing or changing the type or age (i.e., fresh or mature) of tracheostomy tube may be assisted with adjunctive use of the ETI. During urgent/emergent loss of the airway requiring either reinsertion of the tracheostomy or temporizing with an ETT via the stoma, due to accidental decannulation, emergency decannulation for obstruction or displacement, or perhaps cuff leak/rupture, the ETI may offer valuable assistance for reestablishing the airway. Gentle ETI advancement via the tracheostomy should be practiced. ETI advancement into a false passage in the lateral tissues or pre-tracheal space is not impossible. If resistance is encountered, FOB visualization of the airway is recommended.

**Surgical airway access:** There are several methods and techniques for securing an emergent surgical airway. Called variously a scalpel-bougie-cricothyrotomy, a scalpel-finger-bougie cricothyrotomy or a bougie-aided cricothyrotomy, the method is gaining traction as an accepted and preferred technique for providing emergency airway access. Following skin incision,

### Table 2. Tips and Caveats Worth Noting

| ETI-assisted intubation is a two- or three-person procedure. Single practitioners should obtain help. |
| Lubrication is a basic requirement for Seldinger ETT advancement procedures. |
| Understand the intrinsic “memory” of your ETI model and how it may affect DL/VAL success. |
| Tracheal clicks are helpful but are neither mandatory nor confirmatory. |
| Elective ETI may improve 1st-pass success and for at-risk patients (e.g., obese, C-spine, difficult airway traits). |
| Gentle ETI tip hang-up sign (Cheney’s sign) is valuable in distinguishing the trachea from the esophagus. |
| Maintain laryngoscopy during ETT advancement (keep the pathway open). |
| Following hang up, withdraw ETI 3-5 cm, second person maintains ETI position, then advance ETT. |
| Gentle pursuit of hang-up sign is recommended for blind ETI insertion (grades IIIa, IIIb). |
| Mind the gap; larger ETT sizes (7.5-9.0 mm) increase the tip catching arytenoid/corniculate/vocal cord. |
| Preemptive ETT twisting 90 degrees counterclockwise is helpful in reducing tip impingement on the glottic structures. |
| Resistance to advancement at 16-18 cm depth typically means ETT is against the glottic structures. |
| If resistance is met with ETT advancement, stop, withdraw ETT 1-2 cm, turn counterclockwise 90 degrees, then advance again. |
| Grade IIIb has a high failure rate, so prepare for likely ETI failure and think ahead/preplan for next adjunct. |
| Teach/practice ETI use in the mannequin and elective setting to share with the next generation. |
| Routine, elective ETI utilization improves 1st-pass success rate with DL and VAL (not hyperangulated blades). |
| Ensure ETI access in elective and emergency settings for its variable airway management roles. |

ETI, endotracheal tube introducer; ETT, endotracheal tube
tissue spreading and incision of the cricothyroid membrane or tracheal cartilage, bougie-assisted advancement of a smaller caliber ETT (6.0 mm) via the stoma is performed. Likewise, a smaller sized tracheotomy tube may be advanced over the ETI. FOB visualization of the airway is recommended after establishing surgical airway access in the NORA setting.

**ETT exchange:** An ETT exchange procedure is considered a high-risk procedure. If possible, maintaining continuous access to the airway is best. Some advocate the ETI as a useful method of maintaining continuous airway access while exchanging an ETT. Although useful for this task, the ETI may not be the best alternative due to its shorter length and smaller caliber (14-15 Fr) compared with use of a larger diameter and longer catheter, such as a 19 Fr Cook Airway Exchange Catheter (CAEC). The longer length CAEC allows the team to maintain better proximal and distal control of the catheter during the removal of the preexisting ETT and the passing of the new replacement ETI. If the ETI is passed either too deeply or too shallowly, exchange may be hampered. Moreover, the ETI is typically 14 to 15 Fr in caliber, similar to the medium CAEC. The Seldinger-based exchange is best served by minimizing the gap between the ETI and the catheter. Thus, upsizing to the large CAEC (19 Fr) for placing a 7.0- to 9.0-mm ETT in adults is best with fewer attempts overall, a higher first-pass success rate and lower desaturation rates (due to a more efficient exchange).

Some clinical situations do call for a 14-Fr CAEC (e.g., smaller caliber ETT, ETI damage, kinking, luminal narrowing), but the overall length of most ETI models remains a drawback for the exchange procedure. The longer length version of the disposable ETI (70 vs. 50-60 cm) would be preferred if an ETI is used for ETT exchange in the adult patient.

**ETI-guided insertion of the ProSeal LMA:** Some have advocated placing a lubricated ETI in the gastric drainage portal of a second-generation SGA, such as the LMA ProSeal or LMA Supreme (both by Teleflex) to assist with placement of the SGA. In combination with DL to assist placement, the ETI is passed into the esophagus to allow delivery of the SGA to the level of the cricopharyngeal opening. A principal cause of failed SGA placement with standard digital insertion is cuff impaction at the back of the mouth leading to failed passage into the pharynx, folding over of the cuff, or the cuff being directed into the glottic inlet instead of the hypopharynx. Described as the gum elastic bougie–guided technique by Brimacombe, it reduces impaction at the back of the mouth, prevents folding over of the distal cuff, and guides the distal cuff directly into the hypopharynx. Moreover, gastric tube insertion via the gastric portal should have a high success rate because the drainage tube and esophagus have improved alignment.

**ETT position confirmation:** During cardiac arrest or when EtCO₂ monitoring is malfunctioning or unavailable, advancement of the ETI via the ETT may help verify ETT placement within the trachea. Passing an ETI provides feedback by the hang-up sign, the stop sign or Cheney’s sign (ETI tip against the carina or second bronchus at 27- to 37-cm depth in most patients (as described above). Free, unopposed ETI advancement to 40 cm and beyond would strongly suggest a presence within a patent esophagus, barring any stricture, mass effect, pathology or significant hiatal hernia.

**Extubation of the known/suspected difficult airway patient:** Maintaining continuous access to the airway post-extubation by incorporating a conduit for reintubation is an excellent schema in an attempt to maintain a bridge to ease reintubation. The indwelling conduit is typically an AEC, 11 to 14 Fr in diameter, and has the appropriate length to allow adequate intratracheal depth and the ability to control the proximal tip, all while navigating a new ETT into the airway. One model that fits this description is the Cook AEC (83 cm). Substituting an ETI for the AEC has been suggested. This is certainly a viable alternative to the AEC, but the overall length of the ETI is inappropriate to ensure adequate control of the proximal and distal ends of the conduit during the reintubation procedure, if required. Moreover, the smaller diameter 11-Fr AEC is better tolerated than the 14-Fr model, as is the size of most ETIs. If reintubation is required over the small-diameter AEC, either a smaller sized ETI is best to minimize the gap between the AEC and ETT, or an Aintree intubating catheter, which is an excellent adjunct to pass over either the 11- or 14-Fr Cook AEC. This increases its diameter to be equivalent to the 19-Fr AEC. This upsizing of the conduit improves first-pass success (compared with the smaller 11- and 14-Fr AEC or ETI) and allows a larger ETT to be used for reintubation.

**VAL intubation adjunct:** An additional important use for the ETI would be its invaluable role as an intubation adjunct during management with VAL (with the standard or hyperangulated blade). ETI use with standard-angled VAL blades is obviously useful with or without the video display capabilities. ETI use with the hyperangulated blade will vary in success depending on whether you are using the steerable ETI model versus an ETI with reasonable memory that allows the operator to adjust ETI curvature. As previously mentioned, ensuring adequate ETI curvature to assist with ETI advancement through the glottic opening with the hyperangulated VAL blade with the single-use, disposable ETI is fraught with potential failure. Practicing this technique on a mannequin or in the elective surgical setting is warranted before deploying this method in the NORA setting.

Another issue related to using a hyperangled blade, for example with the GlideScope, combined with its proprietary hyperangulated stylet, is the variable position of the periglottic tissues and glottic and subglottic regions. The view may be good to excellent, yet intubation may prove difficult. Delivery of the ETT through the glottic opening may occur with the directional vector of force pointed anteriorly toward the cricoid ring. Once the ETT tip is abutted against the anterior tracheal wall,
particularly when the airway is dry/desiccated and/or the ETT tip is not preemptively lubricated, it may be difficult to maneuver more distally. Frequently, clockwise or counterclockwise twisting of the ETT will allow the tip to disengage the cricoid ring or anterior wall and move into the distal trachea. If twisting the ETT is not successful, consider deploying a lubricated ETI via the ETT, as this may allow it to be advanced distally. Upon gentle ETI advancement and meeting resistance (with the tip against the wall), move the ETT proximally toward you with a slight tug (<0.5-1 cm), advance the ETT distally, possibly into the lower trachea, and then advance the ETT. With accompanying VAL visualization, this salvage maneuver can be witnessed indirectly rather than blindly. When encountering resistance to advancement, applying more force may work against you and also lead to injury.

The second role for ETI deployment during VAL intubation difficulty would be following ETI placement and stylet removal, if the ETT barely advances or retracts above the glottic opening. The ETI tip comes to lie just superior to or within the glottic opening. Despite a good to excellent view, advancing the unstyleted ETT may be unsuccessful. Removal of the ETT, reloading the ETT with the stylet and starting over is one viable option. Alternatively, passing a lubricated ETI via the indwelling ETT may allow the operator, under video assistance, to pass the ETI into the trachea, thus affording ETI advancement.

ETI-Assisted Intubation for Emergency or Urgent NORA Management

The Hartford Hospital NORA management emergency database (1991-2019) of nearly 21,000 intubations (excluding cardiac arrests) reports that the ETI was used in 1,458 encounters (overall, 6.9%). Its role in the vast majority (n=1,313) of these encounters was as an intubation adjunct with DL.

Most clinicians at our institution include the ETI as a rescue adjunct with DL when a restricted or difficult laryngeal view is revealed after one’s best laryngoscopy attempt. Thus, “DL plus bougie” use was distributed across a variety of laryngeal views (grades I-IIlb) with a relatively high overall success rate of 81.8%. Moreover, the ETI was used in a significant number of cases to assist with advancement of the already deployed unstyleted ETT during difficult VAL-based intubation. Its utilization varied during three time periods:

1. Pre-ASA complete guideline implementation (period 1: 1990–early 1996);
2. Post-ASA guidelines implementation with airway adjuncts deployed and available for elective and emergent airway interventions (period 2: 1996–early 2006); and

As noted by the information presented in Table 3, the use of the ETI rose precipitously following our institution’s efforts to equip our STAT airway team with airway adjuncts as recommended by the ASA Guidelines via the DAC and a transportable airway equipment suitcase/bag. Likewise, it was added as a standard item to the OR anesthesia cart, whereupon its utilization rose significantly. Subsequently, in period 3, based on a concerted effort by our department and the institution, there was a ubiquitous deployment of advanced video technology (VAL: e.g, GlideScope) commencing in late 2006 in the OR and for the STAT anesthesia airway team. The subsequent use of the ETI by many individuals contracted significantly, in favor of using VAL as a rescue adjunct for DL-achieved laryngeal views of grades IIb, IIIa and IIIb both in the OR and by the STAT anesthesia airway team (NORA setting).

The successful deployment of the ETI to assist with tracheal intubation was, overall, 81.3% (Table 4). However, this lower success rate resulted from the significant deployment rate and subsequent failure in grade IIIb (down-folded or down-hanging epiglottis). Otherwise, the success rate for grades IIb of 98% and IIIa of nearly 92% remains impressive. The ability to maneuver along the leading or lateral edges of the down-hanging epiglottis proved difficult, leading to failure to advance into the trachea. The incidence of esophageal placement of the ETI was the highest for grade IIIb.

### Table 3. Overall ETI Deployment by Time Period*

|--------------|-----------|-----------|-----------|
| ETI use included conventional ETI-assisted ETT placement (DL) plus cases involving ETT advancement/manipulation during VAL intubation.
DL, direct laryngoscopy; ETT, endotracheal tube introducer; ETI, endotracheal tube; VAL, video-assisted laryngoscopy | 57 (11) | 948 (13.4) | 445 (3.6) |

### Table 4. Success Rate of ETI for Emergency NORA Management

<table>
<thead>
<tr>
<th>View</th>
<th>Grade I</th>
<th>Grade IIa</th>
<th>Grade IIb</th>
<th>Grade IIIa</th>
<th>Grade IIIb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases n (%)</td>
<td>9/9 (100)</td>
<td>6/8 (75)</td>
<td>125/128 (97.7)</td>
<td>772/845 (91.4)</td>
<td>155/323 (48)</td>
</tr>
</tbody>
</table>

N=1,313; success rate 81.3% overall.
It is worth noting that placement of the ETI in the esophagus is not equivalent to esophageal intubation following ETT advancement over the ETI. Prior to the hang-up test, esophageal ETT placement via the ETI in grade IIIb views was rampant. Since actively pursuing the use of the hang-up test for all my bougie-assisted intubations (2003), I recall anecdotally only one case of true esophageal intubation while using the ETI (in retrospect, I likely retracted the ETI too much following the hang-up test, leading to esophageal placement of the ETI). Esophageal placement of the ETI, when confronted with a grade IIIb view, remains quite high (~60%-70%), but fortunately can be discovered by the invaluable hang-up test, thus avoiding erroneous ETI placement into the esophagus. In essence, the incidence of esophageal placement of the ETI (alone) remains unaffected by using the hang-up test. However, the hang-up test had a profound effect on nearly eliminating the esophageal placement of the ETT.

Combining VAL with ETI is a viable pairing for managing the airway. Our emergency department staff is aggressive in pairing VAL (with a conventional-angle blade) and the ETI. The anesthesia-based database logged 12 encounters with the combination of VAL and ETI in an attempt to traverse the glottic opening with the ETI (single-use disposable ETI combined with hyperangled GlideScope blade). Each of these failed, as the operator was unable to navigate the ETI successfully around the exaggerated curve of the VAL blade. Use in the elective OR setting may be more fruitful.

The remaining cases (VAL, n=145) involved one of two scenarios: In the first, following stylet removal, the ETT failed to deploy to or through the glottic opening (i.e., at the glottic level or supraglottic). The ETI was advanced via the ETT and used to traverse the glottic opening to assist ETT advancement (18/22 successful; 82%). In the second scenario, due to the hyperangle of ETT delivery combined with dry mucosa/insufficient lubrication, the ETT tip became impinged on the anterior wall of the subglottic region at or in the vicinity of the cricoid ring. ETT twisting, in hopes of disengaging the ETT, failed, and thus ETI advancement was impeded. With the assistance of continuous video display, the lubricated ETI was then gently advanced via the ETT to the point of meeting resistance, at which the ETI was moved proximally by 0.5 to 1 cm, whereupon the ETT could be advanced (n=123; 117 successful; 95.1% success rate).

The overall incidence of esophageal intubation via the ETI (14.2%, or 187/1,313 DL cases) covers all laryngeal views. The majority of esophageal intubations—67.9%—using DL with ETI occurred with a grade IIIb laryngeal view, and these patients had the highest esophageal intubation rate overall, at 39.3%. Although this percentage seems staggering, the majority of these accidental esophageal intubations took place in the “pre–hang up” era. Accidental advancement of the ETI into the esophagus is an understandable consequence of ETI use, particularly with Cook “restricted” and “difficult” grade IIIb laryngeal views.

Typically, ETI passage into the esophagus is without consequence as long as the operator detects its incorrect location. Passage of the ETT over the ETI into the esophagus is where the trouble begins, especially in the NORA patient setting. In deciding whether or not to perform the hang-up test (Table 5), it is worth emphasizing the vast difference in the potentially life-threatening consequences of an esophageal intubation in the NORA patient, and the number of steps that must be taken to confirm or refute tracheal position of the ETT. Performing the simple hang-up test takes little time, but its use

<table>
<thead>
<tr>
<th>View Grade</th>
<th>Grade I</th>
<th>Grade IIa</th>
<th>Grade IIb</th>
<th>Grade IIIa</th>
<th>Grade IIIb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases, n (%)</td>
<td>0/0</td>
<td>0/0</td>
<td>3/128 (2.3)</td>
<td>57/845 (6.7)</td>
<td>127/323 (39.3)</td>
</tr>
</tbody>
</table>

**Table 5. Steps Required for ETT Placement Confirmation: Influence of the Hang-Up Test**

<table>
<thead>
<tr>
<th>Hang-Up Test Not Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass ETT into the trachea or esophagus.</td>
</tr>
<tr>
<td>Inflate cuff.</td>
</tr>
<tr>
<td>Attach EtCO2 monitor.</td>
</tr>
<tr>
<td>Attach oxygen reservoir bag.</td>
</tr>
<tr>
<td>Squeeze bag, auscultate breath sounds.</td>
</tr>
<tr>
<td>Check EtCO2 for 3-6 breaths.</td>
</tr>
<tr>
<td>Possibly remove ETT from esophagus.</td>
</tr>
<tr>
<td>Treat desaturation, regurgitation, aspiration.</td>
</tr>
<tr>
<td>Re-attempt intubation with a fresh ETT.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hang-Up Test Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove ETI from esophagus or proceed with intubation.</td>
</tr>
</tbody>
</table>

EtCO2, end-tidal carbon dioxide; ETI, endotracheal tube introducer; ETT, endotracheal tube

**Table 6. Incidence of Esophageal Intubation via the ETI (ETT in Esophagus)**
in selected laryngeal grades (IIa, IIb) may provide beneficial information. Does the ETI continue to advance into the esophagus in the grade IIb view patient (Table 6)? Yes, but its detected misplacement should halt the undesired advancement of the ETT into the esophagus.

**Moving Forward While Stepping Backward**

While the medical community and patients welcome the introduction of new technology with the hope of improved outcomes, faster recovery and other benefits, we often see such new methods literally replacing older techniques that still have merit and value in many medical situations.

For example, laparoscopic surgery is so common that resident trainees may be underexposed to an adequate number of open techniques during their training that remain lifesaving and appropriate. Likewise, in airway management, a similar issue stemming from the ubiquitous distribution and widespread deployment of VAL may be leading to an unintended consequence. ETI use in combination with DL as a rescue alternative has been replaced in many practices by the ubiquitous presence and availability of VAL. One drawback to our advancement to high-tech airway management is that it most certainly will hamper the education of our novice airway managers and trainees in regard to learning and gaining competence in ETI utilization.

Increased reliance on VAL may be potentially contributing to a decline in DL utilization, thereby degrading DL skills. A 10-year study in South Korea noted the frequency of DL decreased by 50%, from 92% to 45%, while VAL increased from 8% to 55%. The authors reported that first-pass success rates using DL decreased from 91% to 76% and concluded the decline likely resulted from reduced DL utilization. With the reduction in DL utilization, ETI bougie deployment will likely suffer. This will subsequently reduce trainees’ exposure to DL with ETI techniques, and likely not afford the degree of experience to gain competence in its use.

Although the learning curve for DL with ETI is relatively short, mastering its use likely requires a sizable number of cases and differing laryngeal exposure grades to enhance one’s experience. Clinicians opt for VAL rather than grabbing a time-tested, readily available and reliable adjunct whose batteries have never failed. Following my review of thousands of elective and emergency intubation encounters over the past three decades, a profound trend is emerging. A case with a grade IIb, IIa or IIb laryngoscopic best view, previously considered appropriate for ETI rescue, has seen an almost unanimous shift away from ETI-assisted intubation. Clinicians now employ immediate transition to VAL.

Data from the Hartford Hospital NORA management database revealed that in Period 2, clinicians used the ETI in 59% of grade IIa and 58% of grade IIb cases in its role following DL as Plan B, in order to obtain one’s best view. After the deployment of VAL (Period 3), VAL was the overwhelming choice (Plan B) following DL. ETI use plummeted to 14% (grade IIa) and 10% (grade IIb) as a Plan B adjunct. Similarly, even one’s best DL view in grades IIa and IIb are increasingly managed by personnel forgoing the ETI in favor of VAL, even when VAL is not immediately present at the bedside.

I have witnessed encounters in the OR where staff would rather wait for VAL delivery to the bedside as opposed to deploying the ETI that is adjacent to their anesthesia machine and the patient. The literature does not offer, I believe, a comparison between a DL with ETI for a best view grade IIa or IIb and immediately abandoning the DL with ETI approach in favor of VAL. The improved glottic visualization, in most cases, afforded by VAL is impressive and likely does improve patient care, but the delay in securing the airway may be an important factor, particularly in NORA management.

**Summary**

The ETI is a valuable airway adjunct that has a long, respected history. Its multi-tasking potential, low-tech nature without batteries, portability, low cost, ease of use, short learning curve, excellent track record and worldwide acceptance support its continued presence in the airway arsenal. As Beumof spoke of AECs as a simple concept with potentially great danger, so the ETI must be used carefully and intelligently. Several relevant concepts to improve its success are key for the airway team members to practice during ETI utilization, including understanding the ETI-ETT gap, adoption of a team approach for ETI utilization, the importance of the Coshham twist/ETT rotation, and the “hang-up” maneuver. Recent advancements in airway equipment technology threaten the future viable role of the ETI as practitioners migrate away from its deployment.

**References**


43. Smith T, Vaughan D. Extubation over a bougie in difficult airways: are we missing a trick? *Anaesthesia*. 2013;68(9):974-975.
