PERIODICUM BIOLOGORUM
VOL. 127, No 1–2, 59–63, 2025
DOI: 10.18054/pb.v127i1-2.35778

UDC 57:61
CODEN PDBIAD
ISSN 0031-5362

Review article

Challenges of airway management in obstetrics

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Keywords: airway management; anesthesia, general; obstetrics; respiration, artificial; anesthesia, epidural; anesthesia, spinal

Abbreviations

ACOG	– American College of Obstetricians and Gynecologists
ASA	– American Society of Anesthesiology
BMI	– body mass index
CS	– cesarean section
FRC	– functional residual capacity
HFNO	– high flow nasal oxygen
LAST	– local anesthetic systemic toxicity
LMA	– laryngeal mask airway
NICU	– neonatal intensive care unit
RSII	– rapid sequence induction and intubation
SGA	– supraglottic airway
ULBT	– upper lip bite test

Received March 27, 2025
Revised July 13, 2025
Accepted July 15, 2025

Abstract

Background and purpose: *Pregnant individuals exhibit a lower tolerance for apnea due to heightened metabolic oxygen consumption coupled with a gradual reduction in functional residual capacity (FRC). In obstetric patients, anesthesia-related mortality is frequently attributed to respiratory complications. It is advisable to assess the airway of each patient upon their admission to the labor floor. Should we anticipate challenges in airway management, it is prudent to implement neuraxial analgesia, such as an epidural catheter, as early as possible to mitigate the necessity for general anesthesia and airway management during cesarean delivery if required. Neuraxial anesthesia is predominantly utilized for cesarean deliveries, even in emergency situations, rendering the need for airway management infrequent, with difficulties arising even more rarely. Supraglottic airway devices are reserved for a carefully chosen subset of parturient and are only employed during the first and second trimesters for non-abdominal and non-obstetric procedures. Endotracheal intubation remains the primary and preferred method for securing the airway during cesarean deliveries when neuraxial anesthesia is not feasible due to significant concerns. The use of video laryngoscopy enhances glottic visualization and may improve the success rate of first-pass intubation.*

Conclusion: *The anesthesia team should engage in discussions with the surgical and/or obstetric teams regarding the risks and benefits of proceeding with the procedure once ventilation attempts are successful. When considering extubation, it is essential that pregnant patients are extubated while fully awake at the conclusion of surgery to ensure the preservation of protective airway reflexes.*

INTRODUCTION

The management of the airway in pregnant patients can be challenging due to physiological and anatomical alterations associated with pregnancy, as well as an elevated risk of gastroesophageal reflux and aspiration. General anesthesia may be necessary not only for procedures related to delivery but also for non-delivery and non-obstetric interventions. It is essential to consider the potential implications for both the mother and the fetus during airway management. A systematic review of existing literature indicates that the rates of difficult intubation are comparable between obstetric and non-obstetric patients; however, the rates of failed intubation may be higher among obstetric patients. Pregnancy is known to introduce established risk factors for difficult and failed intubation, such as obesity, airway edema, and the need for emergency procedures *(1).*

RISK FACTORS FOR DIFFICULT AIRWAY IN OBSTETRICS

The specific risk factors that complicate airway management during pregnancy remain unclear. One commonly utilized bedside assessment for predicting difficult intubation is the Mallampati score, which categorizes visibility of the soft palate, uvula, and pillars into four classes. It remains uncertain whether the incidence of difficult intubation increases with a higher Mallampati score during pregnancy and labor. Evidence suggests that the oropharyngeal diameter may decrease as gestation progresses, potentially due to oropharyngeal edema resulting from fluid retention. Notably, the proportion of patients classified as Mallampati class IV rises by 34 percent from 12 to 38 weeks of gestation, which correlates significantly with weight gain *(2).* Furthermore, the antepartum period is characterized by an elevated Mallampati score, and it has been observed that labor and delivery can also adversely affect the airway, a factor that must be considered when general anesthesia is required for surgical procedures following delivery. The deterioration of the Mallampati score was not associated with prolonged labor duration or increased fluid volume administered; however, it had not completely reverted to baseline levels by 48 hours postpartum *(3).* The capacity to anticipate airway complications is constrained in pregnant individuals, akin to their non-pregnant counterparts. Anatomical and physiological alterations in the airway, gastrointestinal tract, and respiratory system during the antepartum and intrapartum periods can elevate the likelihood of challenging intubation and the potential for complications arising from such difficulties. It has been observed that the airway modifications during labor may be exacerbated in patients suffering from preeclampsia. As previously noted, the Mallampati score increases from pre-labor to post-labor in both pre-eclamptic and non-preeclamptic women; however, those with preeclampsia exhibit more significant tissue thickening at the hyoid level throughout labor. Even in the absence of labor, preeclamptic patients may experience greater upper airway constriction and increased airway reactivity compared to non-preeclamptic parturient *(4).* Another clinical assessment tool is the Upper Lip Bite Test (ULBT), which is influenced by the patient's sex and ethnic background due to variations in lip size across different populations. Furthermore, collagen lip injections may yield misleading results, either false negatives or false positives. The ULBT is classified as class I if the lower teeth can bite the upper lip above the vermilion border, class II if below the border, and class III if the upper lip cannot be bitten at all. Additionally, obesity and the necessity for emergency surgical procedures are significant risk factors for complications in airway management. Compared to women of normal weight, those with severe obesity face a heightened risk of cesarean delivery, emergency cesarean delivery, unsuccessful epidural anesthesia, and difficult intubation *(2).* The utilization of a short laryngoscope handle may prove advantageous for patients with increased breast size or obesity, where achieving optimal head and neck positioning can be challenging. Obesity, along with the necessity of positioning the patient in left uterine displacement, may hinder optimal airway management. It is essential to maintain left uterine displacement during airway management with a minimum tilt of 15 degrees to reduce aortocaval compression. This can be accomplished by either tilting the operating table or placing a wedge under the patient's right hip. Anesthesia-related mortality in obstetric patients is predominantly attributed to respiratory complications. These respiratory issues can arise not only during the induction of general anesthesia but also during emergence and recovery, or because of regional anesthetic complications, such as high spinal anesthesia *(5).*

Pregnancy inherently elevates the risk of aspiration of gastric contents due to various anatomical and hormonal changes. These changes include the incompetence of the lower esophageal sphincter, which is linked to gastroesophageal reflux, a low gastric pH, and alterations in gastric anatomy caused by the enlarging uterus as pregnancy progresses. While gastric emptying remains normal during pregnancy, it is delayed during labor, particularly when parenteral or neuraxial opioids are administered for analgesia. Following the induction of general anesthesia in a patient with a full stomach, the absence of protective airway reflexes can complicate airway management, thereby extending the period of aspiration risk. This risk can be mitigated through fasting and the use of pharmacological prophylaxis. The same preoperative fasting guidelines for elective surgery applicable to non-pregnant patients also apply to pregnant patients who are not in labor. However, during labor, the gastric emptying of solid foods is delayed, necessitating the avoidance of solid food intake, especially when neuraxial or parenteral opioids are administered. The impact of epidural analgesia on gastric emptying during labor remains uncertain. The consumption of clear liquids has been relaxed, as outlined in the 2016 practice guidelines from the American Society of Anesthesiology (ASA) and the committee opinion from the American College of Obstetricians and Gynecologists (ACOG), which advocate for a moderate intake of clear liquids for patients in uncomplicated labor. Following the placement of an epidural catheter to provide analgesia, it is essential to assess the individual risk of aspiration and restrict the oral intake of clear liquids to a maximum of 250 mL per hour. Patients with diabetes or those classified as having a complicated airway are at a heightened risk for aspiration, necessitating potential further limitations on their oral intake, particularly for those at increased risk of requiring operative delivery. The ASA guidelines suggest the consideration of administering nonparticulate antacids, H2 receptor antagonists, and/or metoclopramide prior to elective or emergency surgical procedures in pregnant patients. Ideally, the airway of each

patient upon admission to the labor floor should be assessed promptly. In cases where a patient is presented with a potentially difficult airway, specific management plans should be developed, and the entire care team, including the anesthesiologist, obstetrician, and nursing staff, should be informed. For most patients anticipated to have challenges with airway management, early establishment of neuraxial analgesia is recommended to prevent the necessity for general anesthesia and airway management during a potential cesarean delivery. The increased application of neuraxial techniques during labor and cesarean sections has notably decreased the reliance on general anesthesia for delivery.

AIRWAY DEVICES IN OBSTETRICS

The primary factor that enhances the likelihood of successful direct laryngoscopy (DL) and subsequent intubation in pregnant patients is optimal positioning, particularly in those with severe obesity. The initial position to align the laryngeal and pharyngeal axes is the sniffing position, while a ramped position is recommended for obese patients to facilitate the opening of the space between the chin and chest. To extend the duration before oxygen desaturation occurs during apnea related to airway management attempts, preoxygenation is administered prior to the induction of anesthesia for all patients. In pregnant individuals, the interval between the onset of apnea and the onset of hypoxemia is shorter when general anesthesia is initiated. Additionally, the increased metabolic oxygen consumption, coupled with a gradual reduction in functional residual capacity (FRC) throughout gestation, renders pregnant patients less tolerant to apnea. Parturient are typically preoxygenated in a 30-degree head-up position to enhance FRC and, consequently, the effectiveness of preoxygenation. In situations where time is constrained, such as during acute emergencies, instructing the patient to take eight deep breaths over a span of 60 seconds offers optimal and time-efficient protection against O2 desaturation for both pregnant and non-pregnant patients. Furthermore, two additional techniques can also delay desaturation: apneic oxygenation via nasal cannula at a flow rate of 10 to 15 L/min during laryngoscopy, or the application of trans nasal humidified high flow nasal oxygen (HFNO). The latter method has been demonstrated to extend safe apnea duration compared to facemask preoxygenation *(6)*. The use of supraglottic airways (SGAs) after the second trimester is generally avoided, even in fasted parturient, due to the heightened risk of aspiration in pregnant patients. However, SGA devices may be utilized in carefully selected parturient during the first and second trimesters for non-obstetric, non-abdominal surgical procedures.

In the context of cesarean delivery, SGAs are primarily utilized as emergency devices in cases of unforeseen difficult intubation accompanied by inadequate ventilation. Numerous case studies have reported successful SGA interventions following failed intubation attempts during cesarean deliveries, resulting in swift alleviation of hypoxia without signs of pulmonary aspiration. The application of SGAs is deemed appropriate when endotracheal intubation is unsuccessful, as it helps prevent potential airway trauma from repeated intubation efforts. Increasing evidence suggests that, according to one study, second-generation SGA devices may be effectively employed as the primary method for airway management in patients with a low aspiration risk and challenging intubation scenarios during cesarean sections requiring general anesthesia *(7)*. The preferred method for securing the airway during cesarean delivery, when general anesthesia is indicated, remains endotracheal intubation. In cases where patients exhibit increased airway edema, a history of difficult intubation, or a challenging view during the initial laryngoscopy, the use of endotracheal tubes smaller than 7.0 may be necessary *(8)*. Although infrequent, severe laryngeal edema can arise during pregnancy due to upper respiratory infections, particularly in patients with preeclampsia and other comorbid conditions. It is crucial to carefully evaluate the safety of the fetus, the long-term health of the patient, and the imperative of securing the airway *(9)*. The decision between conservative and aggressive urgent airway management must consider the patient's airway security, fetal safety, and the patient's long-term health outcomes. Video laryngoscopy is preferred over direct laryngoscopy, although the choice may depend on the clinician's level of expertise. The utilization of video technology may enhance visualization and potentially improve the success rate of initial intubation attempts; however, the time required for the placement of the endotracheal tube may be extended. Notably, video laryngoscopy did not lead to a decrease in the incidence of challenging orotracheal intubations or the overall duration of these procedures. Furthermore, an increased likelihood of admission to the Neonatal Intensive Care Unit (NICU) has been associated with the use of video laryngoscopy. These observations suggest that in emergency situations involving general anesthesia for cesarean deliveries, video laryngoscopy does not supplant direct laryngoscopy as the established standard for orotracheal intubation *(10)*. Conversely, there is evidence indicating that video laryngoscopy may improve the efficacy and safety of tracheal intubation when compared to direct laryngoscopy *(11)*. In practice, clinicians tend to favor the techniques with which they are most experienced during emergencies. It is crucial to seek assistance promptly following a failed intubation attempt, and to reassess both maternal and fetal conditions in collaboration with the surgical and/or obstetric team. For patients exhibiting signs of gastroesophageal reflux, as well as for pregnant individuals undergoing general anesthesia, rapid sequence induction and intubation (RSII) are typically employed. Historically, the Sellick Maneuver, which involves the application of cricoid pressure, was deemed an essential as-

pect of RSII; however, it may complicate the procedure and hinder intubation and ventilation, thus necessitating a tailored approach *(12)*. Additionally, the use of nasopharyngeal airways should be avoided, as hyperemic nasal passages can elevate the risk of epistaxis during instrumentation. Therefore, it is advisable to utilize topical nasal vasoconstrictors, such as phenylephrine and epinephrine, when nasal mucosal manipulation is necessary for effective airway management *(13)*.

AIRWAY MANAGEMENT IN OBSTETRICS

General anesthesia with endotracheal intubation may be necessary in cases such as significant hemorrhage, local anesthetic systemic toxicity (LAST), high spinal anesthesia, unsuccessful regional anesthesia, or maternal cardiac arrest *(14)*. In most circumstances, neuraxial anesthesia is favored over general anesthesia, particularly for cesarean sections, even in urgent delivery scenarios. Since neuraxial anesthesia is predominantly utilized for cesarean deliveries, the requirement for airway management is infrequent, and complications related to airway management are even less common. Furthermore, general anesthesia is typically employed in emergencies where time constraints are present. Patients who are at an elevated risk for cesarean delivery may find it advantageous to have a functional epidural catheter available for urgent anesthetic needs. This is especially true for patients with potential airway difficulties or those for whom rapid neuraxial placement may pose challenges (e.g., obesity); thus, it is advisable to place and confirm the functionality of an epidural catheter prior to any urgent requirement. Most urgent cesarean deliveries can be conducted under neuraxial anesthesia; if a labor epidural is already in place, it can be promptly administered for surgical delivery. For patients lacking an epidural, spinal anesthesia can generally be initiated swiftly, even when an urgent cesarean delivery is warranted. In cases where a difficult airway is anticipated, this method is often more expedient than performing an awake intubation. For non-delivery surgical procedures in pregnant patients, the choice of anesthetic technique (general, regional, or local anesthesia) should be guided by the specific procedure and the individual patient's circumstances, including a thorough airway assessment. If ventilation is achievable via facemask or SGA following a failed intubation in a parturient requiring urgent surgery (such as due to trauma or hemorrhage), proceeding with the surgery is a reasonable option and may improve outcomes for both the mother and fetus. In situations where intubation is unsuccessful during anesthesia for cesarean delivery, it is advisable to attempt mask ventilation. Engaging two personnel for mask ventilation can enhance the effectiveness of the mask fit and increase tidal volume compared to a single operator. Should ventilation remain inadequate, the use of a SGA is recommended as the primary rescue technique, preferably utilizing a second-generation or intubating SGA; numerous reports indicate that laryngeal mask airways (LMA) have successfully mitigated hypoxia following failed intubation in parturient patients. Once ventilation is established via either facemask or SGA, the decision to continue with the surgical procedure or to awaken the patient necessitates careful consideration of the clinician's confidence in their ventilation skills relative to the health status of both the mother and fetus. In scenarios where the mother faces immediate peril, such as severe hemorrhaging, proceeding with a cesarean section is a prudent decision that may enhance outcomes for both mother and child. Conversely, if the mother's condition is stable but the fetus is in significant distress, the potential risk of pulmonary aspiration during surgery with an unsecured airway must be weighed against the possible detriment to the fetus from postponing delivery. In these instances, many anesthesiologists would choose to carry out the cesarean delivery. When both the mother and fetus are stable, the anesthesiologist, in collaboration with the obstetric team, should determine whether to proceed with the delivery or to awaken the patient. It is advisable to insert a SGA, apply pressure to the cricoid cartilage (unless it hinders SGA placement or ventilation), and continue with the surgical intervention. Should the patient regain consciousness, airway management should be approached with the expectation of potential difficulties. In the absence of endotracheal intubation during surgery, the placement of a SGA is a viable alternative, as it provides a more secure airway. When available, a second-generation SGA can enhance gastric drainage and may offer improved protection against aspiration. In situations where ventilation proves impossible, emergency invasive airway interventions, such as cricothyrotomy, transtracheal jet ventilation, or tracheostomy, should be employed. Cricothyrotomy can be performed by anesthesiologists or surgeons, utilizing either the percutaneous approach when anatomical landmarks are visible or the open approach when they are not. Anesthesia professionals routinely update their skills in cricothyrotomy on an annual basis; however, such emergency invasive airway procedures are generally executed by surgeons. Following successful ventilation attempts, it is crucial to engage in discussions regarding the risks and benefits of proceeding with surgery with the surgical and/or obstetric team. During the failed intubation and ventilation process, there exists a risk of maternal cardiac arrest. For patients who are at least 20 weeks pregnant, a perimortem cesarean section may be warranted *(15)*. Pregnant patients should be extubated while awake at the conclusion of surgery to confirm that their protective airway reflexes remain intact. Notably, for patients who have experienced significant hemorrhage, extubation should only be performed after sufficient resuscitation, in the absence of ongoing bleeding, and when the likelihood of further bleeding is considered low. Patients with factors that predispose them to postoperative respiratory complications (such as severe obesity or obstructive sleep apnea), as well as those at

heightened risk for postpartum hemorrhage, may necessitate more rigorous or extended postoperative monitoring. If required, the patient should be transferred to the intensive care unit for managed ventilation and delayed extubation *(16).*

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