International Journal of Medical and Health Research
ISSN: 2454-9142
Received: 29-09-2019; Accepted: 30-10-2019; Published: 26-11-2019
www.medicalsciencejournal.com
Volume 5; Issue 11; 2019; Page No. 268-273

Study of difficult laryngoscopy and intubation in the cases from Bihar region

Dr. Shailesh Prasad[1], Dr. Bhagwan Das[2*]
[1] Assistant Professor, Department of Anesthesia, Anugrah Narayan Magadh Medical College, Gaya, Bihar, India
[2] Senior Resident, Department of Anesthesia, Anugrah Narayan Magadh Medical College, Gaya, Bihar, India
[*] Corresponding Author: Dr. Bhagwan Das

Abstract
Tracheal intubation can be associated with minor complications such as broken teeth or lacerations of the tissues of the upper airway. It can also be associated with potentially fatal complications such as pulmonary aspiration of stomach contents which can result in a severe and sometimes fatal chemical aspiration pneumonitis, or unrecognized intubation of the esophagus which can lead to potentially fatal anoxia. Because of this, the potential for difficulty or complications due to the presence of unusual airway anatomy or other uncontrolled variables is carefully evaluated before undertaking tracheal intubation. Alternative strategies for securing the airway must always be readily available.
The present study was planned in Department of Anesthesia, Anugrah Narayan Magadh Medical College, Gaya, Bihar. The study was conducted from February 2013 to January 2014. Total 100 cases scheduled for elective surgery under general anaesthesia requiring tracheal intubation were included in the present study.
The data generated from the present study concludes that there are differences in anatomical measurements commonly used to predict a difficult airway between the Indian and non-Indian population. This implies that standard threshold values for predicting a difficult airway may not apply in the Indian population. Airway management remains an important challenge in the contemporary practice of anaesthesia and preoperative airway assessment facilitates appropriate preparation when difficulty with intubation or ventilation is anticipated prior to induction of anaesthesia. Direct laryngoscopy is the gold standard for tracheal intubation. There is no single definition of difficult intubation. Difficult glottic view on direct laryngoscopy is the most common cause of difficult intubation. Difficult laryngoscopy, where in, it is not possible to visualize any portion of the vocal cords after multiple attempts at conventional laryngoscopy.

Keywords: airway evaluation, difficult intubation, difficult laryngoscopy, intubation difficulty scale, etc

Introduction
Laryngoscopy is endoscopy of the larynx, a part of the throat. It is a medical procedure that is used to obtain a view, for example, of the vocal folds and the glottis. Laryngoscopy may be performed to facilitate tracheal intubation during general anaesthesia or cardiopulmonary resuscitation or for surgical procedures on the larynx or other parts of the upper tracheobronchial tree.
Direct laryngoscopy is carried out (usually) with the patient lying on his or her back; the laryngoscope is inserted into the mouth on the right side and flipped to the left to trap and move the tongue out of the line of sight, and, depending on the type of blade used, inserted either anterior or posterior to the epiglottis and then lifted with an upwards and forward motion ("away from you and towards the roof "). This move makes a view of the glottis possible. This procedure is done in an operation theatre with full preparation for resuscitative measures to deal with respiratory distress. There are at least ten different types of laryngoscope used for this procedure, each of which has a specialized use for the otolaryngologist and medical speech pathologist. This procedure is most often employed by anaesthetists for endotracheal intubation under general anaesthesia, but also in direct diagnostic laryngoscopy with biopsy. It is extremely uncomfortable and is not typically performed on conscious patients, or on patients with an intact gag reflex.
Indirect laryngoscopy is performed whenever the provider visualizes the patient's vocal cords by a means other than obtaining a direct line of sight (e.g. a mirror). For the purpose of intubation, this is facilitated by fiberoptic bronchoscopes, video laryngoscopes, fiberoptic stylets and mirror or prism optically-enhanced laryngoscopes.
Some historians (for example, Morell Mackenzie) credit Benjamin Guy Babington (1794–1866), who called his device the "glottiscope", with the invention of the laryngoscope [1]. Philipp von Bozzini (1773–1809) [2, 3] and Garignard de la Tour were other early physicians to use mouth mirrors to inspect the oropharynx and hypopharynx [4].
In 1854, a Spanish vocal pedagogist named Manuel García (1805–1906) became the first man to view the functioning glottis and larynx in a living human. García developed a tool that used two mirrors for which the Sun served as an external light source [5, 6]. Using this device, he was able to observe the function of his own glottic apparatus and the uppermost portion of his trachea. He presented his findings at the Royal Society of London in 1855 [7, 8].
All previous observations of the glottis and larynx had been performed under indirect vision (using mirrors) until 23 April 1895, when Alfred Kirstein (1863–1922) of Germany first described direct visualization of the vocal cords. Kirstein performed the first direct laryngoscopy in Berlin, using an esophagoscope he had modified for this purpose; he called this device an autoscope [9]. It is believed that the

death in 1888 of Emperor Frederick III [10] motivated Kirstein to develop the autoscope [11].

In 1913, Chevalier Jackson was the first to report a high rate of success for the use of direct laryngoscopy as a means to intubate the trachea [12]. Jackson introduced a new laryngoscope blade that had a light source at the distal tip, rather than the proximal light source used by Kirstein [13]. This new blade incorporated a component that the operator could slide out to allow room for passage of an endoracheal tube or bronchoscope [14].

That same year, Henry Harrington Janeway (1873–1921) published results he had achieved using another new laryngoscope he had recently developed [15]. An American anesthesiologist practicing at Bellevue Hospital in New York City, Janeway believed that direct intratracheal insufflation of volatile anesthetics would provide improved conditions for surgery of the nose, mouth and throat. With this in mind, he developed a laryngoscope designed for the sole purpose of tracheal intubation. Similar to Jackson's device, Janeway's instrument incorporated a distal light source. Unique however was the inclusion of batteries within the handle, a central notch in the blade for maintaining the tracheal tube in the midline of the oropharynx during intubation, and a slight curve to the distal tip of the blade to help guide the tube through the glottis. The success of this design led to its subsequent use in other types of surgery. Janeway was thus instrumental in popularizing the widespread use of direct laryngoscopy and tracheal intubation in the practice of anesthesiology [11].

The vast majority of tracheal intubations involve the use of a viewing instrument of one type or another. Since its introduction by Kirstein in 1895 [9], the conventional laryngoscope has been the most popular device used for this purpose. Today, the conventional laryngoscope consists of a handle containing batteries with a light source, and a set of interchangeable blades.

Early laryngoscopes used a straight "Magill Blade", and this design is still the standard pattern veterinary laryngoscopes are based upon; however the blade is difficult to control in adult humans and can cause pressure on the vagus nerve, which can cause unexpected cardiac arrhythmias to spontaneously occur in adults.

Two basic styles of laryngoscope blade are currently commercially available: the curved blade and the straight blade. The Macintosh blade is the most widely used of the curved laryngoscope blades [16], while the Miller blade [17] is the most popular style of straight blade [18]. Both Miller and Macintosh laryngoscope blades are available in sizes 0 (neonatal) through 4 (large adult). There are many other styles of curved and straight blades (e.g., Phillips, Robertshaw, Sykes, Wisconsin, Wis-Hipple, etc.) with accessories such as mirrors for enlarging the field of view and even ports for the administration of oxygen. These specialty blades are primarily designed for use by anesthetists, most commonly in the operating room [19]. Additionally, paramedics are trained to use direct laryngoscopy to assist with intubation in the field.

The Macintosh blade is positioned in the vallecula, anterior to the epiglottis, lifting it out of the visual pathway, while the Miller blade is positioned posterior to the epiglottis, trapping it while exposing the glottis and vocal folds. Incorrect usage can cause trauma to the front incisors; the correct technique is to displace the chin upwards and forward at the same time, not to use the blade as a lever with the teeth serving as the fulcrum.

The Miller, Wisconsin, Wis-Hipple, and Robertshaw blades are commonly used for infants. It is easier to visualize the glottis using these blades than the Macintosh blade in infants, due to the larger size of the epiglottis relative to that of the glottis.

Tracheal intubation, usually simply referred to as intubation, is the placement of a flexible plastic tube into the trachea (windpipe) to maintain an open airway or to serve as a conduit through which to administer certain drugs. It is frequently performed in critically injured, ill, or anesthetized patients to facilitate ventilation of the lungs, including mechanical ventilation, and to prevent the possibility of asphyxiation or airway obstruction.

The most widely used route is orotracheal, in which an endotracheal tube is passed through the mouth and vocal apparatus into the trachea. In a nasotracheal procedure, an endotracheal tube is passed through the nose and vocal apparatus into the trachea. Other methods of intubation involve surgery and include the cricothyrotomy (used almost exclusively in emergency circumstances) and the tracheotomy, used primarily in situations where a prolonged need for airway support is anticipated.

Because it is an invasive and uncomfortable medical procedure, intubation is usually performed after administration of general anesthesia and a neuromuscular-blocking drug. It can however be performed in the awake patient with local or topical anesthesia or in an emergency without any anesthesia at all. Intubation is normally facilitated by using a conventional laryngoscope, flexible fiberoptic bronchoscope, or video laryngoscope to identify the vocal cords and pass the tube between them into the trachea instead of into the esophagus. Other devices and techniques may be used alternatively.

After the trachea has been intubated, a balloon cuff is typically inflated just above the far end of the tube to help secure it in place, to prevent leakage of respiratory gases, and to protect the tracheobronchial tree from receiving undesirable material such as stomach acid. The tube is then secured to the face or neck and connected to a T-piece, anesthesia breathing circuit, bag valve mask device, or a mechanical ventilator. Once there is no longer a need for ventilatory assistance and/or protection of the airway, the tracheal tube is removed; this is referred to as extubation of the trachea (or decannulation, in the case of a surgical airway such as a cricothyrotomy or a tracheotomy).

For centuries, tracheotomy was considered the only reliable method for intubation of the trachea. However, because only a minority of patients survived the operation, physicians undertook tracheotomy only as a last resort, on patients who were nearly dead. It was not until the late 19th century however that advances in understanding of anatomy and physiology, as well an appreciation of the germ theory of disease, had improved the outcome of this operation to the point that it could be considered an acceptable treatment option. Also at that time, advances in endoscopic instrumentation had improved to such a degree that direct laryngoscopy had become a viable means to secure the airway by the non-surgical orotracheal route. By the mid-20th century, the tracheotomy as well as endoscopy and non-surgical tracheal intubation had evolved from rarely employed procedures to becoming essential components of the practices of anesthesiology, critical care medicine, emergency medicine, and laryngology.

Tracheal intubation can be associated with minor complications such as broken teeth or lacerations of the tissues of the upper airway. It can also be associated with potentially fatal complications such as pulmonary aspiration of stomach contents which can result in a severe and sometimes fatal chemical aspiration pneumonitis, or unrecognized intubation of the esophagus which can lead to potentially fatal anoxia. Because of this, the potential for difficulty or complications due to the presence of unusual airway anatomy or other uncontrolled variables is carefully evaluated before undertaking tracheal intubation. Alternative strategies for securing the airway must always be readily available.

Tracheal intubation is not a simple procedure and the consequences of failure are grave. Therefore, the patient is carefully evaluated for potential difficulty or complications beforehand. This involves taking the medical history of the patient and performing a physical examination, the results of which can be scored against one of several classification systems. The proposed surgical procedure (e.g., surgery involving the head and neck, or bariatric surgery) may lead one to anticipate difficulties with intubation. Many individuals have unusual airway anatomy, such as those who have limited movement of their neck or jaw, or those who have tumors, deep swelling due to injury or to allergy, developmental abnormalities of the jaw, or excess fatty tissue of the face and neck. Using conventional laryngoscopic techniques, intubation of the trachea can be difficult or even impossible in such patients. This is why all persons performing tracheal intubation must be familiar with alternative techniques of securing the airway. Use of the flexible fiberoptic bronchoscope and similar devices has become among the preferred techniques in the management of such cases. However, these devices require a different skill set than that employed for conventional laryngoscopy and are expensive to purchase, maintain and repair [20].

When taking the patient's medical history, the subject is questioned about any significant signs or symptoms, such as difficulty in speaking or difficulty in breathing. These may suggest obstructing lesions in various locations within the upper airway, larynx, or tracheobronchial tree. A history of previous surgery (e.g., previous cervical fusion), injury, radiation therapy, or tumors involving the head, neck and upper chest can also provide clues to a potentially difficult intubation. Previous experiences with tracheal intubation, especially difficult intubation, intubation for prolonged duration (e.g., intensive care unit) or prior tracheotomy are also noted [21].

Methodology

The present study was planned in Department of Anesthesia, Anugrah Narayan Magadh Medical College, Gaya, Bihar. The study was conducted from february 2013 to January 2014. Total 100 cases scheduled for elective surgery under general anaesthesia requiring tracheal intubation were included in the present study.

The height of the operating table was adjusted such that the plane of the patient's face was at the level of xiphisternum of the anaesthesiologist performing laryngoscopy and intubation. Anaesthesia was induced with fentanyl 2 µg/kg and propofol 2-2.5 mg/kg until loss of verbal contact. Intubation was facilitated by vecuronium 0.1 mg/kg. The lungs were ventilated with O2, N2O and isoflurane 0.6% for 3 minutes. Degree of difficulty with mask ventilation was graded as easy, difficult or impossible [22]. Laryngoscopic view was graded by Cormack and Lehane grading [23].

Intubation was performed using Macintosh size 3 blade with the patients' head in sniffing position by anaesthesiologists with more than five years' experience in anaesthesia who were unaware of the airway measurements. Tracheal tubes size 7 and 8 were used in female and male patients, respectively.

All the patients were informed consents. The aim and the objective of the present study were conveyed to them. Approval of the institutional ethical committee was taken prior to conduct of this study.

Results & Discussion

One of the primary responsibilities of an anesthesiologist is to establish and maintain airway patency. Airway difficulties and disasters are associated with increased morbidities and even mortality [24]. In elective surgeries, the anesthesiologist has the advantage of being able to evaluate the patient in advance and be prepared for possible difficulties with regard to airway management and subsequently managing them successfully. Conducting a preoperative physical examination may identify the presence of upper airway pathologies or anatomical anomalies which may help predict airway difficulties.

Laryngoscopy is an essential part of airway management with endotracheal intubation used in many surgeries including coronary artery bypass surgeries. Hemodynamic response during laryngoscopy and intubation can alter the myocardial oxygen "demand and supply" balance and potentially precipitate coronary ischemia, especially in patients with ischemic heart disease. It is therefore important to attenuate these hemodynamic responses in these patients who are undergoing coronary revascularization [25].

Laryngoscopy-induced tissue tension in the supraglottic region elicits a vagal response and stimulation of the cardioaccelerator fibers, whereas passing endotracheal tube (ETT) through the cords causes greater stimulation of cardioaccelerator fibers than vagal response [26]. These are responsible for the hemodynamic responses seen during endotracheal intubation. The hemodynamic response during laryngoscopy and intubation directly depends on the force applied and the duration of intubation [27, 28].

The Macintosh laryngoscope has been used conventionally for most of the intubations since it was designed by Robert Macintosh in 1943 [28]. Airtraq is a channeled, rigid video laryngoscope that has an exaggerated curvature of the blade and an internal arrangement of optical components which provides the high-quality glottic view without need for alignment of the oral pharyngeal and laryngeal axis (sniffing position). The head can be kept in neutral position. Hence, the traction on mandible and the force applied during laryngoscopy are expected to be less along with decreased requirement of maneuvers to aid in intubation which ultimately results in less airway trauma.

The ASA Task Force on Difficult Airway has recommended that a patient must be assessed preoperatively for airway difficulties. There are numerous and often contradictory studies regarding whether to use a single parameter or multiple parameters for the assessment of airway. Most of the studies and parameters were defined for Western population whose anthropometry differs significantly from our population. Furthermore, many studies included obese

individuals in their study population even though increased BMI is a known predictor of difficult airway in and off itself [29, 30].

Table 1: Basic Details

Parameters	Observation & No. of Cases
Age (yr)	24 – 52
Sex ratio	
Male	34
Females	66
Weight (kg)	42 – 73
Height (cm)	149.5 – 172.3
Body mass index (kg/m2)	16.4 – 31.3
Inter incisor distance ≤3.5 cm	3
Mallampati class 3/4 (sitting)	16
Mallampati class 3/4 (supine)	24
Sternomental distance (cm)	13.4 – 16.7
Thyromental distance (cm)	5.4 – 7.6
Ratio of height to thyromental distance	21.3 – 29.8
Neck movement <80˚	4
Limited mandibular protrusion	2
Short muscular neck	12

Table 2: Laryngoscopy Observations

Parameters	No. of Cases
Laryngoscopy	
Easy	89
Difficult	11

Table 3: Intubation difficulty scale score and variables

Parameters	Easy	Difficult
No. of Cases	**89**	**11**
Intubation difficulty scale (IDS)		
0	51	0
0-5	38	6
More than 5	0	5
Variables of IDS		
Attempts more than 1	4	8
Operators more than 1	2	3
Increased lifting force	0	4
ELP application	38	9
Vocal cords adducted	0	0
Cormack and Lehane grade		
1	54	0
2	35	0
3	0	10
4	0	1
With external laryngeal manipulation		

Lloyd F. Redick 1987 [31] stressed the importance of the integrity of the temporomandibular joint for tracheal intubation. He stated that forward sliding motion of the joint is very important to obtain an opening of the mandible wide enough to permit laryngoscopy and tracheal intubation. This criterion is one of the essential components of temporomandibular joint integrity and of course of adequate Mouth Opening.

Wilson M E *et al*. 1988 [32] studied parameters to predict difficult intubation. A scoring system was developed by integrating all the parameters as the adverse influence of one factor could offset by the other favourable features which was called as Wilson risk sum scoring.

Frerk *et al*. 1991 [33] compared Modified Mallampati test and the Thyromental Distance which was initially described by Patil and his colleagues to predict difficult intubation. He found that, when both the tests were combined they have greater sensitivity and specificity but when used alone they were poor predictors. Also showed Modified Mallampati test has got greater inter – observer variability and high false positive results.

Benumof JL 1991 [34] has classified difficulty in intubation from zero to infinite. Zero degree of difficulty in intubation is when an endotracheal tube can be inserted into a fully visualized laryngeal aperture with little effort – Grade I laryngoscopic view. As the view worsens, it requires increasing anterior lifting force with the laryngoscope blade, optimal sniffing position, multiple attempts and external laryngeal pressure to push the larynx more posteriorly and cephalad for better view.

Keith Rose *et al*. 1994 [35] in their study described methods, risk factors, and outcomes of airway management in all patients (obstetrics excluded). Preoperatively, anaesthetists recorded patient factors and assessed four airway characteristics. Airway characteristics predictive of 16 difficult tracheal intubation were decreased mouth opening, shortened thyromental distance, poor visualization of the hypopharynx, and limited neck extension. They concluded that difficult tracheal intubations occurred infrequently but were associated with increased morbidity. Patient factors and four physical airway characteristics were useful predictors but limited in identifying all problems.

Tse *et al*. 1995 [36] conducted a prospective, blind study to determine whether a difficult endotracheal intubation could be predicted preoperatively by evaluation of one or more anatomic features of the head. They determined that Modified Mallampati Classification of class 3, a thyromental distance less than or equal to seven centimeters, and a head extension less than or equal to eighty degrees, considered either alone or in various combinations. They concluded that these three tests were of little value in predicting difficult intubation in adults, although the likely hood of an easy endotracheal intubation was high when they yield negative results.

Difficult laryngoscopy and intubation causes high risk of complications (ranging from sore throat to airway trauma) in the patients. In few cases, if anaesthesiologist is unable to maintain the airway patency, the dreaded nightmare for any anaesthesiologist so called 'Cannot intubate- Cannot Ventilate' situation, may lead to serious complications like hypoxic brain damage or death.

Even with the use of multivariate factors there have been instances when a patient predicted to have difficult intubation had an easy intubation and vice versa. So predicting a difficult intubation employing a myriad of measurements and observations has not demonstrated itself to be practicable or even reliable. Thus, the search for a predictive test that has ease of applicability, reliability and accuracy of prediction (discriminating power) continues

Conclusion

The data generated from the present study concludes that there are differences in anatomical measurements commonly used to predict a difficult airway between the Indian and non-Indian population. This implies that standard threshold values for predicting a difficult airway may not apply in the Indian population. Airway management remains an important challenge in the contemporary practice of anaesthesia and preoperative airway assessment facilitates appropriate preparation when difficulty with intubation or ventilation is anticipated prior to induction of

anaesthesia. Direct laryngoscopy is the gold standard for tracheal intubation. There is no single definition of difficult intubation. Difficult glottic view on direct laryngoscopy is the most common cause of difficult intubation. Difficult laryngoscopy, where in, it is not possible to visualize any portion of the vocal cords after multiple attempts at conventional laryngoscopy.

References

1. Hunting Penelope. The history of the Royal Society of Medicine. RSM Press, 2002, p. 79. ISBN 978-1-85315-497-3.
2. Koltai PJ, Nixon RE. "The story of the laryngoscope". Ear, Nose, & Throat Journal. 1989; 68(7):494-502. PMID 2676465.
3. Bailey B. "Laryngoscopy and laryngoscopes--who's first?: the forefathers/four fathers of laryngology". Laryngoscope. 1996; 106(8):939-43. doi:10.1097/00005537-199608000-00005. PMID 8699905.
4. Stark James. Bel canto: a history of vocal pedagogy. University of Toronto Press, 2003, p. 5. ISBN 0-8020-8614-4
5. García Manuel. "Observations on the Human Voice". Proceedings of the Royal Society of London, 1855; 7:399-410. doi:10.1098/rspl.1854.0094. JSTOR 111815. Retrieved 28 August 2010.
6. American Otological Society. The Laryngoscope. Volume, 1905; 15:402-403
7. Radomski Teresa. "Manuel García (1805–1906): A bicentenary reflection" (PDF). Australian Voice, 2005; 11:25-41. Retrieved 28 August 2010.
8. "Con ciencia - Manuel Patricio García". 27 January, 2014.
9. Hirsch NP, Smith GB, Hirsch PO. "Alfred Kirstein. Pioneer of direct laryngoscopy". Anaesthesia. 1986; 41(1):42-5. doi:10.1111/j.1365-2044.1986.tb12702.x. PMID 3511764.
10. Morell Mackenzie. The case of Emperor Frederick III.: full official reports by the German physicians and by Sir Morell Mackenzie. New York: Edgar S. Werner. p. 167, 1888; Retrieved 27 August 2010.
11. Burkle CM, Zepeda FA, Bacon DR, Rose SH. "A historical perspective on use of the laryngoscope as a tool in anesthesiology". Anesthesiology. 2004; 100(4):1003-6. doi:10.1097/00000542-200404000-00034. PMID 15087639.
12. Jackson Chevalier. "The technique of insertion of intratracheal insufflation tubes". Pediatric Anesthesia. 1996; 6(3):230. doi:10.1111/j.1460-9592.1996.tb00434.x.
13. Zeitels SM. "Chevalier Jackson's contributions to direct laryngoscopy". J Voice. 1998; 12(1):1-6. doi:10.1016/S0892-1997(98)80069-6. PMID 9619973.
14. Chevalier Jackson. "I: Instrumentarium" (PDF). A manual of peroral endoscopy and laryngeal surgery. Philadelphia: W.B. Saunders Company, 1922; 17-52. ISBN 978-1-4326-6305-6. Retrieved 27 August 2010.
15. Janeway Henry H. "Intra-Tracheal Anesthesia from the Standpoint of the Nose, Throat and Oral Surgeon with a Description of a New Instrument for Catheterizing the Trachea.*". The Laryngoscope. 1913; 23(11):1082. doi:10.1288/00005537-191311000-00009.
16. Scott J, Baker PA. "How did the Macintosh laryngoscope become so popular?". Paediatric Anaesthesia. 2009; 19(Suppl 1):24-9. doi:10.1111/j.1460-9592.2009.03026.x. PMID 19572841.
17. Robert A Miller. "A new laryngoscope". Anesthesiology. 1941; 2(3):317-20. doi:10.1097/00000542-194105000-00008.
18. Somchai Amornyotin, Ungkab Prakanrattana, Phongthara Vichitvejpaisal, Thantima Vallisut, Neunghathai Kunanont, Ladda Permpholprasert, *et al* "Comparison of the Clinical Use of Macintosh and Miller Laryngoscopes for Orotracheal Intubation by Second-Month Nurse Students in Anesthesiology" (PDF). Anesthesiology Research and Practice, 2010, 1-5. doi:10.1155/2010/432846. PMC 2911595. PMID 20700430. Retrieved 27 August2010.
19. James M Berry. "Chapter 16: Conventional (laryngoscopic) orotracheal and nasotracheal intubation (single-lumen tube)". In Benumof JL (ed.). Benumof's airway management: principles and practice (2nd ed.). Philadelphia: Mosby-Elsevier, 2007, pp. 379-392. ISBN 978-0-323-02233-0. Retrieved 28 August 2010.
20. Rozman A, Duh S, Petrinec-Primozic M, Triller N. "Flexible bronchoscope damage and repair costs in a bronchoscopy teaching unit". Respiration. 2009; 77(3):325-30. doi:10.1159/000188788. PMID 19122449.
21. Miller. Stone DJ and Gal TJ, Airway management, 2000, pp. 1414-51.
22. Stark James. Bel canto: a history of vocal pedagogy. University of Toronto Press, 2003, p. 5. ISBN 0-8020-8614-4
23. Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. Anaesthesia, 1984; 39:1105-11.
24. Apfelbaum JL, Hagberg CA, Caplan RA, Blitt CD, Connis RT, Nickinovich DG, *et al*. Practice guidelines for management of the difficult airway: An updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology, 2013; 118:251-70.
25. Kanchi M, Nair HC, Banakal S, Murthy K, Murugesan C. Haemodynamic response to endotracheal intubation in coronary artery disease: Direct versus video laryngoscopy. Indian J Anaesth, 2011; 55:260-5.
26. Shribman AJ, Smith G, Achola KJ. Cardiovascular and catecholamine responses to laryngoscopy with and without tracheal intubation. Br J Anaesth, 1987; 59:295-9.
27. Henderson J. Airway management in the adult. In: Miller RD, Eriksson LI, Fleisher LA, WienerKronish JP, Young WL, editors. Miller's Anaesthesia. 7th ed. Philadelphia: Churchill Livingstone Elsevier, 2010, p. 1573-610.
28. Macintosh RR. A new laryngoscope. Lancet, 1943; 1:205.
29. Juvin P, Lavaut E, Dupont H, Lefevre P, Demetriou M, Dumoulin JL, *et al*. Difficult tracheal intubation is more common in obese than in lean patients. Anesth Analg, 2003; 97:595-600.
30. Brodsky JB, Lemmens HJ, Brock-Utne JG, Vierra M, Saidman LJ. Morbid obesity and tracheal intubation. Anesth Analg, 2002; 94:732-6.
31. Redick LF, MD. The Temporomandibular Joint and Tracheal Intubation. Anesth Analg, 1987; 66:675-6.

32. Wilson ME, Spiegelhalter D, Robertson JA, Lesser P. Predicting difficult intubation. British Journal of Anaesthesia, 1988; 61:211-6.
33. Frerk CM. Predicting difficult intubat ion. Anaesthesia, 1991; 46:1005-8.
34. Benumof JL. Management of the difficult adult airway. With special emphasis on awake tracheal intubation. Anaesthesiology, 1991; 75:1087-110.
35. Rose DK, Cohen MM. The airway: Problems and predictions in 18,500 pat ients. Canadian Journal of Anaesthesia, 1994; 41:372-383.
36. Tse JC, Rimm EB, Hussain A. Predicting difficult endotracheal intubation in surgical patients scheduled for general anaesthesia: a prospective blind study. Anaesthesia and Analgesia, 1995; 81:254-58.