This issue of the Anesthesiology News Guide to Airway Management includes 3 different perspectives on the added value of recording video laryngoscopies and intubations.

Kenneth Rothfield, MD, describes a quality improvement program that reduced intubation failures by emergency medical services in the field by 90%, largely by reviewing recorded intubations with laryngoscopists. James DuCanto, MD, uses a far more complex recording system: An unobtrusive wide-angle video camera records the operator’s preparation and performance while a device-mounted camera records the laryngeal perspective and yet another records the physiologic monitors. This arrangement requires a degree of electronic sophistication to synchronize, record, and blend the videos and an intense focus on the task. Dr. DuCanto does this exceedingly well, and many have benefited from the videos he has shared, but I suspect few would be able to provide competent clinical care to patients with challenging airways with so many distractions. His approach might be more amenable in the controlled setting of clinical simulation.

Finally, John Sakles, MD, offers a different and potentially game-changing perspective. Few rural emergency medical technicians or emergency room physicians have sufficient experience managing airways to acquire and maintain these skills. Using readily available technology, he has demonstrated that a video laryngoscope, smartphone and videotelephony (such as Skype, FaceTime, and Tango) can connect a base-hospital physician with a laryngoscopist in the field, enabling real-time expert feedback.

Video laryngoscopy has allowed us to see anatomy that was previously concealed from view. Subsequent playback has revealed things we had never before recognized—or documented—such as icteric vocal cords or regurgitation despite cricoid pressure. It has allowed us to share our view in real time and to provide more

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meaningful assistance to students and colleagues. It allows us to learn from our own mistakes and, we hope, to avoid repeating those of others. It also provides a far more accurate and graphic documentation of events. The “easy-or-difficult” dichotomy lacks descriptive potency; the video tells it like it is.

But there are challenges, and questions about the technology remain. Few devices permit smooth video capture. Still fewer have on-board image storage or video replay. The video format is frequently incompatible with that required for archival purposes. Should the burden lie on the clinician to find the right Codec and convert from AVI or BIN to PACS? Devices with video-out ports rarely will accept encrypted data devices, and many hospitals will not read or save data from non-encrypted storage such as USB flash drives or memory cards. Is data collected on portable memory HIPAA compliant? Do video files have protected health information that could result in unauthorized patient identification? Patient consent may be an additional concern, especially when the images may be used for purposes other than internal clinical documentation. Do existing consent forms include the creation of video files and if so, do they restrict the use of such material?

Ahead are technical barriers and privacy concerns. These need to be discussed with the manufacturers of the video laryngoscopes so that data collection in a medically appropriate file format is not technically demanding. We need to involve information technology officers to facilitate seamless clinical uploading of files for archival purposes, much as echocardiography or endoscopy files are retained, not just their reports. Privacy officers must become involved before colleagues unwittingly commit confidentiality breaches that jeopardize their careers, violate patient privacy, and squander the opportunities video recording offers for teaching, learning, research, and clinical documentation.

References

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**Video Laryngoscopy: Evaluation of Stored Intubation Videos for Enhanced Training, Quality Improvement, and Patient Safety**

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Mistakes provide a potent opportunity for effective learning. For example, automotive repair manuals frequently provide photos of both correct and incorrect assembly of parts to help mechanics anticipate and avoid common errors. Professional athletes review videos of competitions with a focus on identifying the causes of mistakes, and strategies for preventing them in future games.

Medicine lags behind other industries in preventing errors. Because of legal, professional, and personal concerns, mistakes often are not shared openly. Therefore, it is not surprising that video examples of actual surgical procedural mistakes are not readily available, despite the fact that they have the potential to prevent harm to future patients. Although a training film showing exactly what it looks like to inadvertently...
staple across the common bile duct during a cholecystectomy in a real patient would provide unforgettable learning to surgeons, no such video is available.

Recognizing the potential value of recording and studying medical errors, we added a unique twist to our facility’s institutional review board–approved, hospital-wide study of video laryngoscopy. Using the newly available GlideScope (Verathon Medical), we automatically captured video records of all emergency intubations performed outside the operating room.1 Operators were not aware that the intubations were being recorded. Videos were reviewed on a weekly basis, and compared with paper records that indicated multiple attempts or intubation failures. In most cases, the videos revealed that the intubations probably would have been successful if steps for remediation were realized and implemented. These videos of intubation failures were assembled into a teaching lecture entitled “The GlideScope Blooper Reel” (Figures 1-4). This was presented to all of the stakeholders in the study, including intensivists, respiratory therapists, and emergency room physicians.

For example, a frequent cause of failed intubation attempt was excessively deep placement of the GlideScope blade. This results in a close-up view of the vocal cords (termed unnecessary zoom at our institution, a phrase borrowed from “Wayne’s World”), which subtly distorts the anatomy by lifting the larynx, and causing the trajectory of the endotracheal tube to be too posterior, aimed at the esophagus. This problem is easily remedied by pulling the GlideScope back until the epiglottis comes into view. However, with no mental model to fall back on, very few intubators employed this simple step to salvage an intubation.

The “blooper reel” provides multiple examples of overly deep blade placement. Other common causes of failures presented in the video include inadequate tongue displacement, failing to use suction first in soiled airways, and the need for muscle relaxation.

Watching the blooper reel has been an epiphany to some of our providers. One of our physicians had been somewhat reserved in his enthusiasm for video laryngoscopy, particularly because he “could see the cords but could not get the tube in.” After seeing some of his own cases projected onto a large screen, he realized that the problems he was encountering were due not to the device, but rather to his technique (Figures 5-6). His success improved dramatically after this training.
Successful intubation more difficult.

Visualization of the epiglottis. This makes too deeply in airway simulator. Note poor intubation success.

Figure 5. GlideScope blade inserted too deeply in airway simulator. Note poor visualization of the epiglottis. This makes successful intubation more difficult.

Figure 6. GlideScope blade withdrawn slightly. Epiglottis in better view. Improved likelihood of intubation success.

Figure 7. Dr. Rothfield has strongly promoted the first-line use of video laryngoscopy to improve patient safety both inside and outside the operating room, as well as in prehospital settings.

This video-based strategy, which focused on causes of intubation failure, was incorporated into our subsequent evaluation of the GlideScope in the prehospital setting (Figure 7). The paramedics of the Howard County, Maryland, Department of Fire and Rescue have reduced intubation failures by more than 90%, using didactics, simulation, and video training with the GlideScope.

Many current video laryngoscopes possess recording capability. Although video examples of neatly performed intubations are readily available on the Internet, memorable and impactful learning occurs when video debriefing is performed after imperfect, real-world procedures. Health care organizations should strongly consider implementing a program for recording, analyzing, and discussing intubations to advance quality improvement and patient safety.

References
Video laryngoscopy (VL) arguably is the most significant development in airway management in this century. It has revolutionized the process of airway management by providing numerous advantages over direct laryngoscopy (DL). VL incorporates a micro-video camera on the laryngoscope blade, thereby bringing the view of the airway out of the patient and onto a monitor. As a result, the operator no longer needs to achieve a direct line of sight of the airway, as is necessary with DL. Moreover, many video laryngoscopes provide a magnified view of the airway, making identification of the laryngeal structures easier.

VL not only allows the operator to be able to see the airway during intubation, the technology enables other health care providers to share the same view of the airway—making them better able to provide assistance during intubation. Many video laryngoscopes also have the ability to record intubations. These recordings are invaluable for review after procedures and extremely useful for educating other health care providers. In addition, saved images can be incorporated into the medical record to provide undisputable proof of correct placement of tracheal tubes.

The use of VL also has contributed to another very novel application for airway management. By combining a VL device with a simple telemedicine unit such as a smartphone, an expert in airway management can provide remote “telebation” assistance to a health care provider performing an intubation at a distant location. Our group pioneered telebation in 2009 and published our initial results in 2011. When initially developing the technique, we used wired T1 connections to transmit the audio and video data. But with the widespread availability of smartphones and videoconferencing software, we developed a completely wireless approach to telebation, which we described in a recent review.

We have experimented with multiple VoIPs to determine the feasibility of supervising telebations remotely. We have studied several inexpensive VoIP clients including FaceTime, Skype, and Tango, using a cellular (3G) or WiFi network. We found that each of these VoIPs provided an excellent view of the video monitor to the remote supervisor with little to no lag time. However,
use of the iPhone (Apple) with FaceTime over WiFi networks provided the best video and audio quality.

We evaluated several video laryngoscopes, including the GlideScope (Verathon Medical), the C-MAC (Karl Storz), the McGrath (Covidien), and the King Vision (Ambu). We were able to assist operators remotely intubating using each of these devices, although those with larger screens were logistically easier to use for telebation.

For the GlideScope and the C-MAC, we developed a small phone cradle to hold an iPhone pointing toward a pole-mounted VL monitor. This approach allowed essentially a “hands-free” setup that was unobtrusive yet it enabled remote viewing by a coach. When using a portable VL, an assistant was necessary to hold the phone close to the video screen to be able to transmit the video image, complicating the situation somewhat.

We now have performed more than 20 telebations using different VoIP clients and video laryngoscopes. We believe that this new technology has the potential to greatly improve the safety of airway management around the world by allowing expert airway managers to assist less experienced airway managers in remote locations without having to be physically present during the intubation. Further evaluation of the technique of telebation is warranted to determine the effect of this technology on improving the quality and safety of emergency airway management.

References

Figure 2. GlideScope intubation using iPhone with FaceTime.
Recording Clinical Procedures To Accelerate Learning and Enhance The Quality of Airway Management

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Video and audio recording of clinical cases involving airway management can offer physicians-in-training, as well as their attending staff, an accelerated path to learning various airway management procedures. Recording of clinical cases and simulations provides tremendous value in helping trainees to analyze the many aspects of clinical airway management, and to recognize and correct mistakes and wasted motions. It can provide an unparalleled tool in quality management projects and the education of students, residents, fellows, and attending physicians.

Pre-procedure consent should be sought from the patient, with an explanation that the video and audio footage will be used for the purpose of medical education and quality management. Inform the patient that strict confidentiality will be maintained, and that any identifying features of his or her body will be obscured. Use an institutional consent form for the collection of video and photographs. If the collected footage may be uploaded to the Internet, inform the patient that the site is focused on medical attention, not public use, and include information to that effect on the consent documents.

Specific analysis of the video recording reveals the degree of preparation of the endoscopist, their approach to maintaining ventilation, their body posture/approach to the airway, and several other factors that determine whether or not the procedure will be smooth. Simultaneous video recording of the patient-care monitor—with embedding of this physiologic data in a corner of the main movie recordingProvides a “heads-up display” of the clinical course of each individual case. Attention to the monitor during the recording of a clinical case can reveal the adequacy of ventilation both pre- as well as postinduction. The monitor also tracks the “major events” of the case, such as the positive and negative effects of the sedative or anesthetic medication. Analysis of the body posture and mechanics of the endoscopist give clues to appropriate or inappropriate maneuvers during the procedure; these reflect their comprehension of the mechanics of the endoscopy procedure as well as their understanding of airway anatomy and physiology.

Recording of airway management procedures is best performed from a side angle that permits a view of the endoscopist, assistant, and the head of the bed. The camera typically is best placed atop the anesthesia machine looking down or on an IV pole from the side (Figure). The most simple and useful device for recording procedures is a GoPro, Contour, or other digital sports action camera. Their wide-angle lenses allows complete capture of the clinical scene from 3 feet away, while their small sizes minimize distraction of the clinical team.

To record the output of video-enabled endoscopes, the endoscope must be able to export the video signal to a recording device. Newer video laryngoscopes (VLs) generally offer direct recording of the endoscopic procedure either to an SD card or a USB memory stick. Older generations of VLs required a separate video recording device, connected to the endoscope through a video output cable. When VLs lack this internal recording feature, the most flexible method for recording the output of airway endoscopes is through a video conversion bridging system that converts analog to digital. If a laptop computer is used, it can serve as an auxiliary or even primary monitor during the airway endoscopy. An example of such a video conversion/capture system is the Elgato Video Capture device.

In one example how video and audio technology can aid the quality improvement process, we recorded 2 separate cardiac arrest resuscitations at a semi-rural emergency department (ED). Careful analysis of the video and audio from both cases revealed inconsistency in CPR quality and the use of capnography during airway management. As result of the analysis of...
these videos, ED physicians at this institution elected to acquire, train, and use an automated chest compression device for all cardiac resuscitation cases, as well as incorporate the standard use of capnography during resuscitation.

In addition to the numerous benefits to physicians in training, video recording of procedures offer the accomplished clinician an opportunity to master airway management procedures through the careful and meticulous analysis of the various factors involved in this aspect of anesthetic care. The process and methodology of reviewing the performance of clinical cases, as well as cases in simulation, is akin to the use of video footage in the analysis of professional athletes during training or actual game play.

It is abundantly clear to even the casual viewer the artistry and athleticism displayed by an outfielder who is able to leap into the air to catch a falling ball before it crests the wall of a stadium. Such an athlete demonstrates mastery of his mind and body as he achieves the catch before a packed baseball stadium. Such mastery over airway management procedures can be similarly developed and demonstrated through careful and meticulous analysis of clinical and simulated cases.