Aspiration Prophylaxis and Rapid Sequence Induction for Elective Cesarean Delivery: Time to Reassess Old Dogma?

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Aspiration of gastric contents is a rare but feared and potentially fatal complication of anesthesia. In Mendelson's landmark article on the pathophysiology of pulmonary aspiration in obstetric patients,[1] he recognized that the clinical presentation is different depending on whether the aspirate is solid or liquid. Solid material resulted in suffocation and death, whereas liquid material resulted in "asthma-like" symptoms. Subsequently, he not only demonstrated that lung injury is secondary to gastric acid but also made 2 critical observations: gastric emptying time is delayed during labor, and aspiration occurs when airway reflexes are obtunded by anesthesia. Since 1946, these observations have been considered valid for every parturient who presents for labor and delivery; however, a question arises when caring for the fasted patient who presents for elective cesarean delivery. Does she have the same risk of aspiration as her laboring counterpart?

We suggest that she may not be at as high risk as previously thought. This issue emerged when we cared for a primigravida with cardiomyopathy, severe global biventricular hypokinesis, and a left ventricular ejection fraction of 20%. Our decision to proceed with general anesthesia forced us to confront the issue of airway management. Traditional and contemporary teaching considers all obstetric patients to be at increased risk for pulmonary aspiration compared with patients scheduled for non-obstetric elective surgical procedures, mandating pharmacological prophylaxis as well as rapid sequence induction of anesthesia with cricoid pressure. However, the requirements of a patient at risk for aspiration are difficult to reconcile with a judicious, titrated induction of anesthesia that is ideal for a patient with severely compromised cardiac function. Faced with this choice, we opted for a careful induction of anesthesia with mask ventilation before endotracheal intubation, omitting cricoid pressure. This case made us reconsider long-held beliefs about the risk of aspiration in a subset of obstetric patients and specifically ask ourselves whether an appropriately fasted patient presenting for elective cesarean delivery is indeed at increased risk for aspiration compared with patients scheduled for non-obstetric elective procedures.

Defining the full stomach has proven difficult. Many investigators have shown that lung injury increases markedly when the pH of the aspirate is <3.[2,3] The oft-quoted threshold values for defining a full stomach and increased risk of aspiration are gastric volume >0.4 mL/kg with a pH <2.5. These data come from an experiment in a single rhesus monkey in which the investigators directly instilled liquid of varying volumes and acidity into the mainstem bronchus.[4,5] Lung injury occurred with a volume >0.4 mL/kg and a pH <2.5. This experiment has led to considerable confusion about gastric volume and the risk of aspiration. The authors defined only the amount of aspirate necessary to cause lung injury if the pH was suitably low. The value 0.4 mL/kg has been erroneously interpreted as the amount of gastric volume that puts a patient at risk of aspiration when in fact it is the volume that produced lung injury in a highly contrived laboratory experiment. The more important question is what amount of gastric volume results in regurgitation. Animal data suggest that the residual gastric volume required to produce regurgitation under general anesthesia is much larger than 0.4 mL/kg.[6] As the volume of liquid gastric contents increases, the risk of regurgitation also increases. At some currently unknown volume, this risk may become unacceptably high. There is, however, much evidence showing that if gastric emptying is normal and patients are appropriately fasted, the risk of significant aspiration is extremely low.[7,8] The critical question to be answered is whether obstetric patients have normal gastric emptying.

Mendelson studied laboring patients whom he correctly identified as having delayed gastric emptying. Since then, delayed gastric emptying has frequently been attributed to all obstetric patients. The presumed mechanisms are a hormonally induced decrease in gastric motility and the mechanical and anatomic effect of cephalad displacement of the stomach with distortion of the gastroesophageal

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junction. These concepts took hold before the availability of modern techniques to assess gastric emptying and lower esophageal sphincter tone. In fact, hormonal and mechanical effects combine to decrease lower esophageal sphincter tone, which accounts for the high incidence of heartburn during pregnancy.[9] Importantly, however, it has now been proven that pregnancy per se does not delay gastric emptying. Many investigators using different modalities have confirmed this finding.[10–12] Obese term pregnant patients have also been found to have normal gastric emptying.[13] We emphasize that these findings apply only to patients who are not in labor. Both pain and opioids have been shown to decrease gastric emptying.[14,15]

The American Society of Anesthesiologists' practice guidelines allow clear liquids up to 2 hours before the induction of anesthesia for uncomplicated patients having elective cesarean delivery.[16] Without being explicitly stated, this recommendation seems to acknowledge that elective cesarean delivery patients have normal gastric emptying. Yet, these same elective cesarean delivery patients, for whom clear liquids are permitted, are also thought to be at risk for aspiration such that "practitioners should consider the timely administration of nonparticulate antacids, H_2-receptors antagonists, and/or metoclopramide for aspiration prophylaxis." These guidelines seem contradictory. If there is a perceived aspiration risk on the basis of delayed gastric emptying, why are clear liquids permitted? Alternatively, if gastric emptying is normal and therefore clear liquids are appropriate, why is aspiration prophylaxis necessary? For non-obstetric patients given clear liquids until 2 hours before induction of anesthesia, no aspiration prophylaxis is advised.[17] With normal gastric emptying, what is the basis of the recommendation in the guidelines to consider "aspiration prophylaxis"? We believe that the only reason nonlaboring pregnant women may be at increased risk for aspiration is decreased lower esophageal sphincter tone, a finding of questionable importance in the setting of normal gastric emptying.

Both nonparticulate antacids and H_2-receptor antagonists are effective in increasing gastric pH. Metoclopramide increases both gastric emptying and lower esophageal sphincter tone. However, when residual gastric volume is already low, a further reduction due to the prokinetic action of metoclopramide is uncertain. Metoclopramide also does not prevent the reduction in lower esophageal sphincter tone induced by cricoid pressure.[18] Although unlikely to cause harm, none of these treatment options have been shown to decrease the frequency or severity of aspiration. Thus, it is potentially misleading to refer to them as "aspiration prophylaxis."

Standard practice for patients having cesarean delivery under general anesthesia is rapid sequence induction with cricoid pressure. Cricoid pressure, known as the Sellick maneuver after the original author, is designed to occlude the cervical esophagus by compressing it between the cricoid cartilage and the vertebral bodies.[19] Passively regurgitated gastric contents are therefore prevented from entering the pharynx. Neither rapid sequence induction nor cricoid pressure has been prospectively studied and proven to decrease the incidence of aspiration. Rapid sequence induction shortens the time between the onset of unconsciousness and securing the airway, which may be of benefit if the aspiration risk is high. However, the use of cricoid pressure is controversial.[20] The esophagus cannot be reliably occluded between the cricoid cartilage and the vertebral bodies. Studies in volunteers (men and nonpregnant women) clearly show that the esophagus often does not lie in the midline or that cricoid pressure displaces the esophagus laterally without occluding it.[21] More recent data suggest that the hypopharynx posterior to the cricoid cartilage is in continuity with the esophageal inlet and this hypopharyngeal area is occluded with the Sellick maneuver.[22] Cricoid pressure is often applied incorrectly or without the appropriate amount of force. In parturients, it can be difficult to identify the cricoid cartilage because of the fluid retention and soft-tissue edema of pregnancy. In addition to unproven effectiveness, an even worse problem with cricoid pressure is that it may make both mask ventilation and laryngoscopy more difficult.[23] Many anesthesiologists can recall struggling to intubate a patient with an anticipated straightforward airway only to find the laryngeal structures miraculously spring into view when cricoid pressure was released.

The authors of a standard obstetric anesthesia textbook advocate rapid sequence induction and cricoid pressure for cesarean delivery and do not distinguish between elective and emergency procedures.[24] Even the chapter on heart disease in pregnancy does not explore trying to balance the conflicting goals of aspiration prevention and an induction technique appropriate for a parturient with significant cardiac disease.[25] The American Society of Anesthesiologists' practice guidelines for obstetric anesthesia emphasize aspiration prophylaxis but are silent on the issue of the appropriate type of induction and airway management. A United Kingdom survey questionnaire found that 98% of practitioners would choose rapid sequence induction with cricoid pressure for an elective cesarean delivery in an otherwise healthy patient.[26] However, this practice remains unproven in preventing aspiration.[27] Textbooks emphasizing an evidence-based approach acknowledge that "the universal use of this technique could be questioned."[28] Because the use of rapid sequence induction and cricoid pressure is so ingrained in our thinking, studies of alternative approaches are rare. The largest case series found no episodes of aspiration in 1067 patients managed with a laryngeal mask airway for elective cesarean delivery.[29]

Clinical care during Mendelson's time bears no resemblance to modern obstetric anesthesia practice. Then, aspiration occurred in the setting of eating during labor followed by ether mask anesthesia administered by a "new and inexperienced intern."[1] Since pulmonary aspiration was first described in obstetric patients, all parturients historically have been considered to be at higher risk for pulmonary aspiration than the general elective surgical population. In managing our patient, we were faced with the choice of an anesthetic technique that was best for her compromised cardiovascular system and the anesthetic technique that was best to minimize the risk of aspiration. In reality, this was a false choice because we believe the

evidence does not support the concept that pregnant patients presenting for elective cesarean delivery have an increased risk of aspiration.

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