The Mystique of Direct Laryngoscopy

Direct laryngoscopy and intubation is easy to define and conceptually very simple. A short, rigid instrument deflects the tongue and jaw, enabling a direct line of sight to the larynx and placement of a tube into the trachea. Historically, laryngoscopy has been taught to all providers of emergency care and resuscitation. It is the predominant intubation method in emergency care and, despite the proliferation of alternative instruments, in anesthesia as well.

Direct laryngoscopy for the purpose of intubation has an impressive success rate: 98–99+% in elective anesthesia and emergency cases.[1–6] Few interventions in medicine can match this high success rate. The problem, however, is that when failure occurs, the consequence can be catastrophic if rescue ventilation cannot be achieved or if rescue intubation cannot be done quickly. For too many patients in emergency settings, intubation delays caused by repeated intubation attempts involve marked hypoxia, bradycardia, and cardiac arrest.[7] For a small percentage of patients, direct laryngoscopy cannot work because of mechanical issues with mouth opening, severe problems of neck position, or unpredicted pathology at the epiglottis or base of the tongue.[8]

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Despite its overall performance, and despite that it is considered by many to be a "basic" procedure in resuscitation, the question of who performs the procedure has been a matter of some debate, especially in teaching institutions. In a study in this issue of RESPIRATORY CARE, Vianello et al report that intubation-trained pulmonologists had a high success rate in performing intubation in urgent and emergency cases in their unit.[9] Why is it necessary to show that pulmonologists can adequately intubate such patients in their own unit?

Even though it is considered a "basic" skill and is widely taught, performance by novice intubators is very poor. On average, initial trainees succeed in only 50% of attempts.[10–12] Within anesthesia, laryngoscopy and intubation is ranked alongside spinal anesthesia as the most difficult procedure in their training.[11] Approximately 50 attempts are needed to achieve 90% competency in elective intubation.[12] What makes the procedure so difficult to learn and explains the performance gap between novices and experts?

The mystique of direct laryngoscopy is a consequence of the visual restrictions inherent to the procedure. This creates difficulty of observation and has led to a historical deficiency of imaging from the operator's perspective. In turn, this situation has inhibited objective research and prevented formulation of a defined and agreed-upon best practice approach. The net effect is that each operator has to figure out the subtleties of the procedure for himself and ends up with his own anecdotal experience. Novices performing the procedure for the first time have never seen the critical anatomical structures because they cannot effectively observe them until they actually do the procedure. Because of the visual restrictions of laryngoscopy, intubation is traditionally learned through trial and failure.

Consider the teaching experience of the trainee in the operating room. During initial attempts, trainees are asked, "What do you see?" followed by, "You get one chance. If you don't see it, put the laryngoscope down." The supervisor cannot provide targeted feedback to the trainee, because the two cannot simultaneously sight the target. Looking over the operator's shoulder does not let the trainee or supervisor effectively see what the other person sees. The "one chance" comes from the awareness that the procedure can cause injury if done incorrectly. Incorrect technique can also lead to bleeding or edema, making subsequent attempts more difficult. The patient may also become hypoxemic and seriously injured if intubation is delayed without intervening ventilation. The time restriction on the procedure limits the sighting of critical structures to only 10–15 seconds, even during elective intubation. Such brief periods of visualizing critical structures, occurring in a difficult educational setting, combined with the fact that the supervisor cannot provide targeted feedback, makes learning the procedure difficult even for clinicians fortunate enough to have operating-room training opportunities. For many nonanesthesia providers, operating-room training is difficult to obtain, and the growing use of supraglottic airways in elective anesthesia care has further diminished training opportunities.

The visual restrictions of laryngoscopy, created by the limited mouth opening, the tongue, the blade flange, and the epiglottis, make the procedure monocular at the level of the larynx.[13] Even though the operator may keep both eyes open, the larynx itself is sighted with one eye.[13] The right and left eye are separated in the skull by about 10–13 cm, and their differing vantage points on the larynx cannot be fused to create stereoscopic sight. The procedure is visually analogous to looking down a narrow pipe a distance of 30–45 cm at a target the size of a quarter. The brain ignores the image from the nondominant eye. This occurs subconsciously, through a phenomenon called binocular suppression. This phenomenon is well known in target sports, and identification of ocular dominance (the targeting eye) is the first step in training for archery or riflery. This should be a standard aspect of laryngoscopy training as well. A novice initially attempting laryngoscopy rotates his or her head from side to side to determine which eye to sight with. Even experienced operators may not be aware of how they actually sight the larynx. When I was first experimenting with my head-mounted camera for imaging laryngoscopy (the Airway Cam, Airway Cam Technologies, Wayne, Pennsylvania), I explained monocular sighting to the chairman of an anesthesia department who had 40 years of intubation experience.[14] He steadfastly believed he sighted the target with both eyes, until during an intubation I asked him to hold his head still after sighting the target, and I then sequentially covered one eye and the other with an index card. Covering the nondominant eye did not affect his view of the target, whereas covering the dominant eye made the target disappear.

In addition to monocular sighting, there is another variable involved in sighting the target, and that has to do with accommodation distance. Though it is commonly believed that novice intubators are more likely to be too close to the target (incorrectly thought to prevent binocular sight, which does not occur at the level of the larynx, regardless of distance), the eye-to-target distance is determined primarily not by experience but by the accommodation (or focusing) distance of the operator. The accommodation distance is a function of age and intrinsic ocular issues. For some operators, corrective lenses can be very helpful.

We have made learning and skill acquisition of laryngoscopy more difficult than it has to be, by failing to realize how visual restrictions impact skill acquisition, performance, and best practice. We have failed to define and teach a best practice approach to all operators from the outset of training. The procedure can be intensively visually studied, before initial practice on patients, using imaging from the operator's perspective.[10,14–19] There is a best practice approach—characterized by the importance of epiglottoscopy, ear-to-sternal notch patient positioning, bimanual laryngoscopy, straight-to-cuff stylet shaping, and an in-depth understanding of laryngeal anatomy.[20–26]

The study by Vianello et al[9] reiterates what we've learned from prior studies—namely, that operators with sufficient training can perform the procedure adequately. The challenge going forward is to improve the effectiveness of our teaching, so that from the beginning we demystify the procedure and define and teach a best practice approach. With the subtleties revealed and the mystique removed, along with intensive videography from the operator's perspective, novice trainees can become more competent faster.[10] The performance goal of emergency laryngoscopy should not simply be plastic in the trachea. It must be first-pass success and the avoidance of hypoxemia, regurgitation, hemodynamic instability, and other untoward effects that accompany repeated intubation attempts.[7,26]

The last challenge we face is not to accept the 0.5–1.0% failure rate that can occur with standard laryngoscopy. This means augmenting direct laryngoscopy with imaging as needed, immediately from the outset, so we can universally achieve first-pass success, even if the direct view is not adequate to intubate under direct vision. Examples of this include imaging technology on the laryngoscope and, better yet, on the stylet.[27–30] This margin of safety should become a standard of care. Given the tremendous advances in medicine, and the routine daily miracles in surgery and other therapeutic interventions, why, as clinicians caring for critically ill patients, do we accept the notion that placing a tube 15 cm from the mouth is a "hit or miss" event? Widespread implementation of a best practice approach to direct laryngoscopy, coupled with fiberoptic or other imaging to augment initial laryngoscopy, holds great promise for improved patient safety and outcomes in emergency airway management.

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REFERENCES

1. Wilson ME, Spiegelhalter D, Robertson JA, Lesser P. Predicting difficult intubation. Br J Anaesth 1988;61(2):211–216.
2. Heidegger T, Gerig HJ, Ulrich B, Kreienbuhl G. Validation of a simple algorithm for tracheal intubation: daily practice is the key to success in emergencies–an analysis of 13,248 intubations. Anesth Analg 2001;92(2):517–522.
3. Williams KN, Carli F, Cormack RS. Unexpected, difficult laryngoscopy: a prospective survey in routine general surgery. Br J Anaesth 1991;66(1):38–44.
4. Levitan RM, Rosenblatt B, Meiner EM, Reilly PM, Hollander JE. Alternating day emergency medicine and anesthesia resident responsibility for management of the trauma airway: a study of laryngoscopy performance and intubation success. Ann Emerg Med 2004; 43(1):48–53.
5. Burkle CM, Walsh MT, Harrison BA, Curry TB, Rose SH. Airway management after failure to intubate by direct laryngoscopy: outcomes in a large teaching hospital. Can J Anaesth 2005;52(6):634–640.
6. Adnet F, Racine SX, Borron SW, Clemessy JL, Fournier JL, Lapostolle F, Cupa M. A survey of tracheal intubation difficulty in the

operating room: a prospective observational study. Acta Anaesthesiol Scand 2001;45(3):327–332.
7. Mort T. Emergency tracheal intubation: complications associated with repeated laryngoscopic attempts. Anesth Analg 2004;99(2):607–613.
8. Ovassapian A, Glassenberg R, Randel GI, Klock A, Mesnick PS, Klafta JM. The unexpected difficult airway and lingual tonsil hyperplasia: a case series and a review of the literature. Anesthesiology 2002;97(1):124–132.
9. Vianello AMA, Arcaro GME, Braccioni FS, Gallan F, Greggio CM, Marangoni A, et al. Management of tracheal intubation in the respiratory intensive care unit by pulmonary physicians. Respir Care 2007;52(1):26-30.
10. Levitan RM, Goldman TS, Bryan DA, Shofer F, Herlich A. Training with video imaging improves the initial intubation success rates of paramedic trainees in an operating room setting. Ann Emerg Med 2001;37(1):46–50.
11. Mulcaster JT, Mills J, Hung OR, MacQuarrie K, Law JA, Pytka S, et al. Laryngoscopic intubation: learning and performance. Anesthesiology 2003;98(1):23–27.
12. Konrad C, Schupfer G, Wietlisbach M, Gerber H. Learning manual skills in anesthesiology: Is there a recommended number of cases for anesthetic procedures? Anesth Analg 1998;86(3):635–639.
13. Levitan RM, Higgins MS, Ochroch AE. Contrary to popular belief and traditional instruction, the larynx is sighted one eye at a time during direct laryngoscopy (letter). Acad Emerg Med 1998;5(8):844–846.
14. Levitan RM. Direct laryngoscopy imaging: teaching and research applications. Educational Synopses in Anesthesiology and Critical Care Medicine The Online Journal of Anesthesia and Critical Care Medicine. June, 1998. Available at http://gasnet.med.yale.edu/esia/1998/jun/samart.html. Reprinted in Am J Anesth 1999;26:39–42. *Accessed November 1, 2006*
15. Cooper R. Airway Cam Video Series, Vol 4: secrets of curved blade laryngoscopy (video review). Can J Anaesth 2004;51(5):524–525.

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16. Heffner JE. Airway Cam Video Series, Vol 3: adult intubation (video review). Respir Care 2002;47(11):1343–1344.
17. Crean P. Airway Cam Video Series, Vol 2: pediatric intubation (video review). Paediatr Anaesth 2002;12(6):563.
18. Burg DM, Donner N. Airway Cam guide to intubation and practical emergency airway management (video review). Acad Emerg Med 2005;12(8):789–790.
19. Ovassapian A. Airway Cam guide to intubation and practical emergency airway management (video review). Anesth Analg 2005; 101(3):930.
20. Jackson C. Peroral endoscopy and laryngeal surgery. St Louis MO: The Laryngoscope Company; 1915.
21. Benumof JL. Difficult laryngoscopy: obtaining the best view. Can J Anaesth 1994;41(5 Pt 1):361–365.
22. Levitan RM, Kinkle WC, Levin WJ, Everett WW. Laryngeal view during laryngoscopy: a randomized trial comparing cricoid pressure, backward-upward-rightward pressure, and bimanual laryngoscopy. Ann Emerg Med 2006;47(6):548–555.
23. Levitan RM, Mechem CC, Ochroch EA, Shofer FS, Hollander JE. Head-elevated laryngoscopy position: improving laryngeal exposure during laryngoscopy by increasing head elevation. Ann Emerg Med 2003;41(3):322–330.
24. Collins JS, Lemmens HJ, Brodsky JB, Brock-Utne JG, Levitan RM. Laryngoscopy and morbid obesity: a comparison of the “sniff” and “ramped” positions. Obes Surg 2004;14(9):1171–1175.
25. Delson NJ, Hastings RH, Weiner MB, Lee J, Patel B. Motion and force trajectories in direct laryngoscopy: a comparison of expert and novice skill (abstract). Anesth Analg 2002;94:S-123.
26. Levitan RM. Chapter 11: Putting it all together: a pre-planned laryngoscopy strategy for first pass success. In: Levitan RM. The Airway Cam guide to intubation and practical emergency airway management. Wayne PA: Airway Cam Technologies, Inc; 2005: 195–200.
27. Kaplan MB, Hagberg CA, Ward DS, Brambrink A, Chhibber AK, Heidegger T, et al. Comparison of direct and video-assisted views of the larynx during routine intubation. J Clin Anesth 2006;18(5):357–362.
28. Biro P, Battig U, Henderson J, Seifert B. First clinical experience of tracheal intubation with the SensaScope, a novel steerable semirigid video stylet. Br J Anaesth 2006;97(2):255–261.
29. Biro P, Weiss M, Gerber A, Pasch T. Comparison of a new video-optical intubation stylet versus the conventional malleable stylet in simulated difficult tracheal intubation. Anaesthesia 2000;55(9): 886–889.
30. Levitan RM. Design rationale and intended use of a short optical stylet for routine fiberoptic augmentation of emergency laryngoscopy. Am J Emerg Med 2006;24(4):490–495.