**Direct Laryngoscopy and Endotracheal Intubation**

**Introduction:**

In emergent cases and patients with cardiopulmonary instability a team approach to ensure first pass success is indicated, due to increased morbidity with multiple laryngoscopies. It is emphasized that attaining the optimum position for laryngoscopy when a poor view is encountered is a matter of increasing flexion of the cervical spine and even the upper thoracic spine, which is quite fatiguing for the laryngoscopist. Assistance by someone who is trained to provide lifting during the laryngoscopy preserves left arm strength, and allows for the fine motor motions necessary to manipulate the epiglottis and expose the larynx. Another departure from conventional recommendations for laryngoscopy is the early incorporation of external laryngeal manipulation with the right hand as an integral part of obtaining a view of the larynx. Trained assistants are essential for this technique as well. Hence the concept of a “team approach” to laryngoscopy.

**Technique of Laryngoscopy: Introduction**

While the motor skills required to use curved and straight blades are distinctive, there are some common elements to either technique, particularly at the start of the procedure. In particular, positioning the patient appropriately is of utmost importance, and has been alluded to above.

Simply rotating the blade for insertion, then turning it into the correct plane once insertion is accomplished, may be all that is required. Alternatively, the laryngoscopist may elect to use a short-handled laryngoscope, or one which permits adjustment of the angle between the blade and the handle.

Thus, utilizing the right hand for laryngeal manipulation during retraction with the left arm, coined “external laryngeal manipulation” (ELM) by some authors, and “bimanual laryngoscopy” by Levitan, allows the laryngoscopist to position the larynx back down, into the line of site. With the blade tip in place in the vallecula, or just under the tip of the epiglottis in the case of the straight blade, one may “advance” the larynx down onto the blade, improving the view. ELM counteracts the forces of suspension/retraction, essentially pushing the laryngeal structures back down into the vision of the laryngoscopist. This maneuver is accomplished with the right hand, while the left hand provides retraction. Once the optimal view is established, an assistant must be directed to place his/her fingers in exactly the same spot, with the same direction of force, on the thyroid cartilage. Blind attempts by assistant to manipulate the larynx are not nearly as effective for the laryngoscopist, and should be discouraged, as should the “BURP” (backwards, upwards, rightwards pressure) maneuver (8). The automatic placement of the thumb and forefinger of the right hand on the thyroid cartilage as laryngoscopy proceeds should be reflexive.
This maneuver may improve the view in more than 50% of inadequate laryngeal views (9,10).

Blade insertion: midline or lateral?
Exactly how to insert the laryngoscope blade, with relationship to the oral cavity, is largely a matter of expertise. Most authors recommend insertion in the “right side of the mouth,” without precise detail. Levitan recommends a midline insertion for those learning the technique, in order to improve the likelihood of encountering the epiglottis and enhancing its recognition, as opposed to any distortion that may occur with insertion and retraction when the blade is placed laterally. We agree with that priority, but encourage use of the lateral approach for more reliable access when not confused in navigation.
Henderson in 1997 summarized lateral approaches and offered a justification for a far-lateral insertion technique dubbed the “paraglossal” straight blade approach. The advantages of this type of insertion are many, including better tongue control (avoiding the “curtain” effect of this structure encroaching on the view from both sides, as in midline insertion), less force required to displace the tongue so that a view of the glottis can be obtained with less strain, a shorter distance to traverse with the blade tip before the epiglottis is encountered, and less chance of levering against the upper incisor teeth. Subsequently Henderson developed a blade that provides a visual indicator at the tip and a lumen sized to pass an 8 mm ET when necessary (ref).

For the curved blade, there is less literature that specifically addresses where to place the blade on insertion, though most authors recommend insertion in the “right side of the mouth,” without precise detail. Optimal insertion angle remains an area of active investigation.

**Technique of Laryngoscopy with The Macintosh Blade**

This section is oriented to conventional DL with less emphasis on ‘first-pass’ elements than elsewhere in the course.
Once the mouth is sufficiently opened to allow blade insertion without traumatizing the teeth, the emphasis shifts to controlling the tongue and advancing the blade toward the epiglottis. Insertion along the right side of the mouth allows the vertical flange of the blade to cordon off the tongue, keeping it from flopping into the observer’s line of site. Most authorities recommend this approach (1) while others recommend insertion down the midline, using deft maneuvering after the epiglottis is located to push the tongue off to the right of the mouth (2). In either case, the tongue must be effectively kept out of the line of sight while the glottis is located.

Finding the epiglottis at the base of the tongue is the essential next step, as this structure represents a key landmark for determining location of the blade tip within the posterior mouth/anterior oropharynx, as well as being a major obstacle to actually viewing the glottis. Careful and controlled advance of the tip of the blade around the curvature of the tongue should allow one to locate the epiglottis. Careful forward movement of the blade
tip, which we term “spooning,” while gently lifting every few centimeters, should allow recognition of the epiglottis and prevent inadvertent insertion of the blade beyond it.

Insert table of spoon vs slide vs bimanual?

Further controlled advance may either push the tip into the vallecula, the recess between the base of the tongue and the epiglottis, or may fold the epiglottis backwards, completely covering the glottis, or distorting the anatomy. In the extreme, the down-folded epiglottis may actually be pressed up and out of the way with lifting pressure on the laryngoscope, revealing some portion of the posterior glottic aperture, but this is not the most effective way to use the curved blade, and should be discouraged. If the blade is inserted in an uncontrolled fashion and placed deep into the pharynx without attempting to locate the epiglottis, the entire larynx may be bypassed and the view will reveal only the pharynx and the proximal portion of the esophagus, which may or may not be recognized as such—another practice which is to be discouraged.

With effective placement of the blade tip into the vallecula, the appropriate position of the curved blade is achieved to reveal the best possible view of the glottis. Subtle forward motions of the blade tip, or pulling back slightly, may be necessary under watchful guidance, to obtain this correct position. Ideally, the tip of the blade is placed against the cord-like structure that attaches the epiglottis to the hyoid bone, the hyo-epiglottic ligament. This structure may be seen as a midline reflection beneath the mucosa of the vallecula when the view is optimal, and represents the key to “flipping” the epiglottis up and out of the way of the laryngoscopist. Placing the tip of the blade into the vallecular recess, off of the midline, may fail to lift the epiglottis as effectively, so not provide the superior available better view of the glottis. Typically in DL the hyoepiglottic ligament is not visible, but as soon as the epiglottis can be seen to move with blade tip movement, the most effective pressure point (“sweet spot”) can be determined by observing the response of the epiglottis tip either to slight forward-lifting movements of the blade tip or to similar downward movement of the larynx by the right hand.

Once the blade is correctly seated in the midline in the vallecula, retraction begins. Up until this point, for easy cases the laryngoscopy should require minimal exertion. The process of guiding the laryngoscope blade tip into the vallecula requires gentle probing, with just enough lift on the tongue to ascertain where the end of the blade is. Many novices begin retracting forcefully well before the blade is in the correct position, which may result in either a poor view, early fatigue or both. The need to lift the head, when the view is not optimal, is common. Ideally, a trained assistant at the bedside provides this lift, allowing the laryngoscopist to preserve strength and retain fine motor coordination. In addition, early manipulation of the thyroid cartilage with the fingers of the laryngoscopist’s right hand should be integrated to provide an optimal view during the first pass. This approach can be used in every case. Simpler approaches work in easy cases but the best possible patient care requires the whole integrated coordinated sequence be practiced as though every case was unpredictable. Preparing for disaster is essential, because it’s a guaranteed event and only timing can’t be predicted, so surprise is no excuse and the cost of catching up is too high to justify less careful preparation.
The objective to sight the epiglottis determines each movement the laryngoscope, including the depth of insertion, angle, lift and rotation. The blade is vertical when first inserted, and the horizontal handle is held and maneuvered with a light touch. Depth of insertion is limited to that which the operator is certain will not pass the epiglottis. Each spooning movement involves advancing the blade, then lifting forward while rotating the handle slightly backwards. The lift of the laryngoscope handle should be sufficient to enable backward rotation of the handle without levering on the teeth; touching the teeth indicates poor technique or insufficient lift (see below). When head-lift is performed in communication with a well-oriented assistant, stepping back on the tongue may be continued and control of the epiglottis established during head lift. The optimal head and neck position is determined empirically by the best possible view of the glottis, and optimal support is that which requires least lifting effort by the operator’s left hand. Having an assistant provide lift frees the right hand for external laryngeal manipulation, beginning with the initial approach of the blade to the epiglottis. Manipulation of the larynx toward the blade at the same time as initiating blade-tip search for the epiglottis can sharply reduce time the required for optimal control of the epiglottis. The small quick lifting movements that help optimize blade tip position on the hyoepiglottic ligament can be provided externally. That is, for the last few millimeters the larynx can be moved onto the blade as much as the blade is advanced; and the effect of small quick thyroid cartilage compressions to “flip” the epiglottis define the ‘sweet spot’ as effectively as do internal manipulations of the blade tip. Once the tip of the epiglottis is sighted optimal positioning is indicated by the response of the epiglottis to small forward-lifting movements of the blade tip as the blade is moved slightly forward and backward.

The upward lifting force of retraction with the curved blade results in a degree of “suspension” of the tissues distal to the blade, including the larynx. ELM counteracts the forces of suspension/retraction, essentially pushing the laryngeal structures back down into the vision of the laryngoscopist. This maneuver is accomplished with the right hand, while the left hand provides retraction. Once the optimal view is established, an assistant must be directed to place his/her fingers in exactly the same spot, with the same direction of force, on the thyroid cartilage.

Effort when challenged by the fine-motor requirements of epiglottis control. Subsequently, an assistant must maintain this position, which requires continued confirmation of the glottic view during careful transfer to the assistant. Alternatively the operator may use his or her own chest or upper abdomen as a support, though this requires considerable practice and coordination. Although usually not essential for the experienced practitioner it is preferable to request an informed assistant to provide head elevation by lifting behind the occiput, reducing stress on the laryngoscopist’s left arm, and allowing deft manipulation of the blade tip without the fatigue that would otherwise accompany such lifting, and to perform bimanual laryngoscopy to assist with epiglottis control from the beginning, rather than introduced as a backup measure. With or without an assistant, the force vector for retraction remains the same with the curved blade.
Once the glottic view is revealed, and found to be adequate, the endotracheal tube is placed with the right hand. Attempts at laryngoscopy may become quite involving, with the laryngoscopist losing track of the actual duration of the patient’s apneic period. Because pulmonary instability can cause rapid alveolar closure and hypoxemia laryngoscopy attempts should be limited to 30 seconds, or the occurrence of oxygen desaturation, whichever comes first.

References:


**Technique of Straight-Blade Laryngoscopy**
As with curved blade laryngoscopy, the initial step in laryngoscopy with a straight blade is to open the mouth to provide room to insert the blade atraumatically. This is accomplished in the same way: with gentle head extension by the right hand, or by scissoring with the thumb and forefinger of the right hand on the upper and lower teeth. However, the techniques begin to diverge at this point, in order to take advantage of the design characteristics of each of these two types of blades.

Once the straight blade has been introduced into the mouth, the laryngoscopist will once again advance its tip slowly along the tongue, seeking the epiglottis. While it was once taught [I was taught only to avoid this] to push the blade initially past the larynx, into the hypopharynx, then lift as the blade is removed to expose the glottic opening, this practice can no longer be recommended, since blind thrusting of the metal instrument up against the mucosa in the peri-glottic region may produce significant trauma, to the larynx, pharynx or esophagus. Furthermore, lifting with the laryngoscope in this position may reveal the orifice of the proximal esophagus, tempting the operator to mis-identify it as the airway (1.). Instead, the epiglottis should be sought in a controlled, deliberate manner as the blade is inserted down the midline or along the right side of the tongue [Make seeking the epiglottis a positive point from the beginning, as Jackson does? Same for the lateral approach?. As with the curved blade, the straight blade may be inserted in the midline (2) or to the right of the mouth (3), and the tongue ultimately must be displaced to the left in order to effectively view the glottis and provide adequate space to insert the endotracheal tube [We’ve discussed the confusion about this – we were both taught those words but in the easy cases I think often don’t do it, so the must seems too strong. Since the tongue is a large and patulous structure in the unconscious, relaxed adult, its tendency is to engulf, or enfold the straight blade, markedly reducing the area for viewing the glottis. Control of the tongue to the left with the straight blade is imperative, just as in the case of the curved blade.

The straight blade may be inserted well to the right side in the mouth, utilizing the natural “gutter” between the displaced tongue and the teeth. This “paraglossal” straight blade technique has been described as a rescue technique when attempts at curved-blade laryngoscopy fail to provide a view of the glottis (4). The Miller blade, with its low vertical profile and narrow spatula, is particularly useful in this relatively cramped region of the oral cavity. The tip of the Henderson blade is designed to inform position of the tip relative to the tissues impinged, and the lumen allows tube insertion if necessary. The blade is advanced into the groove between the tongue and tonsillar pillar. Lateral and anterior pressure should be used to keep the tongue to the left, allowing identification of the epiglottis, and the tip of the blade is then moved posterior to the epiglottis. The blade is subsequently lifted in an anterior (upward) direction to expose the glottis. If the view remains poor turning the head to the right may be helpful. An even more extreme lateral insertion site that has been described for the straight blade on the right side of the mouth is termed the “retromolar” or “molar” approach (5). The paraglossal technique is most useful when the absolute, or relative, size of the tongue is large compared to the space into which it must be compressed with the curved blade. Let’s include more detail from Henderson, and his emphasis re must be practiced – as is true for earlier team approach…
The essence of straight blade laryngoscopy is to place the tip underneath the epiglottis, lifting it to reveal the glottis. The tip will thus be advanced all the way into the proximal portion of the laryngeal inlet before retraction actually begins. The straight blade frequently allows a more complete view of the laryngeal inlet, since the epiglottis is lifted completely up and out of the way. This must be balanced against a smaller viewing port and reduced area in which to manipulate the tube, making actual tube insertion somewhat more challenging than occurs with an adequate curved-blade laryngoscopic view.

Upon placing the tip of the blade under the epiglottis and controlling the tongue, retraction should begin, in an upward direction, to move both the soft tissues and the epiglottis out of the way. As with curved blade laryngoscopy, the temptation to pull back on the laryngoscope blade must be avoided. When an adequate view of the larynx is established, the tube is placed, inserting it from the right side of the mouth, with as little interference of the line of sight as possible. The lips often are more of an impediment to this extreme rightward approach than in curved blade laryngoscopy, and use of the fourth and fifth fingers, or an assistant, to retract the lip, permits easier insertion of the tube.

Nevertheless, if at all possible, the tube should be kept to the right of the blade, not fed down its lumen, in order to retain control of the direction of insertion of the tube, and also to permit visualization of its tip as it passes into the laryngeal opening.

Some advantages of straight blades are apparent. Particularly for the Miller blade, entry into the mouth is easier if there are limitations of opening, because the large vertical flange of the typical curved blade may be restrictive. When the front incisors are quite prominent, the straight blade is advantageous, since it is often introduced well to the right of these, avoiding contact, and there is no tendency to “lever” to get the epiglottis to flip upwards, which might damage protuberant teeth. A long, floppy epiglottis may be troublesome to manage with the curved blade, if recalcitrant to pressure over the hyoepiglottic ligament, and may be more subject to direct lifting with the straight blade. In addition, when the larynx is situated rather forward of the line of sight, or with a receding chin, the view with a straight blade may be superior to that with a curved blade—hence the preference for this type of blade in infants and small children (1). Finally, pathology at the base of the tongue which precludes access to the vallecula or pressure upon the hyoepiglottic ligament renders the curved blade much less effective, while presenting less of an obstacle to the path of a straight blade (6).

Most physicians, however, prefer to initiate laryngoscopy with the curved blade. Its larger spatula permits greater area for both viewing and manipulation of the tube, as does its vertical profile. Further, the “feel” of a curved blade is more anatomic as it curves along the tongue and seats in the vallecula.

As with the curved blade, the view with the straight blade may be insufficient despite all of the above steps. When this occurs, several maneuvers may be used to optimize the view of the glottis. One method is to augment neck flexion, either by lifting, or with a pillow that is higher than the standard “sniffing” position (6). Alternatively, an assistant at
the bedside who is capable of lifting the occiput for the laryngoscopist could be used. In addition, external laryngeal manipulation may be useful with straight blade laryngoscopy, as described above for use with the curved blade (4).

References:


Bougies as Adjuncts for Direct Laryngoscopy

Another means of coping with a poor grade laryngoscopy view is to use a bougie as an adjunct to intubation. These devices are primarily useful when the glottis is not well-visualized, but its location can be inferred from the position of the inter-arytenoid notch or the epiglottis (a POGO of 0% or a grade 3 view of the larynx). The Eschmann introducer is malleable, but has a stiff, angulated distal tip. Because of its relatively small size and its flexibility, it is easier to manipulate in the confines of the pharynx than is an endotracheal tube. The stiff tip of the bougie is used to “probe” for the glottic opening, and its end is firm enough to rattle against the tracheal rings as it is advanced in the airway, which provides feedback about placement. Sometimes this sense of the tracheal rings is not evident, but the tip of the bougie will encounter resistance as it passes down one of the mainstem bronchi to the smaller airways, usually by 30 cm of insertion length. On the other hand, if the bougie is placed into the esophagus, no resistance will be encountered as the bougie is advanced.
A number of case reports and case series attest to the utility of the bougie when the view of the glottis is inadequate (1-3). Nolan et al reported 100% success in intubation with the use of a bougie, of 79 cases of simulated cervical spine injury with in-line immobilization in general anesthesia patients, compared to 93% success in this setting among 78 cases with direct laryngoscopy, without the aid of a bougie (4). In a similar comparative study of the bougie in simulated difficult intubation, Gataure et al reported success rates of 96% with the bougie but only 66% with a styletted endotracheal tube (5).

The bougie is relatively simple to use. When performing direct laryngoscopy, if an unfavorable view of the glottis persists despite the above measures, the tip of the bougie is placed beneath but close to the epiglottis. Because the bougie is being passed from right to left, slight rotation clockwise might compensate for crossing the midline, so help avoid the left cord, as it is advanced into the airway. If the inter-arytenoid notch is visible, the tip should be placed just above it and advanced. Resistance implies that soft tissue is interposed between the tip of the bougie and the glottis, so the bougie should be pulled back and maneuvered slight more anteriorly, or to either side. When insertion proceeds unimpeded, one should feel for the impact of the tip on the tracheal rings or the “seating” of the bougie in the bronchus (usually at about 28-30 cm from the teeth). To avoid airway trauma, the bougie should be advanced gently throughout the procedure. Once the bougie has passed, an assistant should place the endotracheal tube over the bougie (a bit of lubricant at the tip of the ETT will enhance passage and bougie removal) while the laryngoscopist stabilizes it, and observes the glottis as the tube is advanced. Continued retraction of soft tissues with the laryngoscope blade as the bougie is advanced will facilitate passage of the tube. If resistance is encountered at the glottis, the ETT should be pulled back slightly and rotated either clockwise or counterclockwise, to disengage the bevel of the tube from the aryepiglottic fold or vocal cord, by which its progress is probably obstructed.

References:


Complications of Direct Laryngoscopy

The complications which may occur during laryngoscopy and intubation underscore the invasive nature of this procedure. In particular, difficult laryngoscopy and intubation predispose to adverse outcomes in this setting (1). Direct trauma may occur in the oral cavity, pharynx, larynx and trachea. Such injuries include lip, tongue, pharyngeal wall and even esophageal lacerations, as well as dental disruption (2,3). Laryngoscope insertion, retraction and tube insertion into the glottis may cause vocal cord injury, dislocation of the temporomandibular joint or arytenoids cartilages, and blunt or penetrating injury to the larynx or trachea (4-6). In addition, extremes of motion may result in cervical spinal cord injury in those with unstable cervical spine fractures or other compromising conditions of the vertebral column (7).

Adverse occurrences related to the process of intubation, as opposed to direct trauma, are not uncommon. These include aspiration of gastric contents (8), bronchospasm (9), prolonged attempts leading to hypoxemia with resultant end-organ damage (10), and unrecognized esophageal intubation, which results in both hypoxemia, and hypoventilation. Positive pressure ventilation preceding (and following) direct laryngoscopy, especially if high pressures are required to ventilate the lungs, predispose to barotraumas, including pneumothorax (11), as well as hypotension with hypoperfusion. The placement of the laryngoscopy blade tip into the pharynx or larynx, followed by forceful retraction, has a profound impact on the sympathetic nervous system, and may lead to tachycardia, dysrhythmias, hypertension and myocardial ischemia or infarction (12,13). Finally, long-term consequences of endotracheal tube
placement include damage to the airway that may be manifest as laryngomalacia, trachomalacia or laryngeal stenosis (14).

References:
