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Mallampati Classification, an Estimate of Upper Airway Anatomical Balance, Can Change Rapidly during Labor

THE Mallampati classification is a rough estimate of the tongue size relative to the oral cavity.[1] Although the single usage of the Mallampati classification has limited discriminative power for difficult tracheal intubation,[2] it is a simple, reproducible, and reliable preanesthetic airway assessment method when performed properly. In addition to difficult tracheal intubation, Mallampati class 3 or 4 is an independent predictor for difficulty of mask ventilation during anesthesia induction and presence of obstructive sleep apnea.[3,4] Increase of the Mallampati class during labor and delivery reported in this issue of ANESTHESIOLOGY[5] provides insight for exploring and understanding the mechanisms of difficulty in perioperative airway management of pregnant women, particularly during or immediately after labor. In the article, the authors thoroughly discuss the clinical implications of their findings on difficult tracheal intubation; therefore, I would like to assess their data focusing on perioperative upper airway obstruction of pregnant women.

Clinical Significance of Upper Airway Changes during Pregnancy and Labor

Kodali *et al.*[5] did not directly test the clinical significance of the increased Mallampati class because none of the women underwent general anesthesia; however, careful interpretation of their data reveals noticeable features of the upper airway structures in pregnant women. First, Mallampati class 3 and 4 seem to be more prevalent in parturients at the beginning of labor (28%) than in the general adult population (7–17%), suggesting that tongue volume increases even during normal pregnancy as previously reported.[6] Increased tongue volume presumably due to fluid retention during pregnancy may be partly responsible for increasing both prevalence of obstructive sleep-disordered breathing in pregnant women and incidence of difficult tracheal intubation in obstetric anesthesia.[7]

◆ This Editorial View accompanies the following article: Kodali B-S, Chandrasekhar S, Bulich LN, Topulos GP, Datta S: Airway changes during labor and delivery. ANESTHESIOLOGY 2008; 108:357–62.

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More surprisingly and significantly, half of the parturients demonstrated Mallampati class 3 or 4 by the end of labor, predicting a further increase in difficulty of airway management during labor or immediately after delivery upon medical interventions such as general anesthesia. The risk of emergency cesarean delivery and surgery for postpartum hemorrhage is particularly high in obese parturients, presumably because of their higher incidence of maternal complications and fetal growth retardation.[7–9] Hood *et al.*[8] reported that 48% of laboring morbidly obese parturients required emergency cesarean delivery compared with 9% of control laboring parturients. Considering the high prevalence of obstructive sleep apnea in obese subjects and the growing problem of obesity among industrial countries, the finding of Kodali *et al.* is not trivial and carries particular importance to practitioners when anesthetizing obese parturients. In fact, a recent survey of anesthesia-related maternal deaths in Michigan identified obesity and African-American race as common characteristics of these cases.[10] Noticeably, there were no deaths during anesthesia induction, and five of eight anesthesia-related deaths resulted from hypoventilation or airway obstruction during emergence, endotracheal extubation, or recovery. Although safety of airway management during anesthesia induction seems to have greatly improved as a result of development of the airway algorithm and various intubation devices, an unsolved and significant problem in obstetric anesthesia is how to assess and manage the upper airway upon emergence and endotracheal extubation. The data of Kodali *et al.* suggest the labor is a potential risk factor for perioperative airway catastrophe in parturients in addition to obesity, craniofacial abnormalities, and sleep-disordered breathing. Pregnancy and labor are inevitable and physiologic processes for human beings that significantly burden the respiratory system by decreasing lung volume and thoracic compliance and narrowing the upper airway. Labor potentially makes some parturients more susceptible to pathologic upper airway narrowing.

Upper Airway Anatomical Imbalance in Parturients

The pharyngeal airway is a collapsible tube whose patency is precisely regulated by upper airway dilating muscles such as the genioglossus. Increase in the dilating muscle activity acts to maintain the narrowed pharyngeal airway during wakefulness in patients with obstructive

sleep apnea.[11] Similar neural mechanisms presumably compensate the progressive upper airway narrowing in parturients. Preservation of these neural regulatory mechanisms is, therefore, crucial for parturients with a high Mallampati class to maintain their breathing. Regional anesthetic techniques have only minimal influence on the neural mechanisms; however, the neural compensatory mechanisms become weaker during general anesthesia, sedation, and sleep with residual anesthetics. The pharyngeal airway patency entirely depends on its structural stability in parturients undergoing emergency cesarean delivery during general anesthesia.

Structurally, the pharyngeal airway is surrounded by soft tissues such as the tongue and soft palate, which are enclosed by bony structures such as the mandible and spine. Size of the airway space is determined by the balance between the bony enclosure size and soft tissue volume (anatomical balance) when pharyngeal muscles are inactivated by general anesthetics and muscle relaxants.[12] Pharyngeal edema, presumably due to fluid retention during pregnancy, and pharyngeal swelling acutely developed during labor increase the soft tissue volume surrounding the airway, narrowing the pharyngeal airway in parturients. Recent extensive research on the pathophysiology of upper airway obstruction revealed a significant role of the lung volume reduction in pharyngeal narrowing. Tagaito *et al.*[13] demonstrated that lung volume dependence of pharyngeal airway patency is more pronounced in obese patients. Accordingly, obese parturients, a high-risk group for perioperative airway catastrophe, are prone to develop progressively narrower pharyngeal airways due to increase of soft tissue volume surrounding the pharyngeal airway and decrease of lung volume during pregnancy. Lung volume reduction during general anesthesia is known to be more prominent and prolonged in obese patients. General anesthesia for emergency cesarean delivery in obese parturients during or immediately after labor may tend to exaggerate upper airway swelling and lung volume dependence, in addition to impairment of neural compensatory mechanisms, and is, therefore, a worst-case scenario for upper airway maintenance. Application of positive end expiratory pressure during anesthesia and full consciousness at endotracheal extubation are strongly recommended for these patients.

Mallampati Classification for Assessment of Upper Airway Anatomical Balance

Kodali *et al.* demonstrated a decrease in upper airway volume of approximately 10 ml during labor and delivery. Although they did not simultaneously assess changes in Mallampati class in this group of parturients, it is of interest how much reduction of the upper airway volume, *i.e.*, how much increases in the tongue volume, leads to a 1-point increase in Mallampati class. Assuming similar changes of the Mallampati class in both study groups, *e.g.*, a 26-point increase of the Mallampati class in 61 subjects leads to a 10-ml reduction of upper airway volume on average, it can be roughly estimated that a 1-point increase of the Mallampati class approximately corresponds to a 20-ml increase of the tongue volume in women with Mallampati class 3 or 4 before labor. Upper airway volume differed between patients with and without difficult tracheal intubation by 30–40 ml.[14] Tongue volume was significantly larger in patients with obstructive sleep apnea, by approximately 20–25 ml, than in nonapneic persons.[15] For every 1-point increase of the Mallampati class, the relative risk of obstructive sleep apnea doubles and apnea hypopnea index increases by 5 h^{-1}.[4] Accordingly, a 20-ml increase of the tongue volume during labor potentially results in difficult tracheal intubation and upper airway obstruction under influence of general anesthetics and sedatives.

The Mallampati classification allows us to instantaneously identify such small but significant increases in the tongue volume at the bedside without using sophisticated apparatuses. The Mallampati classification originated in our specialty, and recently, clinicians and researchers in other specialties have recognized its usefulness for assessment of upper airway anatomical balance. We anesthesiologists should be proud of the Mallampati classification and are encouraged to use this classification to assess the upper airway anatomical balance with it before every general anesthesia induction. The article by Kodali *et al.*[5] reminds us that the Mallampati classification is not static, but can change over hours with processes such as labor, and we should assess it just before instrumentation, rather than relying on an assessment even a few hours earlier.

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