Clinical Practice Guidelines for the Management of the Difficult Airway in Obstetric Anesthesia

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The purpose of this review is to discuss clinical practice guidelines for the management of the difficult airway in obstetric anesthesia. In the obstetric population, most anesthetic-related maternal deaths still result from complications of airway management following induction of general anesthesia for cesarean delivery (1-4).

Airway management in pregnant patients is widely accepted as being more difficult, with a reported incidence of failed tracheal intubation of eight to ten times higher than in the non-pregnant population (5-7).

Aspiration of gastric contents remains a clear risk during induction of general anesthesia and this risk is increased in a situation of difficult airway. Every parturient should be considered at risk of aspiration during induction of general anesthesia. Prophylactic treatment to neutralize and minimize stomach acid should be administered (2).

Having safe strategies plans is the key to avoid maternal and fetal morbidity and mortality.

Why is airway management a problem in pregnant patients?

Difficult airway in obstetric anesthesia is mostly attributable to: physiologic changes of pregnancy, the stressful environment of an emergency cesarean delivery, and the relative inexperience with the obstetric airway due to reduced incidence of general anesthesia for cesarean delivery.

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Physiologic changes of pregnancy related to airway management

Airway edema

Airway edema is a result of estrogen induced fluid retention during pregnancy, and can be exacerbated by pregnancy-induced hypertension, fluid overload, head-down position, oxytocin infusion (fluid retention due to the antidiuretic effect), prolonged Valsalva efforts during delivery, and β-adrenergic tocolytic therapy (7-8). Using photographs, Pilkington et al (9) showed that airway edema can exacerbate during the course of pregnancy, resulting in increased Mallampati score. Furthermore, Kodaly et al. (10) described a significant increase in airway class during the course of labor, concluding that a careful airway evaluation is essential just before administering anesthesia during labor, rather than obtaining this information from prelabor data.

In addition, 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. The edema is accentuated in cases of pregnancy induced hypertension. Laryngeal edema may prevent the passage of a standard size endotracheal tube, despite adequate vocal cord visualization at laryngoscopy, and requires a smaller internal diameter tube size (11). A 6.5 mm endotracheal tube is a good choice for most pregnant patients.

Nasal intubation should be avoided because of the increased risk of mucosal bleeding.

Increased risk of hypoxia

In pregnant patients desaturation follows even brief periods of apnea, due to increased oxygen consumption and decreased functional residual capacity (resulting in airway closure and an increased alveolar- arterial oxygen gradient during normal tidal respiration).

Therefore, the time from induction to endotracheal intubation should be shorter and the number of attempts of laryngoscopy limited to three. The onset of desaturation can be delayed by efficient pre-oxygenation (12).

Weight Gain

Weight gain in pregnancy may exaggerate the anatomic changes, interfering with airway management. The parturient can gain 20 kg or more during pregnancy, and obesity is frequent. In the morbidly obese parturient the cesarean delivery rate exceeds 50% (13). Obese patients also have an increased incidence of associated co-morbidities (e.g. diabetes, hypertension),

intra-operative bleeding and longer surgical time. The incidence of failure of 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) (14). Furthermore, chest compliance is often poor, and mask ventilation may prove to be difficult. Obesity and late pregnancy predisposal to hiatus hernia, make regurgitation of gastric contents more likely to occur.

Emergency situations

General anesthesia is more likely to be used in the stressful situation of an emergency cesarean delivery and the need for rapid induction makes endotracheal intubation more difficult. The surgeons are ready for the incision, the patient is draped and the conditions for airway management are suboptimal.

The majority of cases of failed intubation happen during an emergency cesarean delivery, occur out of normal working hours when minimal backup is available, and involve residents (15-16).

In an emergency situation a full airway assessment may not be performed. Therefore it is recommended to perform a routine pre-anesthetic assessment in every patient admitted to the labor and delivery unit.

Rapid sequence induction with cricoid pressure is the standard practice for the induction of general anesthesia in obstetric anesthesia. Cricoid pressure is used to prevent regurgitation of gastric contents into the pharynx and subsequent aspiration into the pulmonary tree. However the effectiveness of cricoid pressure has been questioned, especially if it is inappropriately applied. Moreover, it has been suggested that incorrect or over-enthusiastic application of cricoid pressure, makes tracheal intubation more difficult, by obscuring airway anatomy (17-19). Although there are concerns regarding the consequences of the misapplication of cricoid pressure, it remains, so far, a standard manoeuvre during rapid sequence induction for cesarean delivery.

Lack of experience

With the increase number of cesarean deliveries performed under regional anesthesia, the skills required to manage a difficult obstetric airway are used infrequently. Educators face the challenge of teaching general anesthesia for cesarean delivery 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 delivery.

Ideally, anesthesia trainees should have access to simulators suitable for

learning and practicing how to manage airway difficulties. Medical simulators are becoming more sophisticated, and combined with formal teaching may be used as a tool to acquire skills in a risk free environment. Drills are critical elements of the emergency preparedness process; they provide training exercises and identify weaknesses in the response plan so that shortcomings can be addressed. However, it remains uncertain whether simulated training improves clinical performance.

Airway assessment

It is crucial to perform an airway evaluation, to identify the factors predictive of difficult intubation. The vast majority of difficult intubations (98%) may be anticipated by performing a correct evaluation of the airway in advance (20). A complete airway assessment can be performed in approximately 1–2 min (21). 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 be not limited) to the following steps:

- Examination of previous anesthetic records, if available in a timely manner, may yield useful information about airway management (22).
- Mallampati classification. Based on the original Malampatti classification (23) and the Samsoon and Young (24) modification, there are four classes to evaluate the relationship of the base of the tongue to the oropharyngeal structures: 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 Mallampatti 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 (25). 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 inset 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 the 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 (35^0) 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 optimizing the glottis 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). Thirty-five degrees of extension is normal. Reduction of this angle by one third or more predicts difficulty with intubation.
- Evaluation of the teeth. This is performed specifically for assessment of maxillary overbite or protruding maxillary incisor teeth.

Positioning the patient

Correct positioning of the patient is very important for 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. Proper positioning of the overweight patient (shoulders elevated with several pads, the head and neck extended, the external auditory meatus in line with the sternal notch) is of critical importance (26).

Brest engorgement may interfere with the placement of the laryngoscope, necessitating use of a short handle.

The operating room table should be adjusted to the level of the laryngoscopist's intercostals margin, and tilted 15 degree to the left, to avoid aortocaval compression.

Management of the difficult airway – Decision Making

The American Society of Anesthesiologists' (ASA) difficult airway algorithm, does not address specific problems of the obstetric patient.

Decisions regarding airway management most consider the emergency of the delivery of the baby and whether a difficult airway is predicted.

Recognized difficult airway

When a difficult intubation is anticipated, suitable precautions and early communication with the obstetrician are necessary. It is important to have a strategic back-up plan for every patient. The location of the cricothyroid membrane should be identified for possible use in unexpected airway loss.

If a difficult airway is suspected, decision must be made between the use of regional anesthesia or an awake fiberoptic intubation followed by general anesthesia.

Regional anesthesia is the best choice for cesarean section in most cases of anticipated difficulty with endotracheal intubation (4,7,8). Instituting a "prophylactic" epidural anesthesia early ensures that it may be rapidly extended if cesarean delivery is necessary. The American College of Obstetricians and Gynecologists recommends considering the placement of epidural catheter in early labor, with confirmation that the catheter is functional, in patients at risk for difficult airway (27).

In morbidly obese parturient, even though very controversial, a continuous spinal technique can be used for urgent cesarean delivery (28).

One should be prepared for potential complications of regional anesthesia (*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.

Combined spinal-epidural anesthesia provides the advantages of a spinal anesthesia 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 the successful completion of this procedure (4,29). The preference for awake fiberoptic - aided intubation includes the following reasons: the natural airway and the normal position of the larynx are preserved, muscular tone is better maintained facilitating the identification of anatomical landmarks of the upper airway and spontaneous respiration is maintained (29,30).

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

Attention must be paid when performing local anesthesia of the upper airway (selective nerve blocks or direct application of local anesthetics) due

to increased mucosal vascularization and increased sensitivity of peripheral nerves to local anesthetics during pregnancy (2).

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

Call for help immediately!!!!!

Management of the unanticipated difficult tracheal intubation must concentrate on the maintenance of oxygenation and ventilation and the prevention of airway trauma. Repeated attempts at intubation increase the risk of hypoxia and aspiration. Atraumatic manipulation of the airway is crucial, as with every intubation attempt, the airway edema may increase and there is a higher risk of bleeding of the airway. *A maximum of three optimal attempts at laryngoscopy and intubation should be allowed.* The intubation attempts should be done in optimal conditions by the most qualified anesthesiologist, with good positioning, using an appropriate laryngoscope blade, (length and type) adequate muscular relaxation, and correct 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), use of a rigid stylet, or a gum elastic bougie (e.g. Eschmann tracheal tube introducer) can improve intubation success. The recently developed Glidescope has not been evaluated, so far, in pregnant patients. However video-laryngoscope may be useful in obstetrics (2). It consists of a similar to Macintosh blade with a miniature high resolution wide angle video-camera attached to its inflection point. The addition of the video camera allows for a more pronounced 60º blade angulation and detailed image visualization on a video monitor, which significantly improves the view of the glottis and endotracheal intubation rate in comparison with the standard Macintosh laryngoscope (31-33).

After three properly controlled attempts at intubation fail, further management is dictated by whether ventilation and oxygenation can be maintained by mask.

Failed intubation, possible ventilation

If endotracheal intubation fails but oxygenation and ventilation can be maintained, further management is dictated by the wellbeing of the fetus.

No fetal distress

If endotracheal intubation fails after a maximum of three attempts, the patient should be allowed to awaken and proceed to awake fiberoptic intu-

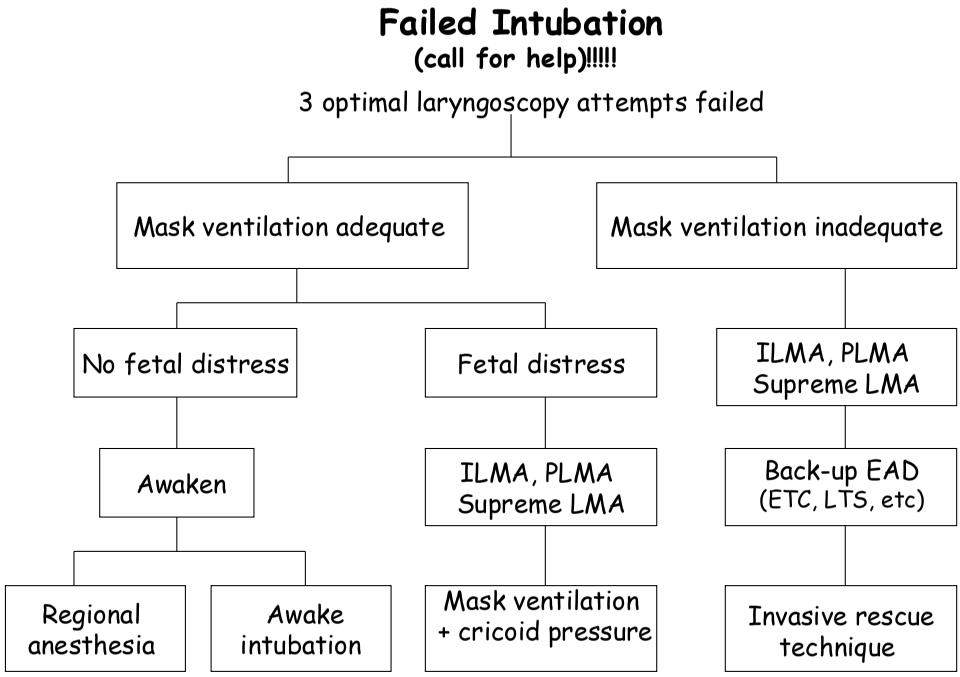

Fig.1 The Unrecognized Difficult Airway

bation or regional anesthesia. Cricoid pressure should be maintained until the patient is fully awake and able to protect her airway, however, it should be released cautiously if it interferes with intubation and ventilation.

Fetal distress

If the attempts at tracheal intubation have been unsuccessful, primary management goals include maternal oxygenation, airway protection, and prompt delivery of the baby (8). Management options include:

• Option 1:

Larygeal Mask Airway (LMA) placement. Existing algorithms (2,7,11) recommend the use of the classic laryngeal mask airway (cLMA) *or* LMA variants as a rescue airway device for a cannot ventilate, cannot intubate situation. I would suggest using one of the LMA variants, the multiple use Proseal LMA (PLMA) or the single use Supreme LMA, as a *primary rescue airway device* in obstetric anesthesia. These devices were developed in an attempt to overcome the cLMA's shortcomings: low-pressure seal and lack of protection for aspiration. Both devices have a modified cuff designed to improve the seal and a drainage tube for gastric tube placement (34-36). When placing an LMA, Proseal LMA or the Supreme LMA, cricoid pressure needs to be released transiently. The PLMA and the Supreme LMA are definitely not a replacement for the endotracheal tube, and should not be considered as absolutely safe, regarding the increased risk of regurgitation or aspiration. Importantly, the drainage tube tip must be positioned correctly for it to work correctly (37). However, these LMA variants are designed to provide superior airway protection over the LMA.

Even though the Intubating LMA (ILMA) does not protect the airway against aspiration, it should be given a high priority in the algorithm, probably in preference to a cLMA. It has the advantage of being an effective ventilatory device and a conduit for blind/fiberoptic intubation in patients with abnormal airways, having similar insertion success rate and times to the cLMA (38-40).

• Option 2:

Mask ventilation may be safer than further attempts at intubation. Another option could be to continue anesthesia via mask ventilation, while an assistant maintains cricoid pressure with a level of anesthesia deep enough to avoid laryngospasm.

Cannot Ventilate, Cannot Intubate. Life threatening situation!!!!!!!!

Persisting at endotracheal intubation may lead to increased maternal morbidity and mortality. Don't start surgery if oxygenation and ventilation are

unsatisfactory. After maternal oxygenation is secured, surgery may proceed. Allow for resumption of spontaneous ventilation, if possible.

If the patient cannot be intubated or ventilated by mask, the airway should be secured by an LMA variant. Existing algorithms (2,7,11) propose an emergency invasive airway access when the LMA (or other intubation choices) fails to provide successful oxygenation and ventilation. Before starting an invasive rescue technique, maximum effort should be made to achieve ventilation and oxygenation with non-invasive techniques, such as optimum mask ventilation and use of an LMA variant or other extraglottic airway devices.

We suggest using a backup extraglottic airway device to the primary rescue device (Proseal LMA or Supreme LMA) before proceeding with an invasive rescue technique. Extraglottic airway devices are developed with increasing frequency. However, so far, the Esophageal Tracheal Combitube (ETC) and Laryngeal Tube Suction are the best evaluated. The use of the second generation extraglottic airway devices, that separate the alimentary and respiratory tracts, should be encouraged.

The American Society of Anesthesiologists (ASA) Task Force on difficult airway management recommends ETCs among other devices for unrecognized difficult airway problems, especially in „cannot ventilate, cannot intubate" situations (22).

It is recommended to use the extraglottic airway device, which the operator is most familiarized with.

Invasive airway choices

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

- Choose regional anesthesia whenever possible,
- Assume that every parturient has a potentially difficult airway,
- Evaluate the airway of every parturient,
- Have a back-up plan for every patient,
- Call for help early,
- Optimize patient's position for intubation,
- Provide adequate muscular relaxation,
- Choose the rescue airway device that you are most experienced with,
- Do what you do best,
- Don't start the surgery if the oxygenation and ventilation are unsatisfactory.

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