The airway in the obstetrical patient

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Airway management of the parturient has serious implications for the anesthetist. Meticulous patient evaluation and preparation is essential. A management plan that can be implemented in the event of failed intubation should be familiar to all anesthetists who are involved in obstetrical anesthesia.

Key words: Airway, anesthesia, difficult airway, intubate, obstetrics.

Introduction
Airway management of the parturient has serious implications for the anesthetist. Anesthesia-related causes, particularly an inability to accomplish endotracheal intubation, remain a significant factor in maternal morbidity and mortality. Davies and associates reported the composite incidence of failed intubation in parturients to be one in 500, while Lyons' experience was one for every 300 general anesthetics given. This problem is common enough so that many anesthetists will be confronted with this frightening situation at some time in their careers. As a result, every anesthetist must be familiar with the special anesthetic and airway needs of the pregnant woman and have a carefully thought out management plan ready to implement in the event of a failed intubation.

Anatomic and physiologic changes in the parturient
Management of the obstetrical airway necessitates full knowledge of the physiologic and anatomic demands placed on the mother by the fetus. Such changes have a profound impact on the safe clinical management of the parturient.

Anatomic alterations of the respiratory system are an important consequence of pregnancy. Capillary engorgement of the respiratory tree, including the nasopharynx, larynx, and vocal cords, results in mucosa that is commonly edematous and friable. The edema is accentuated in parturients with pregnancy-induced hypertension or who have had a prolonged strenuous second stage of labor. Cephalad displacement of the diaphragm by the expanding uterus produces a compensatory increase in the anterior-posterior and transverse diameter of the chest, resulting in an overall expansion of the thoracic cage circumference of 5-7 cm. Radiographs of the lungs exhibit increased pulmonary markings, which may simulate mild congestive heart failure.

Weight gain associated with pregnancy may further exaggerate anatomical changes that interfere with airway management. This is particularly evident in the obese parturient whose propensity
for large, pendulous breasts; fat shoulders; thick neck; large chest; and limited neck extension present additional challenges to the anesthetist.\textsuperscript{10}

Respiratory physiology is altered dramatically during pregnancy (Table I, Figure 1).\textsuperscript{10} Increases in tidal volume and minute volume are due to elevated progesterone levels and carbon dioxide production associated with pregnancy.\textsuperscript{11, 12} The decrease in residual volume, expiratory reserve volume (ERV), and functional residual capacity (FRC) are secondary to cephalad displacement of the diaphragm from the gravid uterus. Because of the decrease in ERV, closing volume may approximate FRC, creating the potential for regional ventilation-perfusion mismatching and hypoxia. Supine and Trendelenburg positioning further distort the relationship between closing volume and FRC. As many as one third of parturients may experience early airway closure during normal respiration in the supine position with PaO\textsubscript{2} values of less than 90 mmHg.\textsuperscript{13, 14} Preexisting conditions, such as scoliosis, tobacco abuse, and obesity, further exacerbate premature airway closure and associated hypoxemia in parturients of advanced gestation.\textsuperscript{15}

The metabolic demands of the fetus and the additional energy expended during maternal respiration increase the parturient's oxygen consumption by 20%.\textsuperscript{10} Oxygen consumption is further increased by painful contraction. In preoxygenated patients who were undergoing cesarean section with general anesthesia, PaO\textsubscript{2} values decreased an average 139 mmHg/min ± 13 mmHg as opposed to 50 mmHg/min ± 8 mmHg in nonpregnant patients during 1 minute of apnea.\textsuperscript{16}

Gastrointestinal changes place the parturient at increased risk for regurgitation and aspiration. Elevated progesterone levels decrease gastric motility, food absorption, and lower esophageal sphincter tone.\textsuperscript{17} Placental gastrin increases gastric volume and acid production. As many as 49% of parturients presenting for elective cesarean section after an overnight fast were found to have gastric volumes greater than 25 mL and a gastric pH of less than 2.5, placing them at high risk for aspiration pneumonitis.\textsuperscript{10} The gravid uterus also produces upward displacement and rotation of the stomach, with elevated intragastric pressure, delayed gastric emptying, and distortion of the gastroesophageal angle.\textsuperscript{12}

**Clinical implications for the anesthetist**

All patients who present for emergent or elective cesarean section should be considered to have full stomachs, and measures should be taken for rapid intubation of the trachea. Within 60 minutes of induction, an oral nonparticulate antacid should be administered. If time permits, metoclopramide and histamine H\textsubscript{2}-receptor antagonist may be given. Metoclopramide, administered intravenously 15-30 minutes prior to induction, increases lower esophageal sphincter tone and gastric mobility. Cimetidine increases gastric fluid pH when given parenterally 1-3 hours in advance of surgery. Both metoclopramide and cimetidine appear to be free of adverse fetal effects.\textsuperscript{12, 18} Properly applied cricoid pressure as a part of a rapid sequence induction technique is recommended to minimize the risk of regurgitation and pulmonary aspiration.\textsuperscript{19}

The combination of increased oxygen consumption and decreased pulmonary reserve renders the parturient particularly susceptible to hypoxia following induction of general anesthesia.\textsuperscript{17} Preoxygenation for 3-5 minutes is an important step in denitrogenation of the FRC, although four deep breaths of 100% oxygen before induction may be sufficient in an emergency, provided the fresh gas flow greatly exceeds the patient's minute volume.\textsuperscript{20, 21}

Edematous, friable mucosa within the respira-
tery tree makes it imperative to avoid repeated traumatic attempts at tracheal intubation, which may cause a complete loss of airway due to hemorrhage and edema. Likewise, nasal intubation and nasogastric tubes are relatively contraindicated because of the risk of bleeding. Small-diameter endotracheal tubes may be necessary and should be readily available. Postintubation obstruction due to upper airway edema may occur and requires constant observation in the immediate postoperative period.

The airway of the obese parturient can be unpredictable. Because 6-10% of pregnant patients can be considered obese and at an increased risk for anesthesia-related morbidity and mortality, the anesthetist must be particularly meticulous in managing the patient's airway. A short handle laryngoscope may be helpful when pendulous breasts or limited neck extension complicates laryngoscopy. Alternatively, the laryngoscope blade may be inserted orally prior to attaching the handle. Elevation of the head and shoulders with blankets may alleviate many problems by favorably realigning the orolaryngeal axis and facilitating laryngoscopy.

**Equipment for airway management**

Proper equipment is essential for the management of the airway in the obstetrical patient. Table II lists basic equipment which should be readily available in the anesthetic work area of the operating room. A laryngoscope with a variety of blades, endotracheal tubes, and a stylet should be all that is necessary for routine and somewhat more difficult intubations. If an intubation proves to be very difficult, a selection of airways should be readily accessible to help provide assisted ventilation while an assistant obtains the equipment reserved for difficult airways (Table III).

A difficult airway cart or box should be placed in a convenient location in the operating room suite. Specialty items, such as a short handle laryngoscope, polio blade, bougie stylet, and a fiberoptic scope, may prove invaluable in a difficult intubation. It is recommended that a percutaneous transtracheal jet ventilation kit be readily avail-
Table II
Basic airway equipment

Laryngoscope
Curved blades #3, #4
Straight blades #2, #3
Malleable stylet
Endotracheal tubes 6.5, 7.0, 7.5-mm internal diameter
Face masks—adult small, medium, large
Oropharyngeal airways—adult small, medium, large
Nasopharyngeal airways—various sizes (22-34 Fr)
Headstrap
Lubricating jelly
Suctioning equipment
Percutaneous transtracheal jet ventilation kit

Table III
Difficult airway equipment

Laryngoscope—short handle
Specialty blades, i.e., polio blade, Bellhouse blade with prism
Endotracheal tubes—5.0, 5.5, 6.0 mm internal diameter
Gum-elastic bougie stylet
Fiberoptic scope
Laryngeal mask airway
Esophageal gastric tube airway
Percutaneous cricothyrotomy/tracheostomy kit
Surgical cricothyrotomy kit
Retrograde tracheal intubation kit

able, either in each operating room or in the difficult airway cart. Depending on the anesthetist's experience with a particular device, it may be desirable to stock a laryngeal mask airway, an esophageal gastric tube airway, a percutaneous cricothyrotomy or tracheostomy kit, and a surgical cricothyrotomy kit. Anesthetists should be familiar with a variety of airway devices in order to be better prepared in the event of a difficult airway.

Techniques for airway management

- Percutaneous transtracheal jet ventilation. In a desperate situation where the parturient cannot be intubated or ventilated, percutaneous transtracheal jet ventilation (PTJV) is an effective and relatively safe method of temporarily establishing oxygenation and removing carbon dioxide. Its use and efficacy has been well documented in laboratory animals and humans, but experience with this technique in obstetrics is limited. Nevertheless, PTJV is an integral part of most obstetric protocols after a failed intubation.

Benumof and Scheller recently described three acceptable systems for transtracheal ventilation.23 They preferred jet injection powered by regulated wall or oxygen tank pressure; unregulated wall or tank oxygen pressure with a jet injector was an acceptable alternative. The simplest and least expensive system consisted of oxygen supply tubing, a 15-mm endotracheal tube adaptor for a 4-mm internal diameter endotracheal tube, a one-fourth inch hose Barb male luer lock or cutoff 1-mL syringe, and a 14- or 16-gauge intravenous (IV) catheter (Figure 2).

All anesthetists should be familiar with the technical aspects of establishing PTJV. With one hand on the cricothyroid membrane, a 14- or 16-gauge IV catheter and needle with a syringe attached is advanced in the midline at a slightly caudad angle through the cricothyroid membrane. Using negative pressure, the trachea is identified by the aspiration of air into the attached syringe. The plastic IV catheter is advanced into the trachea, the needle is removed, and the position is again verified by the aspiration of air. With the catheter stabilized, the luer lock or cutoff 1-mL syringe is affixed to the catheter hub, while the 15-mm endotracheal tube adaptor is attached to the fresh gas outlet of the anesthesia machine (or to wall/tank oxygen if a jet injector device is utilized). The oxygen flush valve or jet ventilation apparatus is used to administer 40-50 breaths per minute.

This method of ventilation is capable of establishing normocarbia or hypocarbia and hyperoxia, but it is considered a temporary device until the airway is secured by other means (i.e., surgical cricothyrotomy or tracheostomy, fiberoptic intubation) or the patient resumes spontaneous ventilation.

Complications arising from PTJV occur in as many as 29% of cases and include subcutaneous emphysema (7.1%), mediastinal emphysema (3.6%), arterial perforation (3.6%), and difficulty with exhalation (14.3%).27 The potential for laryngeal

Figure 2
Components of a transtracheal ventilation system

1. 15-mm endotracheal tube adaptor for a 4-mm internal diameter tube
2. Oxygen supply tubing
3. ¼-inch hose Barb male luer lock (or a cutoff 1-mL syringe
4. 14- to 16-gauge intravenous catheter

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damage has led some to suggest that the puncture site should be below the cricoid cartilage. The anesthetist must be highly suspicious of any hypotension, tachycardia, or bradycardia that occurs during the use of PTJV, because of the possibility of barotrauma and pneumothorax. The likelihood of barotrauma increases when a total upper airway obstruction makes the patient unable to exhale injected gas. This situation requires a surgical cricothyrotomy or tracheostomy as soon as feasible.

- **Esophageal gastric tube airway.** Intubation of the esophagus, either deliberately or inadvertently, has been used as a means of establishing an airway in obstetrical airway disasters. While utilizing the esophageal tube as an obturator to prevent the passage of gastric contents from the esophagus into the trachea, it was discovered that the ability to ventilate was actually improved. It is believed that the cuffed tube helps displace the larynx anteriorly away from the posterior pharyngeal wall, thus creating an open air passage from the pharynx to the trachea.

The esophageal gastric tube airway (EGTA) is a modification of the esophageal obturator airway first used for cardiopulmonary resuscitation by personnel who were not trained in tracheal intubation. It consists of an esophageal or endotracheal tube that passes through a holder in a special face mask that allows for aspiration of gastric contents and also for a breathing circuit to be attached to a second aperture. Typically, the EGTA is placed in a paralyzed or anesthetized patient, and the patient is subsequently allowed to breathe spontaneously while receiving general anesthesia. Potential risks include esophageal trauma, mediastinal perforation, and vomiting upon the airway’s withdrawal.

In the authors’ practice, use of the EGTA is not initially considered in a difficult airway scenario, but if the esophagus is inadvertently intubated and emesis flows up through the tube, consideration is given to leaving it in the esophagus with the cuff inflated. The stomach is suctioned through the tube, and an attempt is made to establish ventilation by mask. If ventilation is successful and further attempts to intubate are abandoned, the patient is permitted to breathe spontaneously while general anesthesia is maintained. At the end of surgery, the patient is awakened, and the stomach is suctioned again before removing the esophageal tube.

- **Laryngeal mask airway.** In several instances, a laryngeal mask airway has been reported to be a valuable tool in the very difficult airway (Figure 3). Experience with its use in obstetrical anes-

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*Experience with its use in obstetrical anesthesiology is limited,* but it offers another viable alternative when intubation is unsuccessful. Cricoid pressure should be maintained after the airway's insertion to reduce the risk of regurgitation and aspiration. The laryngeal mask airway appears to be best suited to the patient who is spontaneously ventilating, although it has been used in conjunction with assisted ventilation until breathing resumes. If indicated, general anesthesia may be continued using the laryngeal mask airway and allowing the patient to breathe spontaneously. The airway is removed only when the patient is awake and able to protect her airway.

- **Percutaneous tracheostomy/cricothyrotomy.** The desire to achieve a functional tracheal airway expeditiously while avoiding surgical dissection has led to the development of several percutaneous tracheostomy and cricothyrotomy kits. Devices such as the Nu-trake cricothyrotomy kit, the Pertrach Emergency Percutaneous Airway, the Rapitrach Tracheostomy Kit, and the Melker Transcricothyrotomy Catheter were developed for this purpose. Each device follows a similar concept, i.e., the insertion of a needle into the trachea and dilation of the puncture site to facilitate placement of a functional airway. The device's advantages over surgical dissection include less bleeding, easier to learn, and faster insertion. Clinical experience in 100 patients revealed a complication rate of 14%, of which 6% was due to false passage of the device paratracheally rather than intratracheally. One death was directly related to
airway insertion in an obese woman in whom the tube was too short. The airway was lost, resulting in hypoxia and cardiac arrest. A longer tube was subsequently developed.

Use of this device in obstetrics has not been tested and cannot be recommended unless the anesthetist is familiar with its use.

Other techniques of airway management. In the very difficult airway, it is helpful to be familiar with as many techniques as possible to successfully ventilate the patient. One such technique involves the use of a long, lubricated, malleable gum-elastic bougie (Eschmann tracheal tube introducer), which has been flexed into a J shape. The tip is extended approximately 6 cm beyond the end of an endotracheal tube, gently passed behind the epiglottis, and directed anteriorly toward the vocal cords. When the bougie is assumed to be in the trachea, the endotracheal tube is advanced over the bougie into the trachea. Alternatively, an endotracheal tube with an anterior bevel is used with the stylet placed through the eyelet.

A malleable illuminating stylet can be used in a manner similar to the bougie. TUBE-STAT or Flexi-lum are illuminated stylets which, when placed in the trachea, will be readily observed externally, particularly if the room is darkened. The stylet is lubricated, inserted into an endotracheal tube until the bulb just emerges from the distal tip, and then flexed into a J shape. After anesthetizing the oropharynx, the awake patient is asked to protrude his or her tongue, and the stylet is inserted. With the anesthetized patient, the tongue is grasped with gauze and pulled forward. The illuminated stylet with an endotracheal tube is placed in the oropharynx and advanced toward the larynx. As the tube is advanced into the trachea, a transilluminated glow within the trachea will be visible in the anterior neck at the level of the larynx. Light seen in the lateral neck suggests placement in the vallecula while a dull, diffused light indicates esophageal placement. When successfully placed intratracheally, the endotracheal tube can then be advanced, and the usual steps to confirm proper placement can be undertaken. In the obese patient and/or the patient with a thick neck, the light may be dimmer than expected when it is in the trachea and can be misleading to the anesthetist. Conversely, in the thin patient, the light may be bright despite being in the esophagus.

However efficient this method is in routine and difficult intubations, very little experience with its use in obstetrics is available. The illuminating stylet may be useful as an alternative intubation technique when direct laryngoscopy has failed but only if the anesthetist is familiar with this method and cricoid pressure is maintained throughout intubation.

The Bullard laryngoscope is a rigid, hockey stick-shaped blade that contains a fiberoptic bundle along its posterior surface that permits the anesthetist excellent visualization of the larynx. Because use of this laryngoscope required little or no manipulation of the neck, it has been recommended for patients with unstable cervical spine injuries. An intubating stylet has been added as an integral part of the blade, and it appears to facilitate endotracheal tube placement. While use of this new device may require some time and effort to master, it could be a useful addition to the anesthetist's armamentarium. It would seem to be particularly helpful in the patient with cervical spine disease or injury and the parturient with known or anticipated difficult airway who presents for elective cesarean section under general anesthesia.

As with any fiberoptic device, excessive oral secretions or bleeding may interfere with visualization. Therefore, the Bullard laryngoscope may be a difficult device to use in a patient who cannot be intubated after numerous attempts and has copious secretions, although the provided suction port may help somewhat. Another problem with the use of the Bullard laryngoscope exists in patients with long necks. It has been reported that patients with necks that are significantly longer than normal, such as those who would require a #4 Macintosh or #3 Miller blade, cannot be successfully intubated due to inadequate length of the Bullard laryngoscope.

Other laryngoscope blades used in difficult airway management incorporate either one or two angles to take advantage of the features offered by both the straight and curved blades. The Belscope is a modified straight blade with a 45-degree bend at the midpoint. A prism can be added to further facilitate the line of vision anteriorly. Another blade has two incremental curves of 20 and 30 degrees along a wide, flat blade shaft. By eliminating the flange more room is available for manipulation of the endotracheal tube than with a standard straight blade. Jellicoe and Harris have reported a modification of a standard Macintosh blade, whereby the angle between the blade and the handle is increased to facilitate the introduction of the blade into the mouth but is not obtuse enough to produce the difficulty associated with the polio blade. More experience with these new laryngoscope blades is necessary before their routine use in obstetrics can be recommended.
Although it is typically not recommended in obstetrical patients, blind nasotracheal intubation has been performed successfully. In two cases, the intubation was accomplished in an awake patient, one of whom was a failed intubation who had been allowed to awaken. Use of topical oropharyngeal anesthesia is considered essential to shrink the nasal mucosa and reduce its vascularity. Still, the passage of a nasal tube in this population must be considered dangerous in view of the potential for upper airway hemorrhage.

The Combitube™ is a new airway that was designed for emergency intubation. It is placed blindly without a laryngoscope and can provide sufficient ventilation whether the airway is placed into the trachea or esophagus. Because it has a double lumen, if it is placed in the esophagus, the distal orifice can be used for the removal of gastric contents through a suction catheter that is provided. There are two cuffs, proximal and distal. The disal cuff seals off the esophagus so that, in the event of regurgitation, the risk of aspiration should be minimal. Use of the Combitube is contraindicated in patients under the age of 16 and under 5 feet tall. Its role in obstetrical anesthesia is unclear.

Surgical cricothyrotomy/tracheotomy should only be undertaken by a practitioner, preferably a surgeon, who is experienced with this procedure. The reader should consult surgical texts for a review of the anatomy and technique.

**Airway management scenarios**

The initial step in airway management is to assess the patient's airway in the hope of identifying those patients who are at risk. In an ideal setting, the anesthetist would thoroughly evaluate the parturient's airway and devise an appropriate course of action prior to surgery. Unless the anesthetist is solely responsible for the obstetrical ward and has time to visit each patient early in her labor, it is more likely that his or her first assessment will be made on the way to the operating room for an emergency cesarean section.

Certainly, some difficult airways will be easily recognized when a patient has obvious trauma or deformities of the face, upper airway or cervical spine, or relates a history of difficult intubation. Difficult airways in other patients will be much less obvious, and it is for these patients that various criteria for estimating the probability of a difficult intubation have been developed. One such simple maneuver is to evaluate the oropharyngeal structures in the seated patient whose mouth is open widely and whose tongue is maximally protruded. First described by Mallampati and colleagues and later modified by Samsoon and Young, this technique found a significant correlation between visibility (or lack of visibility) of faucial pillars, soft palate and uvula, and exposure of the glottis by direct laryngoscopy (Table IV).

Common errors include assessment in the supine position and having the patient phonate “ah,” neither of which was part of the original studies and may distort the test's reliability. A recent investigation assessed risk factors associated with difficult intubation in obstetric anesthesia. A strong correlation between the structures seen on oropharyngeal assessment and a subsequent difficult intubation was confirmed in 1,005 patients who were undergoing general anesthesia for cesarean section.

Head extension is another important consideration in airway evaluation. Atlanto-occipital extension is assessed by visually estimating the angle traversed by the occlusal surface of the maxillary teeth when the head is extended from the neutral position. Thirty-five degrees of extension is normal at the atlanto-occipital joint. Reduction of this angle by one third or more predicted difficulty with intubation.

A receding lower jaw reduces the space anterior to the larynx and diminishes the line of vision along the orolaryngeal axis when the head is extended. Described as the mandibular space by Bellhouse and Dore, it is estimated by viewing the patient from the side with the mouth open and the head extended. An imaginary line is drawn from the upper central incisor to a point 1.5 cm behind the laryngeal prominence of the thyroid cartilage. The observer then estimates the perpendicular distance to the mandibular genial tubercle.

| Table IV | Oropharyngeal assessment and classification
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<td><strong>Class</strong></td>
<td><strong>Physical assessment</strong></td>
</tr>
<tr>
<td>I</td>
<td>Soft palate, fauces, uvula, tonsillar pillars visible</td>
</tr>
<tr>
<td>II</td>
<td>Soft palate, fauces visible, tip of uvula obscured</td>
</tr>
<tr>
<td>III</td>
<td>Soft palate, base of uvula visible</td>
</tr>
<tr>
<td>IV</td>
<td>Soft palate visible</td>
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in front of the line. A distance of less than 2.5 cm was associated with difficulty during laryngoscopy. Similarly, the distance from the thyroid notch to the mentum may be assessed by the number of finger breadths or with a ruler when the patient's head is extended. A distance of less than 3 finger breadths or 6 cm may suggest problems.

In addition to these bedside evaluations, classic teachings emphasize visual assessment of physical characteristics that may pose problems.\textsuperscript{60, 63} Beware of patients with a short, muscular neck and a full set of teeth; a high, arched palate associated with a long, narrow mouth; and poor mobility of the mandible, and a receding mandible, as previously mentioned.

The clinical evaluations of the airway as described are all relatively simple and quick to perform. While these investigations were not performed in an obstetrical population, the investigators who used the three predictors (head extension, mandibular space, visualization or oropharyngeal structures) reported 100% accuracy in identifying difficult intubations.\textsuperscript{61} While some clinicians suggest airway assessment of the parturient in the recumbent position,\textsuperscript{6, 62} it would potentially negate the accuracy of these valuable predictors.

In an emergency situation, it is preferable to quickly assess body habitus and then evaluate the other three predictors in the sitting position. This can be conveniently done when the patient moves over the operating table or sits up to drink the required nonparticulate antacid. Such an evaluation should take only seconds to perform and may have a profound impact on decision making during preparation for induction. If the situation makes it impossible for the patient to sit up, the best assessment possible should be done with the patient in the supine position while her history is being obtained.

**Elective or nonemergency cesarean section**

In this instance, the anesthetist should have adequate time to assess the patient and her airway and to administer a nonparticulate antacid (Figure 4). A patient with a known difficult airway can be safely managed with awake or fiberoptic intubation. Regional anesthesia is an alternative, but the anesthetist must always be prepared for the possibility of a high block that requires respiratory support. Use of a carefully placed epidural catheter may allow for a more controlled dermatomal level of anesthesia than a single-shot spinal anesthetic.

The anesthetist must make a slightly more difficult decision when a parturient's airway assessment is suspect. Again, regional anesthesia is a viable option. The anesthetist may consider performing an awake laryngoscopy (after topical anesthesia is applied) to grade the visualization of the larynx prior to embarking on the anesthetic. Poor visualization of the larynx should encourage the anesthetist either to proceed with fiberoptic intubation or to use a cautious regional technique.

The most stressful scenario involves the unanticipated difficult airway. If repeated attempts to intubate, including techniques utilizing the flexible bougie or light wand fail, the anesthetist must make a critical decision either to wake the patient or proceed with another method of ventilation. If Doppler probe assessment of fetal heart tones indicates fetal stability, an attempt should be made to awaken the patient. However if the fetal status is tenuous and mask ventilation is possible, the anesthetist may consider proceeding with the cesarean section while maintaining cricoid pressure. In all cases, the parturient's life takes priority and should be the prime concern of the anesthetist.

If the patient cannot be ventilated by mask, she must be awakened. Often, the patient will not awaken in this situation and must be ventilated by

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**Figure 4**

Airway management flow chart for elective or nonemergency cesarean section

- Known airway difficulty
  - Consider regional anesthesia
    - Proceed with surgery
- Suspect difficult airway
  - Consider regional anesthesia
    - Awake or fiberoptic intubation
      - Proceed with surgery
  - Unanticipated difficult airway/cannot intubate
    - Fetal status stable?
      - Yes
        - Proceed regional or perform local
        - Awake/awake fiberoptic intubation
      - No
        - Mask ventilation
          - Patient does not awaken
            - Convert to regional or perform awake/fiberoptic intubation
        - Patient does not awaken
          - PTJV
            - Laryngeal mask
              - Cricothyrotomy
                - Proceed with surgery
            - EGTA
              - Laryngeal mask
                - Cricothyrotomy
                  - Proceed with surgery

EGTA—Esophageal gastric tube airway
PTJV—Percutaneous transtracheal jet ventilator

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other means. Percutaneous transtracheal jet ventilation, laryngeal mask, esophageal gastric tube airway, and percutaneous or surgical cricothyrotomy are all viable options at this point, and the anesthetist should institute the technique with which he or she is most familiar. After the airway is secured, surgery may proceed. When the patient has been wakened but the fetal status is precarious, the anesthetist should consult with the surgeon regarding the delivery of the child under local anesthesia. After delivery and hemostasis, the airway can be secured with an awake or fiberoptic intubation.

**Emergency cesarean section**

The same caveats that apply to nonemergency cesarean section also apply to the emergency situation (Figure 5). In such an instance, patient assessment, airway evaluation, and aspiration prophylaxis are performed, albeit more quickly. Parturients with a known difficult airway should be considered for awake intubation or regional anesthesia, if it is not contraindicated. Time constraints make spinal anesthesia preferable to epidural anesthesia in such a situation. If awake intubation is unsuccessful and regional anesthesia is undesirable, local anesthesia may be used for delivery and hemostasis, the airway can then be secured, and the surgery completed.

If a probable difficult airway is suspected, the anesthetist should convey his or her concerns to the surgeon and patient immediately, then proceed with awake laryngoscopy and intubation if possible. Regional anesthesia (spinal) should be considered if an awake laryngoscopy confirms suspicions, or the baby should be delivered under local anesthesia.

When difficulty in intubation is not anticipated or, worse yet, cannot be accomplished, the parturient's life is again the primary concern of the anesthetist. If mask ventilation is possible, the decision to proceed with surgery should be considered. When the patient cannot be ventilated by mask and shows no signs of awakening, other means of ventilation should be instituted. The baby can be delivered once the airway is secured.

A few additional factors should be mentioned regarding airway disasters. When problems arise, call for help; extra experienced hands can be invaluable. The successful use of mask ventilation precludes further attempts at intubation, unless the anesthetist is reasonably assured of tracheal intubation. It is better to continue with a successful technique than to risk losing the airway due to trauma and excessive secretions from repeated laryngoscopy.

Cricoid pressure should be maintained until the airway is secured. The only exception would be if the esophagus is intubated. Occasionally, misapplied cricoid pressure can interfere with intubation/ventilation, and the pressure can be cautiously released to evaluate its effects. Some anesthetists recommend placing the patient in the left lateral decubitus and head down position while maintaining mask ventilation. This is a difficult task for many anesthetists, so the patient is typically kept supine when utilizing mask ventilation. However, if the patient has vomited, the head is immediately lowered and the patient is tilted to the left.

Use of a muscle relaxant with mask ventilation is controversial. When using mask ventilation, the patient should be allowed to resume spontaneous respiration while doses of inhalation agent, narcotic, and midazolam are titrated. If difficult ventilation is suspected, it may be improved with muscle relaxation, and small incremental doses of succinylcholine may be cautiously administered.

The patient who has proven to be difficult or impossible to intubate must be counseled postoperatively regarding this problem. The patient should be given a letter that she can present to other anesthetists, or she can wear a medical alert...
bracelet that identifies her as a difficult airway patient.

Summary

Obstetrical anesthesia is one area of the anesthesia specialty where the rewards are many and the risks are frightening. Airway management in this population requires meticulous attention to patient evaluation and preparation. The need for a thorough understanding of the unique demands of these patients is obvious. A management plan that can be enacted during airway disasters should be reviewed and practiced at regular intervals.

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