

A Historical Perspective on Use of the Laryngoscope as a Tool in Anesthesiology

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EACH year, one of the first skills anesthesia residents must master is direct visualization of the vocal cords to safely and successfully intubate the trachea of surgical patients. Debates have raged in teaching centers about the superiority of one laryngoscope over another or the merits of a straight *versus* a curved blade. However, this yearly debate is a phenomenon of the twentieth century, as anesthesiologists sought better tools to facilitate patient care. Physician interest in visualizing the vocal cords can be traced to at least the mid-1700s.^{1,2} However, controversy remains as to who deserves historical credit for the development of the laryngoscope.² An appreciation of the contributions of several innovative scientists involved with the development of the laryngoscope over more than 250 yr may be of greater importance.¹⁻⁴ Although the laryngoscope was initially a tool developed solely for the otolaryngologist, advances in anesthesia during the early 20th century made the addition of the laryngoscope and development of the skills to use it successfully essential to the anesthesiologist. The introduction of the laryngoscope into the practice of clinical anesthesia is best described by considering these advances in the "surgeon" and "anesthesiologist" periods.

Fits and Starts

Early pioneers invented a variety of tools useful in the visualization of areas of anatomic interest for diagnostic and therapeutic purposes. Naturally, these attempts were neither continuous nor smooth. For example, in 1743, Leveret reported visualization of the nose and oral pharynx through the use of a brightly polished metal spatula.¹ This instrument was used to assist in the excision of choanal polyps.² Sixty-four years later, Philipp von Bozzini of Germany published a report on the use of a speculum to visualize internal body cavities. Von Bozzini's reflective device consisted of two parallel metal tubes³ (fig. 1). One of the tubes allowed for illumination of the site, and another allowed for visualization of the

area of interest. Unlike the reflective instrument described by Leveret, an external light source (of either sunlight or candlelight) was used. Von Bozzini is therefore credited as the first to use an external light source to illuminate body cavities.² Although von Bozzini described the use of his device to observe the nasopharynx and the hypopharynx, visualization of the larynx was not mentioned.²

In 1929, Benjamin Guy Babington of London, England, was the first to publish a report describing use of a device to view the larynx. This device used sunlight as an external light source, a speculum was used to move the tongue out of the way, and the larynx was reflected to the operator through the use of mirrors. Although the larynx was said to be in view, no reference was made in Babington's reports to observation of the vocal cords.²

The man generally regarded as one of the fathers of laryngology is Manuel Garcia.³ He is considered to be the first individual to view the functioning glottis in its entirety. A singing teacher by trade, he had become frustrated by an inability to observe the vocal cords in action.³ He reportedly observed the sun reflecting off windowpanes while walking through a garden in Paris. From this observation, he developed a tool that used two mirrors for which the sun served as an external light source.⁴ Garcia was able to observe his own functioning vocal cords and the upper segments of his trachea using this device and described full glottic function.³ His findings were presented at the Royal Society of London in 1855.²

Enter the Surgeon

All observations of the vocal cords had been under indirect vision until Alfred Kirstein of Germany first described direct visualization of the vocal cords. Kirstein may have been motivated by the interest in direct visualization of the vocal cords brought on by Kaiser Frederick's death from laryngeal cancer in 1888. One of Kirstein's colleagues mistakenly passed an endoscope intended to view the esophagus of a patient into the trachea instead. This event motivated Kirstein to develop the *autoscope*, a device that facilitated direct visualization of the larynx⁵ (figs. 2-4). Many adaptations were made to the device after the first autoscope was described in 1895. These modifications led to great improvements in laryngeal visualization and decreased the adverse consequences of direct laryngoscopy. By combining a proximal electrical light source within the handle of the autoscope with one of two thickened and

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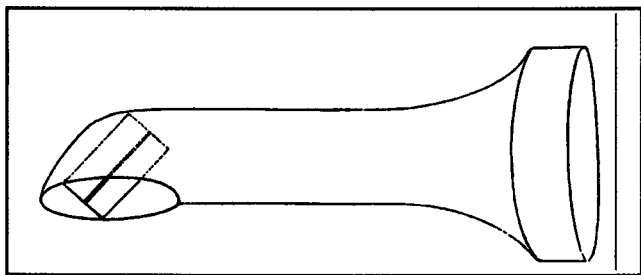


Fig. 1. Ozzin's laryngeal speculum (after Hufeland). The speculum was divided by a vertical partition, and two mirrors were placed at its extremity. In the drawing from which this is taken, the mirrors are directed upward as they would be when used in rhinoscopy. From Bailey²; reprinted with permission.

rounded metal blades, the epiglottis could be elevated to bring the vocal cords into view. As a result, Kirstein has become known as the pioneer of direct laryngoscopy. Basic techniques to remove foreign bodies from the airway and to visualize the tracheobronchial tree for diagnostic purposes resulted from his work. Kirstein's basic devices and techniques are widely accepted in the practice of modern anesthesiology and laryngology.

Chevalier Jackson, Professor of Laryngology at Jefferson Medical College in Philadelphia, Pennsylvania, a great American endoscopist, was the first to describe the combination of direct visualization of the larynx with the passage of an endotracheal tube with a high rate of success.⁶ Jackson was greatly influenced by Kirstein's earlier work, with the importance of a light source to properly view the larynx apparent to both individuals. However, Jackson was able to design a laryngoscope

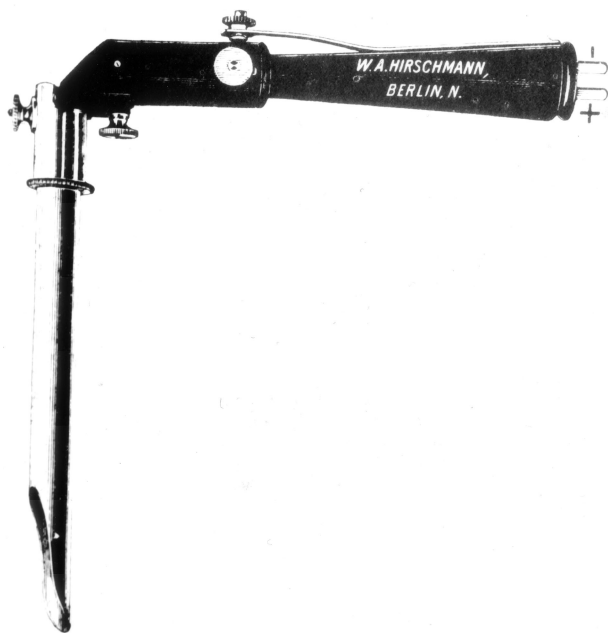


Fig. 2. Kirstein's original autoscope, consisting of an esophagoscope and an electroscope (Yale Medical Library, New Haven, Connecticut). From Yale University, Cushing/Whitney Medical Library; reprinted with permission.

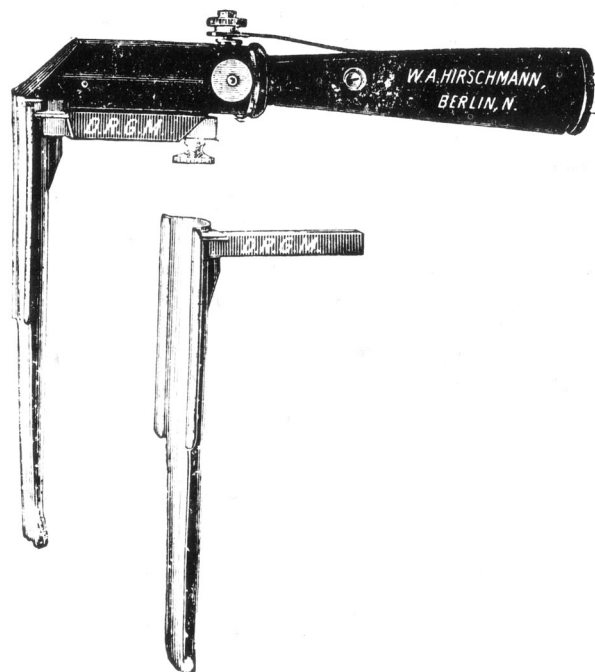


Fig. 3. Kirstein's modified autoscope. The standard blade is shown attached to the handle, with the intralaryngeal blade shown below (Yale Medical Library, New Haven, Connecticut). From Yale University, Cushing/Whitney Medical Library; reprinted with permission.

blade with a distal light source rather than the proximal design used by Kirstein^{3,7} (fig. 5). Through the design of a removable or sliding floor to the laryngoscope blade, room for passage of an endotracheal tube or bronchoscope was established.^{3,7} Jackson published his work in this area in a 1913 article entitled "The Technique of Insertion of Endotracheal Insufflation Tubes."³



Fig. 4. Kirstein performing direct laryngoscopy. Note both the position of the patient's head and the use of the left hand to hold the autoscope (Yale Medical Library, New Haven, Connecticut). From Yale University, Cushing/Whitney Medical Library; reprinted with permission.



Fig. 5. Jackson's laryngoscope. Reprinted with permission from Wood Library-Museum of Anesthesiology, Park Ridge, Illinois. Gift of Naomi L. Dalton, M.D.

Enter the Anesthesiologist

Up to this time, the laryngoscope was a tool widely used only by laryngologists.⁵ However, several potential advantages of direct laryngoscopy in the practice of anesthesia were apparent. Henry Janeway, an American anesthesiologist practicing at Bellevue Hospital in New York, New York, was instrumental in popularizing the widespread use of direct laryngoscopy in anesthesiology. In 1913, the same year Chevalier Jackson published his article, Janeway published an article entitled "Intratracheal Anesthesia from the Standpoint of the Nose, Throat and Oral Surgeon With a Description of a New Instrument for Catheterizing the Trachea."⁸ At this time, surgery involving the mouth and nose was performed by inhalation anesthesia (by applying a cone over the mouth and nose), through the topical application of local anesthetics to the nasal or pharyngeal mucosa using a bulb-type apparatus, by rectal anesthesia, or by intravenous anesthesia. Many of these techniques had the disadvantages of not protecting the airway from obstruction by the tongue and exposing patients to the risk of aspiration of blood and mucus into the trachea. Janeway believed the greatest success in these cases could be achieved through intratracheal insufflation of anesthetics. However, he expressed concerns about the ease of placing a proper intratracheal catheter. Janeway developed a laryngoscope designed for the sole purpose of allowing the anesthesiologist to place an intratracheal conduit with consistent success to help alleviate these concerns (fig. 6). The "speculum" Janeway designed incorporated a distal light source with battery power within the laryngoscope handle itself. This handle-inclusive battery power was the first of its type. Additional features included a shortened distal end of the speculum that eliminated the need for a telescope to adequately view the larynx, a central notch for maintaining the catheter in the midline during placement, and a curve to

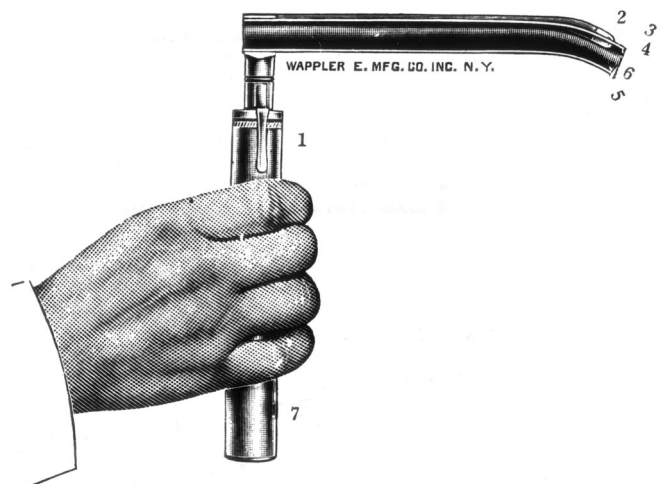


Fig. 6. Direct speculum for catheterizing the trachea. (1) Press button for illuminating the lamp. (2) Lamp. (3 and 4) Direction of vision. (5 and 6) Direction taken by the catheter. (7) Handle containing two dry cells. From Janeway⁸; reprinted with permission.

the distal end of the blade to help direct the catheter through the vocal cords.^{8,9} Although Janeway's motivation for designing a laryngoscope to facilitate placement of an intratracheal catheter was prompted by the requirements of oral and nasal surgery, it was subsequently generalized to include provision of intratracheal anesthesia for other types of surgery as well.

Janeway's laryngoscope never gained widespread popularity. However, endotracheal anesthesia became increasingly popular around this time as a safe means to provide anesthesia for face and upper respiratory tract surgery during the First World War.¹⁰ Shortly thereafter, from 1914 to 1918, Sir Harold Gillies and two British anesthesiologists, Ivan W. Magill and E. S. Rowbotham, described methods to provide safe intratracheal anesthesia during face and respiratory tract surgery during service with the British Army Plastic Unit. Through the use of two insufflation catheters placed into the trachea with the aid of intubating forceps, the trachea could be protected from aspiration. Subsequently, Magill and Rowbotham established the use of a single larger bore tube allowing inhalation and exhalation through a single conduit. This method was more physiologic in nature, more feasible economically, and allowed for better heat and moisture retention than the insufflation techniques previously described.¹⁰ This work further developed techniques for inhalation anesthesia that remain in use today.

Equipment Design: The Case of the Mayo Clinic

John S. Lundy, the head of the section on anesthesia at the Mayo Clinic, Rochester, Minnesota, met Sir Ivan Magill at a medical meeting in 1930. During the course of the meeting, Magill taught Lundy his method of tracheal intubation.⁵ Lundy and his colleagues at the Mayo Clinic further developed this technique and published several

articles on its use in a variety of different surgical procedures.^{7,8} They reported 5,117 surgical cases using intratracheal anesthesia between 1930 and 1937.¹¹ In the 1933 Mayo Clinic Department of Anesthesia Report, Lundy described the placement of an endotracheal tube by blind passage or with the use of a laryngoscope and lighted forceps.¹² Information from another active academic center, the University of Wisconsin, indicates just over 7% of their surgical cases included the use of an endotracheal tube in 1933.¹³

There is little doubt the advantages of endotracheal anesthesia over insufflation anesthesia were becoming better known and more popular. However, equipment designed explicitly for the needs of the anesthesia community was rare. A cooperative agreement between manufacturers and physicians developed to create anesthesia-specific laryngoscopes. An example of this is the communication between Dr. Lundy in Rochester, Minnesota, and the Welch Allyn Company in Auburn, New York. Welch Allyn designed what they called the *Lundy blade* after much correspondence and several trials of particular blade designs.

Dr. Lundy wrote to Welch Allyn in a letter dated November 22, 1938:

I should like to have the blade closer to the handle, instead of the 1 1/2-inch neck which separates the blade from the handle. I should like to try it and return the other one that I do not want. Under what description will this scope go, so that if we want another we can order a duplicate.¹⁴

In reply to Dr. Lundy, the Welch Allyn Company wrote:

We shall be glad to supply you with an instrument with a different length of neck in exchange for the one that you have. This type will be known as the Dr. Lundy Scope.¹⁵

The Lundy scope evolved from the combined efforts of a clinician and a medical equipment manufacturer. The Lundy scope incorporated a rigid laryngoscope design because transport from hospital to hospital was of minimal importance in Lundy's practice setting. Guedel, on the other hand, used a folding laryngoscope blade and light source for ease in transport from one anesthetizing location to another because a rigid laryngoscope was less well-suited for transport from one hospital to another. These devices had in common their own light source powered by a dry-cell battery.

Current Laryngoscope Blades

Many other designs for laryngoscope blades were also being developed around this time. The *Wisconsin blade* used a straight blade design with one light source, whereas the *Searle blade* used two bulbs, one on each side of the blade. Information regarding laryngoscope blades was not published until 1941, when Robert Miller authored an article in *ANESTHESIOLOGY*.¹⁶ In this article,

Miller reported his design of a blade with a curve on the bottom and a curved distal tip, currently known as the *Miller blade*.^{1,3,16} In 1943, Robert Macintosh designed a blade with a continuous curve.^{3,17} The added curve was designed to lessen the chance of damage to the patient's upper teeth.¹⁷ Modifications over the years have been made to both blades for the purpose of providing better intubating conditions in particular patient subtypes.

Conclusion

Much has transpired since Leveret used a brightly polished metal spatula to facilitate the removal of choanal polyps in the mid-eighteenth century. Advances in the practice of anesthesia established a need for the laryngoscope, but its development also allowed for advances in the specialty. Janeway deserves considerable credit for his role in the transition of the laryngoscope as a tool used solely by the laryngologist to a fundamental instrument of the anesthesiologist. He popularized a technique commonly used by contemporary anesthesiologists to perform safe and effective intratracheal anesthesia. Without the curiosity, imagination, and industry support of these pioneers, anesthesia care as we know it today would be impossible.

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