DIFFICULT AIRWAY IN OBSTETRIC ANESTHESIA

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INTRODUCTION

Anesthetic management of parturient patients is a challenge, as it involves simultaneous care of two lives. Complications related to anesthesia are the sixth leading cause of pregnancy-related death in the United States.¹ According to the American Society of Anesthesiologists Closed Claims Study, maternal death claims are predominantly related to use of general anesthesia.² Hawkins et al published in 1997 the characteristics of anesthesia-related deaths during obstetric delivery in the United States from 1979-1990.³ Most of the deaths were due to airway management problems, which included aspiration, intubation problems, inadequate ventilation, and respiratory failure.

The incidence of difficult airway in the pregnant population is eight times higher than in the non-pregnant population or about 1 in 250-300 patients.³⁻⁴ The morbidity associated with difficult intubation is about thirteen times higher than the general population.⁴

The trend is to perform lower and lower rates of general anesthesia for cesarean delivery, which accounts for the relative inexperience with the obstetric airway. A major challenge facing obstetric anesthesiologists is teaching general anesthesia to new trainees. With the steady decrease in the use of general anesthesia, residents may go through their training without administering general anesthesia for a cesarean section.

CAUSES FOR DIFFICULT INTUBATION IN PREGNANT PATIENTS

Difficult airway in obstetric anesthesia is mostly due to airway edema, weight gain during pregnancy and preexisting anatomical deformities.⁶

Airway edema

Airway edema is a consequence of hormonally induced fluid retention during pregnancy, and it can be
amplified by preeclampsia, fluid overload, head-down position, oxytocin infusion (fluid retention due to the antidiuretic effect), prolonged Valsalva efforts during delivery, beta-adrenergic tocolytic therapy, and upper respiratory tract infection.6,7

Preeclamptic patients have narrower upper airways than normal pregnant patients. Coagulopathy in the preeclamptic patient complicates repeated attempts at laryngoscopy, causing lacerations and bleeding of the upper airway.

Using photographs taken in a standardized fashion, Pilkington et al. showed that the Mallampati classification of the airway changed between the first and third trimesters.8

Vascular engorgement of the respiratory tract and oro-pharyngeal mucosa during pregnancy accounts for reduced internal diameter of the trachea and increased risk of bleeding during airway manipulation. Smaller endotracheal tubes should be used in pregnant patients, because of the mucosal swelling and decreased area of the glottic opening.7

Weight Gain

Obesity is frequently encountered during pregnancy; the parturient can gain 20 kg or more during pregnancy. In the morbidly obese parturient the cesarean delivery rate exceeds 50%.9 Obese patients also have an increased incidence of associated co-morbidities (e.g. diabetes, hypertension), intraoperative bleeding and longer surgical time. The incidence of failure with regional anesthesia is higher in the obese pregnant patients due to technical difficulties (e.g. identification of the epidural space and dislodgement of the epidural catheter).10

Difficult intubation in the obese patient may be due to a short neck or large tongue and breasts, which make laryngoscopy and intubation laborious. Proper positioning of the patient (with the head, upper body and shoulders significantly elevated above the chest) and the use of a short-handled laryngoscope blade are recommended.

Furthermore, chest compliance is often poor, and mask ventilation may prove to be difficult.

Preexisting anatomical abnormalities

Examples of conditions involving the airway and predicting difficult intubation are: receding mandible, micrognathia, protruding maxillary incisors, large teeth, high arched palate, poor temporo-mandibular joint mobility, short neck, decreased cervical mobility, limited range of motion of the neck, airway tumors, surgical induced deformities, and several systemic diseases (e.g. rheumatoid arthritis, ankylosing spondylitis, dwarfism).

RISK OF HYPOXIA

Pregnant women become hypoxemic more rapidly than non-pregnant women during episodes of apnea because of: reduced functional capacity, (resulting in airway closure and an increased alveolar-arterial oxygen gradient during normal tidal respiration) higher oxygen consumption and decreased cardiac output in supine position (aorto-caval compression). Therefore, the pregnant woman requires more efficient denitrogenation and preoxygenation prior to induction of general anesthesia.

RISK OF ASPIRATION

Gastrointestinal system also undergoes significant change and every parturient should be considered at risk of aspiration during induction of general anesthesia. The pressure from the enlarging uterus increases intragastric pressure. The lower esophageal sphincter tone decreases secondary to the hormones of pregnancy. As a result, barrier pressure (lower esophageal pressure minus intragastric pressure) decreases and reflux occurs.11

Among the hormonal factors, increased gastrin, secretin and progesterone and decreased secretion of motilin are responsible for the delay in gastric emptying.6

Pharmacologic prophylaxis usually consists of intravenous administration of an H₂ receptor antagonist and metoclopramide combined with oral administration of a clear, non-particulate antacid before induction.

Rapid sequence induction (with correctly applied cricoid pressure) should always be used in general anesthesia for the parturient.

CRICOID PRESSURE

The gastrointestinal changes emphasize the need for the application of cricoid pressure before the patient loses consciousness in order to prevent aspiration or regurgitation during induction of general anesthesia. Cricoid pressure is applied directly over the cricoid cartilage, which is the only solid structure in the larynx, with the intent of applying pressure on the esophagus and preventing regurgitation into the oropharynx. However, the effectiveness of cricoid pressure has been questioned, especially if it is inappropriately
applied. Appropriate application of cricoid pressure in an upward and backward direction may yet improve the laryngoscopic view.\textsuperscript{7,8} Cricoid pressure should be applied with an initial force of 10 N when the patient is awake, increasing to 30 N as consciousness is lost.\textsuperscript{12}

**AIRWAY ASSESSMENT**

The vast majority of difficult intubations (98\%) may be anticipated by performing a correct evaluation of the airway in advance.\textsuperscript{13} It is necessary to apply a variety of criteria to identify potential difficult airway. No single factor reliably predicts airway difficulties and consequently the evaluation of the airway should include, (but should not be limited to) the following steps:

**Examination of previous anesthetic records,** if available in a timely manner, may yield useful information about airway management.\textsuperscript{14}

**Mallampati classification.** Based on the original Mallampati classification and the Samsoon and Young modification there are four classes to evaluate the relationship of the base of the tongue to the oropharyngeal structures:\textsuperscript{15,16}
- Class 1 = visualization of the soft palate, uvula and tonsillar pillars;
- Class 2 = visualization of the soft palate, and the base of uvula with a portion of the posterior pharyngeal wall;
- Class 3 = visualization of the soft palate only;
- Class 4 = only hard palate visible.

The Mallampati class evaluation is performed while the patient is in the sitting position, the head held in a neutral position, the mouth wide open, and the tongue protruding to the maximum. False indicators of the Mallampati score like evaluating the patient in supine position or asking the patient to arch her tongue should be avoided.\textsuperscript{4} If the patient phonates, this falsely improves the view. If the patient arches her tongue, the uvula is falsely obscured.

**Mouth opening**

The patient should be asked to open her mouth as widely as possible. Mouth opening can be assessed by asking the patient to insert 2-3 fingers held vertically in the oral cavity. An opening of at least two large finger breadths (3 cm or more) between the upper and lower incisors is desirable, corresponding to mandible opening of 50-60 mm.

The presence of loose teeth or protruding upper teeth, a high-arched palate or a long narrow mouth, and temporomandibular joint problems may predispose to difficulty with direct laryngoscopy.

In the pregnant patient, it is important to assess the severity of upper airway edema.

**Thyromental distance** is the distance from the mentum of the mandible to the thyroid cartilage notch, with neck fully extended, and it evaluates the mandibular space. The mandible provides the skeleton for the floor of the mouth and is housing compartment of the tongue and larynx. A normal thyromental distance is considered a measurement of > 6.5 cm.

**Atlanto-occipital joint extension.** Extension of the head at the atlanto-occipital joint while the neck is moderately flexed (35°) brings the oral, pharyngeal and laryngeal axis into almost a straight line. Alignment of these axes is required to achieve the “sniffing position” which is recommended for optimization of glottic visualization under direct laryngoscopy (sniffing or Magill position = slight flexion of the neck on the head and extreme extension of the head on the neck, which aligns the oral, pharyngeal and laryngeal axes into a fairly straight line).

**Evaluation of the teeth.** This is performed specifically for assessment of maxillary overbite or protruding maxillary incisor teeth.

**PREPARATION FOR GENERAL ANESTHESIA**

Vigilance is the key along with back-up plan for every patient and the availability of necessary equipment.\textsuperscript{4}

**Positioning of operating room table:** should be adjusted to the level of the laryngoscopist intercostals margin, and tilted 15 degree to the left, to avoid aortocaval compression.

**Patient position:** Correct positioning of the patient appears to be the main determining factor for obtaining a good glottic visualization under direct laryngoscopy.

The head must be extended on the neck (extension of the atlanto-occipital joint) to achieve a “sniffing position” by bringing the oral axis in line with the pharyngeal and laryngeal axis. Appropriate neck positioning is facilitated by placing several pads or blankets under the shoulder and upper back, thereby flattening the kyphotic curvature of the thoracic spine. The Elevation Pillow (Mercury Medical, Clearwater, FL, USA) is especially useful for positioning the morbidly obese parturient.\textsuperscript{7}

**CHOICE OF SUPRAGLOTTIC AIRWAY DEVICES FOR THE MANAGEMENT OF THE DIFFICULT AIRWAY**

A variety of airway devices are available to facilitate oxygenation and ventilation in a situation of
unrecognized difficult airway. The American Society of Anesthesiologists’ Task Force on Management of the Difficult Airway suggests considering the use of the Laryngeal Mask and Combitube (“but not limited to”) when intubation problems occur in patients with a previously unrecognized difficult airway, especially in a “cannot ventilate, cannot intubate”. The classic laryngeal mask airway and the Combitube are used in obstetric anesthesia as life-saving emergency ventilatory device when time is crucial and hypoxemia threatens the patient’s life. These devices should be a part of the armamentarium of every obstetric anesthesia setting for the management of the difficult airway.

A number of alternative airway devices are available and all anesthesiologists should be competent in the use of at least one of the alternative methods of managing the difficult airway.

Laryngeal Mask Airway

Since its introduction in clinical practice in 1988 the Laryngeal Mask Airway (LMA) (LMA North America, San Diego, CA) has achieved great worldwide popularity, and changed the landscape of difficult airway management. LMA was originally developed for the use in routine cases in spontaneous ventilation and its role in airway management has expanded, as practitioners have become comfortable with the device.

Over 80% of anesthesiologists in a US survey preferred the LMA as a first choice airway in a “cannot ventilate, cannot intubate” scenario. In the United Kingdom, 72% of obstetric anesthesiologists favor using the LMA as the first option for the “cannot ventilate, cannot intubate” situation.

The most significant limitation of the LMA consists in the lack of an effective seal against pulmonary aspiration of gastric contents, though it can be used as a rescue device in a “cannot ventilate, cannot intubate” situation in obstetric anesthesia.

However, Han et al reported the effective and successful use of the LMA in 1060 healthy patients requiring elective general anesthesia for cesarean section. Cricoid pressure was used during this study until delivery, but there is no data on the frequency with which it had to be relaxed to facilitate LMA insertion or ventilation. As reported by Asai et al application of cricoid pressure may impair LMA insertion. Cricoid pressure may be temporarily released to permit LMA insertion.

Another limitation of the LMA is the suboptimal controlled ventilation. Many anesthesia providers are hesitant to choose LMA when positive pressure ventilation is needed. When inspiratory pressures exceed 20 cm H₂O, gas tends to leak around the inflatable cuff, leading to gastric distension and/or reduced efficacy of positive pressure ventilation.

Several new variants of the LMA Classic are available, including the LMA Flexible (wire reinforced flexible LMA), LMA Unique (disposable LMA), LMA Fastrach (intubating LMA), and, most recently, the LMA Proseal.

While any of the LMA types can be used in a difficult airway case in obstetric anesthesia, the Proseal LMA offers a better protection against aspiration.

ProSeal Laryngeal Mask Airway. (Fig. 1)

ProSeal Laryngeal Mask Airway (PLMA) (Laryngeal Mask Company, Henley-on-Thames, United Kingdom) was introduced into the clinical practice in 2000. It is a new LMA with a modified cuff designed to improve the seal around the glottis and with an added drain tube to provide a bypass channel for regurgitated fluid, prevent gastric insufflation, and allow gastric tube placement. These features are designed to offer an improved safety of the LMA and a better use in positive pressure ventilation.

PLMA has been used successfully as a rescue ventilation device following failed obstetric intubation.

Intubating Laryngeal Mask Airway – Fastrach. (Fig. 2)

The Fastrach (LMA, North America, Inc., San Diego, California, USA) is an modified form of the LMA designed specifically as a conduit for endotracheal intubation. It is a short, anatomically curved, wide-bore, stainless steel tube with a guide handle. It has an epiglottic elevator bar replacing the mask aperture bars and a guiding “Y” shaped ramp built into the floor of the mask aperture. The metal shaft of the Fastrach allows the insertion of up to 8.5-mm I.D. endotracheal tube. The success rate of blind intubation with the Fastrach is very high, reaching 95-97%. The Fastrach

Figure 1. Proseal Laryngeal Mask Airway.
has also been successfully used in obstetric anesthesia after failed intubation.\textsuperscript{28} 

\textbf{Combitube.} (Fig. 3)

The esophageal-tracheal Combitube (Tyco-Healthcare-Kendall, Pleasanton, California, USA) is a double-lumen, double-cuffed tube that enables ventilation with either tracheal or esophageal intubation, but is usually enters the esophagus in more than 95\% of cases. The two lumens are divided by a partition. It can be placed blindly or using a laryngoscope.\textsuperscript{29} It has been demonstrated that the Combitube can be placed by anesthesiologists with relatively little formal training, and by relatively inexperienced personnel.\textsuperscript{30-31}

The LT consists of an airway tube and two low pressure cuffs (proximal and distal). There are two oval apertures located between the two cuffs which face the glottic aperture, as well as two side holes that allow ventilation.

When inflated, the distal balloon seals the esophagus and may protect against regurgitation. The proximal balloon (oro-pharyngeal balloon) seals both the oral and nasal cavity.

When the LT is inserted, it lies along the length of the tongue, and the distal tip is positioned in the esophageal inlet. During ventilation, air passes into the pharynx, then over the epiglottis into the trachea, since the mouth, nose and esophagus are blocked by the balloons.\textsuperscript{33}

The LT has been successfully used in unexpected difficult airway situation.\textsuperscript{34}

\textbf{Laryngeal Tube.} (Fig. 4)

The Laryngeal Tube (LT) (VBM Medizintechnik GmbH, Sulz a.N, Germany) is a newly developed, multiuse, latex-free, single-lumen silicon tube closed at the distal end, with oro-pharyngeal and esophageal low-pressure cuffs, and ventilation outlets located in between.

\textbf{Laryngeal Tube Suction.} (Fig. 5)

The newly introduced Laryngeal Tube Suction (LTS) (VBM Medizintechnik GmbH, Sulz a.N, Germany) is a further development of the LT, which allows better separation of the respiratory and alimentary tracts.

The LTS is a double-lumen silicon tube wherein one lumen is used for ventilation and the other for suctioning and gastric tube placement. This new device, like the original LT, is inserted blindly with the distal tip positioned in the hypopharynx/upper esophagus.

The successful use of the LTS was recently reported after a failed tracheal intubation in a parturient.\textsuperscript{35}
MANAGEMENT OF THE DIFFICULT AIRWAY - DECISION MAKING

Strategies for making critical management decisions in the management of the difficult airway depend on whether surgery is urgent or elective, the condition of the fetus, and whether a difficult airway is predicted.

Recognized difficult airway

It is important to have a strategic back-up plan for every patient. Preparatory efforts enhance success and minimize risk to the patient. The location of the cricothyroid membrane should be identified for possible use in unexpected airway loss.

If there is any doubt regarding the ability to maintain airway patency during general anesthesia, consider: regional anesthesia or awake fiberoptic-aided intubation.

Regional anesthesia is the best choice for cesarean section in most cases of anticipated difficulty with endotracheal intubation.\(^3,6,36\) However, the anesthesiologist should be aware that regional anesthesia itself does not solve the problem of a difficult airway, anticipate potential complications (e.g., failed anesthesia, high block resulting in respiratory arrest, seizures), and be fully prepared to administer general anesthesia. In a case of recognized difficult airway spinal anesthesia is preferred over epidural anesthesia because of: higher success rate, faster onset, lower risk of local anesthetic toxic reaction.

A combined spinal-epidural anesthesia (CSE), a relatively new technique, has gained popularity. The CSE provides the advantages of a spinal with the additional flexibility of supplementation of the block with an epidural catheter.

Awake fiberoptic-aided intubation

Although awake fiberoptic-aided intubation can be time-consuming, it is a very safe option, reducing airway related adverse outcomes. However, special technical skills and experience are necessary for a successful completion of this procedure.\(^3,12,36\)

The preference for awake fiberoptic-aided intubation includes the following reasons: the natural airway is preserved, muscular tone is better maintained facilitating the identification of anatomical landmarks of the upper airway, spontaneous respiration is maintained, normal position of the larynx is preserved, and protection against aspiration.\(^14,37\)

Psychological preparation of the parturient including detailed explanation of the technique is of a major importance.

Premedication with an anticholinergic agent dries the airway mucosa, and is essential for establishing good topical anesthesia. Glycopyrrolate given in doses of 0.2 mg IV is poorly transferred across the placenta.\(^38\)

The risk of causing bleeding is higher when the nasal route is used, especially in a pregnant patient with an engorged nasal mucosa, so that the oral route is preferred for fiberoptic-aided intubation.

Topical anesthesia is the primary anesthetic for awake fiberoptic intubation and can be obtained with 4% lidocaine by nebulizer.

Superior laryngeal nerve block can also be performed, injecting 2 ml of 2% lidocaine just inferior to the greater cornu of the hyoid bone and superior to the thyroid cartilage.

Mild sedation can be administered.

In order to improve oxygenation during the procedure, the suction device of the fiberoptic bronchoscope can be substituted for a flow of oxygen via the same port, using intermittent oxygen flow, controlled by the operator via the suction control valve.

The oxygen flow stents open the laryngo-pharynx and may prevent collapse of soft tissue which hinders visibility of the vocal cords in addition to delaying desaturation of the hypoventilating sedated patient.

The Unrecognized Difficult Airway. (Fig. 6)

Call for help immediately!!!!!
The patient who cannot be intubated but can be ventilated by mask with no fetal distress present

A maximum of three optimal attempts at laryngoscopy and intubation should be allowed. An optimal conventional laryngoscopy attempt implies several criteria: laryngoscopy performed by an experienced anesthesiologist, patient in optimal sniffing position, and optimal external laryngeal manipulation (BURP - Backward Upward Right Pressure on thyroid cartilage may bring posterior larynx into view). The use of laryngoscopes of alternative size and design (e.g. Glidescope (Saturn Biomedical Systems, Inc., Burnaby, British Columbia, Canada) (use of a rigid stylet, or a gum elastic bougie [e.g. Eschmann tracheal tube introducer]) can improve intubation success.\(^{12,29}\)

It is very important to limit the number of attempts at laryngoscopy, in order to prevent trauma and development of a ‘cannot ventilate’ situation. Atraumatic manipulation of the airway is crucial, as with every intubation attempt the airway edema and possible bleeding of the airway will increase.

If endotracheal intubation fails after a maximum of three attempts, the patient should be awakened. Cricoid pressure should be maintained until the patient is fully awake and able to protect her airway.

Further management options after awakening the patient include regional anesthesia or awake fiberoptic intubation.

The patient who cannot be intubated but who can be ventilated by mask with fetal distress present

If the attempts at tracheal intubation have been unsuccessful, primary management goals include maternal oxygenation, airway protection, and prompt delivery of the baby.\(^7\)

Management options include:
- The first option is to awaken the patient (safety of the mother is the major concern of the anesthesiologist).
- Another option could be to continue anesthesia via mask ventilation while an assistant maintains cricoid pressure, maintaining a level of anesthesia deep enough to avoid laryngospasm.
- Although LMA does not protect against aspiration it could be an option in this situation. When placing the LMA, cricoid pressure needs to be released transiently.
- The use of the Proseal LMA should be considered as it is designed to provide superior airway protection over the LMA.

The patient who cannot be intubated or ventilated by mask (Cannot ventilate, cannot intubate)

Life threatening situation!!!!!!!

If the patient cannot be intubated or ventilated by mask the following options should be considered: the use of supraglottic airway devices (LMA, Combitube, Fastrach, PLMA) retrograde intubation, transtracheal jet ventilation, cricothyroidotomy.

Before starting an invasive rescue techniques, (transtracheal jet ventilation, cricothyroidotomy) maximum effort should be made to achieve ventilation and oxygenation with non-invasive techniques, such as optimum mask ventilation and use of LMA or other supraglottic airway devices.

Transtracheal Jet Ventilation (TTJV)

TTJV is used in extreme situations, when other modalities of ventilation, including LMA and Combitube, fail or are not available. It consists of a simple I.V. plastic cannula (14 or 16 gauge) inserted through the cricothyroid membrane into the trachea.

A jet injector provides ventilation under high pressures with oxygen pressurized to 50 pounds per square inch (psi). The major risk of TTJV is barotrauma, which may occur if the inflation pressure is not controlled by a pressure regulator, and emptying of the lungs is not fully allowed by maintenance of an inspiration to expiration ratio of at least 1:3.\(^6\)

Other complications of the TTJV are: pneumothorax, pneumomediastinum, pneumopericardium, subcutaneous emphysema and esophageal perforation. Compared with emergency surgical cricothyrotomy or tracheostomy, establishment of percutaneous TTJV is quicker and simpler.

Cricothyroidotomy

The preferred technique is the Seldinger type needle and wire technique, over which a guide and then a single one-step dilator is passed.

SUMMARY

- Assume that every parturient has a potentially difficult airway.
- Evaluate the airway of every parturient; have a back-up plan for every patient.
- Have difficult airway equipment available.
- Optimize patient’s position for intubation.
- Provide adequate muscular relaxation.
- Call for help.
- When faced with a difficult intubation,
practitioners should choose the device they are most experienced using. Do what you do best!!!
- Don’t start surgery if oxygenation and ventilation are unsatisfactory.
- Choose regional anesthesia whenever possible.

REFERENCES