

The History of Endotracheal Intubation

Frank Borschke, MD, FACEP*

Bradford L. Walters, MD, FACEP**

**William Beaumont Hospital, Department of Emergency Medicine
Oakland University William Beaumont School of Medicine**

Airway management in the opinion of many is one of the defining skills of an emergency physician. The ability to sedate and paralyze a patient and to then establish a definitive airway is an essential task in many medical and trauma resuscitations. Emergency physicians now use various modalities to visualize the glottic opening when intubating a patient and if required can create a surgical airway. The modern era of airway management was a culmination of advancements both in medicine and technology.

The first case of using general anesthesia for surgery was on the famous Ether Day, on October 16, 1846 at the Massachusetts General Hospital. Seven years later on April 7, 1853, Dr. John Snow administered chloroform analgesia to Queen Victoria for the delivery of her eighth child, Prince Leopold, thus ushering in the era of obstetrical anesthesia. During the Civil War most of the capital surgeries were done using general anesthesia even in the primitive conditions of the medical aid stations. Despite the common use of chloroform, ether, and nitrous oxide for general anesthesia, intubating the patient was not part of the management of these patients. Because undergoing general anesthesia lead to the loss of airway reflexes, death from these surgeries was not that uncommon.

Prior to these elective surgeries there was interest in intubation and its use to resuscitate drowning victims. In 1778 a surgeon, Dr. Charles Kite, developed the first endotracheal tube. He described placing a catheter through the nares or mouth of drowning victims and using it to resuscitate them by providing positive pressure breaths with bellows. His paper that described his experiences was titled *The Recovery of the Apparently Dead* and he advised that once the tube was in place one could blow into it or use a bellows to ventilate the lungs. In 1793 the French surgeon Pierre-Joseph Desault (1674-1750) avoided a tracheostomy by using a flexible catheter introduced through the mouth and into the larynx to provide artificial respirations to a patient with dyspnea. This was one of the first reports of intubation for a disease state as opposed to a drowning victim. This type of catheterization of the airway briefly became a common procedure in France before later falling out of favor.

In the 1800's diphtheria and croup were devastating infectious diseases, especially lethal in children. The cause of death was most often asphyxia as the airway was obstructed by the diphtheria pseudomembrane or narrowed by the inflammation of croup to the point where the child could not breathe. Prior to endotracheal intubation the only treatment available to prevent this was an emergent tracheotomy. This was a difficult procedure in children because of the

small size and the mobility of their trachea. Mortality in patients afflicted with diphtheria was greater than 70% even with tracheotomy. The patients that survived the surgery often succumbed to an inevitable post-operative tracheal stenosis. The high mortality and complication rate of early tracheostomies lead physicians to develop new and less invasive treatments for these patients.

The attempts to perfect airway management continued and in 1839 Dr. Johann F. Dieffenbach (1792-1847) of Berlin reported his failed attempt to catheterize the larynx of a patient with diphtheria. The noted French physician J. F. Reybard (1795-1863) was later reported to have used a catheter to relieve a laryngeal obstruction from diphtheria in 1855. These early attempts opened the door to more experimentation and the subsequent developments by Drs. Eugene Bouchut (1818-1891) and Joseph O'Dwyer (1841-1898).

In 1858 Eugène Bouchut, a pediatrician in Paris, refined a method to bypass a laryngeal obstruction due to diphtheria without having to perform a tracheotomy. This consisted of introducing a small straight metal tube (2cm x 7cm) within the glottic space for several days and securing it by means of a silk thread. The tube was placed in the trachea by means of a curved catheter. Bouchut's tubes had the disadvantage of being rigid with sharp edges that caused mucosal trauma to the larynx and were painful for the patient. Bouchut presented his technique, used in seven cases to the National Academic Conference. Of these, only two patients survived and both of those needed tracheostomy. Bouchut abandoned his research efforts after being ridiculed at the conference by the eminent Armand Trousseau (1801-1867) who was the surgeon credited with perfecting the technique of surgical tracheotomy. But, the idea of a tube stenting the trachea and acting as an artificial airway inserted through the vocal cords began to draw attention for the medical establishment.

In 1878 the first elective intubation was done by a Scottish Surgeon, William Macewan (1848-1924). He placed a flexible metal tube in a patient prior to using chloroform-air for anesthesia. The tube became dislodged and the patient died, causing Macewan to lose confidence in the procedure. However, the technique he described was used by other physicians as they continued to address the difficult problem of establishing a definitive airway in the patient who could not maintain one.

Thirty years after Bouchut's research an American surgeon and pediatrician, Joseph P. O'Dwyer, developed another technique for laryngeal intubation in children with diphtheria or croup. The tubes he developed were smaller and, although still made of a metal, had rounded less traumatic edges. These small adjustments made the procedure technically easier and more tolerable for the patient. After a number of revisions, the final tubes were made of brass, lined with gold, and came in five different lengths ranging from 1.5 to 2.5 inches. The tubes had a "shoulder" at the top so that they would not slip past the larynx. The actual technique of intubation as developed by O'Dwyer was with the patient

sitting facing the physician. The physician's index finger was then inserted to blindly pull back on the epiglottis while guiding an angulated introducer into place. This was then used to pass the endotracheal tube into the trachea. A small thread was placed through the outer edge of the tube to aide in removal. Once intubated the patient was ventilated using a bellows attached to a T-piece developed by Dr. George Fell (1849-1918) of Buffalo, New York. O'Dwyer's tubes and method was quickly adopted by American physicians and became the first widely used endotracheal technique. O'Dwyer is frequently cited as the "*father of laryngeal intubation in croup.*" By 1889 the rubber endotracheal tube devised by Thomas Annandale (1838-1907) supplanted metal tubes. This type of endotracheal tube would be used for the next 40 years virtually unchanged save for a small cap that contained cotton wool that one would sprinkle chloroform. It was abandoned as anesthesia machines were developed. By the late 1890's multiple physicians had advocated endotracheal intubation in the noted medical journals of the day with the procedure gaining wide-spread acceptance. With that acceptance, advances and innovations were developed in rapid order taking advantage of new materials and better devices to ventilate the lungs.

One of the more vexing problems faced once a patient was intubated was that air would leak around these tubes making it difficult to ventilate the patient. This same flaw in design led to aspiration should the patient vomit. There was high mortality rate when with aspiration pneumonia. In 1893 the first cuffed endotracheal tube was developed by a German physician, Victor Eisenmenger (1864-1932). It substantially improved the ability to ventilate a patient and reduced the dreaded complication of aspiration pneumonia in the pre-antibiotic era.

Considering the difficulties of the blind intubation technique used by O'Dwyer the need for visualization of the larynx became more evident. The first laryngoscope to visualize the airway was used by Kirsetein in Germany in 1895. His device used sunlight as a lighting source until 1913 when battery powered laryngoscopes became available. Various improvements to the laryngoscope were rapidly made as orotracheal intubation during surgery and for diseases that compromised the upper airway became routine. During WWI Dr. Ivan W. Magill (1888-1986) developed a technique of blind nasotracheal intubation for facial trauma, a type of straight blade for a laryngoscope in 1921, and in 1920 his eponymous forceps to aid passage of an endotracheal tube into the trachea and to retrieve foreign bodies from the oropharynx. Dr. Henry Janeway (1873-1921) of Bellevue Hospital in New York City developed a direct laryngoscope quite similar to ones used today. Various blades were also developed with the most popular being the Magill and one developed in 1921 by Dr. Robert R. Macintosh (1897-1989). By 1964 endotracheal tubes were made of polyvinylchloride plastic with low-pressure balloon cuffs. In the last decade advances in video camera assisted laryngoscopes were developed with various models available that have increased the ability to visualize the glottic opening particularly in patients with a difficult airway. Today endotracheal intubation is performed across emergency

departments on a daily basis and is considered a routine procedure. The techniques and instruments used represent one of the most innovative chapters in medical history as physicians struggled with the problem of the patient with a compromised airway and the need for a definitive one.



FIG. 2.



FIG. 3.



Joseph P. O'Dwyer, MD (1841-1898) and a set of O'Dwyer tubes for a child 2-3 years old. The blind techniques of intubation is noted below.



FIG. 11.—Method of performing intubation.

O'Dwyer method of digitally assisted endotracheal intubation.

Examples of modern Miller and Macintosh laryngoscopes and blades.





Examples of the Glidescope and CMAC video laryngoscopes

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*Frank Borschke, M.D., FACEP

William Beaumont Hospital, Department of Emergency Medicine, Royal Oak, Michigan

Assistant Professor, Oakland University William Beaumont School of Medicine, Rochester, Michigan

** Bradford L. Walters, M.D., FACEP

Assistant Residency Director, Beaumont Health System Emergency Medicine Residency, William Beaumont Hospital, Department of Emergency Medicine, Royal Oak, Michigan

Associate Professor, Oakland University William Beaumont School of Medicine, Rochester, Michigan