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Postpartum Perioperative Risk of Aspiration Pneumonia

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Obstetric patients are at increased risk from aspiration of gastric contents, probably secondary to hormonal and mechanical factors. Although many of the factors that contribute to regurgitation and pulmonary aspiration of gastric contents among obstetric patients are alleviated after delivery, an appropriate interval of time after which postpartum patients may undergo general anesthesia without a high risk of pneumonitis should aspiration occur remains unknown.

A report on postpartum surgery in 1976 stated that, although a large percentage of postpartum patients undergoing bilateral tubal interruption were at risk from aspiration pneumonia, they were no more at risk than were elective surgical patients.[1] Thus, these investigators suggested that there was no increased risk 8 h after delivery. That study did not include early postpartum surgery, that is, surgery 0–8 h after delivery, a time interval after which for cost- and time-effective reasons, many obstetricians prefer to perform bilateral tubal interruptions. Another study in 1979 stated that all postpartum patients should be regarded as being at high risk from aspiration pneumonitis should aspiration occur.[2] In that study, the *p*H and volume of gastric contents did not correlate statistically to the delivery-to-surgery interval; however, the range of that interval was not specified. In light of this controversy, we attempted to determine a delivery-to-surgery interval that would lower the risk of pneumonitis should aspiration occur by studying the *p*H and volume of gastric contents in postpartum patients undergoing bilateral tubal interruption from 1 to 48 h after vaginal delivery and in elective surgical patients.

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METHODS

We divided 45 postpartum patients into three groups of 15 each, depending on the delivery-to-surgery interval: Group 1: 1–8 h; Group 2: 9–23 h; and Group 3: 24–45 h. All postpartum patients underwent general anesthesia without preoperative medication for bilateral tubal interruption. In a parallel study, 15 women undergoing elective gynecologic and orthopedic procedures with general anesthesia, and either no preoperative medication or only a barbiturate or a benzodiazepine served as controls (Group 4). All patients gave informed consent as approved by the Institutional Review Board.

Anesthesia was induced in the postpartum groups with *d*-tubocurarine followed by thiopental and succinylcholine with simultaneous application of cricoid pressure. Induction of anesthesia in the control patients was achieved by administration of *d*-tubocurarine followed by a slower administration of thiopental and succinylcholine. After intubation of the trachea, anesthesia was maintained with either halothane, enflurane, or isoflurane and nitrous oxide and oxygen.

After induction of anesthesia, a gastric tube was inserted orally and a sample of gastric contents was obtained to determine *p*H with an Orion *p*H meter. Next, 50 ml 1% polyethylene glycol solution, a nonabsorbable indicator, was instilled into the gastric tube. The solution then was aspirated, reinstilled, and reaspirated numerous times, with external abdominal massage to ensure adequate mixing. The gastric contents then were aspirated completely, and the volume was calculated by the turbidimetric method.[3]

Patients with a $pH < 2.5$ and a volume > 25 ml were considered at risk from aspiration pneumonitis should aspiration occur. Mean *p*H was determined by converting to hydrogen ion concentration and converting back to *p*H.

The mean gastric *p*H and volume in the four groups were compared by analysis of variance (ANOVA). When the analysis of variance demonstrated a significant F value, a t test was used to make pair-wise comparisons of the group means, and a Fisher's exact probability test was used to compare the proportion of patients in each group with gastric $pH < 2.5$, gastric volume > 25 ml,

TABLE 1. Age, Weight, and Fasting Periods

	Age (yr)	Weight (kg)	Delivery-to-Surgery Interval (h)	Fasting-to-Surgery Interval (h)
Group 1 (1–8 h)	27.3 ± 5.3	75.1 ± 21.7	4.8 ± 2.1	15.9 ± 5.3
Group 2 (9–23 h)	27.1 ± 4.8	79.5 ± 13.5	17.3 ± 4.7	17.1 ± 4.6
Group 3 (24–45 h)	27.0 ± 4.3	70.1 ± 13.5	32.6 ± 6.9	17.6 ± 4.0
Group 4 (control)	27.9 ± 5.5	67.3 ± 19.5		15.1 ± 3.5

Values are means ± SD.

and the combination of pH < 2.5 and volume > 25 ml; $P < 0.05$ was considered significant.

RESULTS

The mean delivery-to-surgery interval was 4.8 ± 2.1 h, 17.3 ± 4.7 h, and 32.6 ± 6.9 h for Groups 1, 2, and 3, respectively. The mean age and weight (table 1) did not differ statistically among the groups. Likewise, the mean fasting period did not differ among the groups, although some of the patients in Groups 2 and 3 did not fast after delivery due to the long delivery-to-surgery interval.

Despite the wide range of gastric volume (7–82 ml) in all groups, mean volume for Group 2 (24.0 ± 14.6 ml [SD]) was statistically less than that of Groups 1 (39.1 ± 21.8 ml [SD]) and 3 (40.9 ± 20.5 ml [SD]) but did not differ statistically from that of Group 4 (38.1 ± 23.6 ml [SD]) (table 2). Sixty-two per cent of postpartum patients and 67% of control patients had gastric volumes > 25 ml.

The mean pH among all postpartum patients was low at 1.47 and only 1.56 among the controls. Moreover, the pH ranged from only 0.98 to 2.80 in the postpartum groups, which did not differ statistically. All of the postpartum patients undergoing surgery within 24 h of delivery (Groups 1 and 2) had gastric contents with pH < 2.5. Eighty per cent of Groups 3 and 4 had gastric contents with pH < 2.5. Moreover, 40% of all postpartum patients and 26% of control patients had gastric contents with a pH < 1.4.

The incidence of patients at risk from pneumonitis should aspiration occur (gastric pH < 2.5 and volume > 25 ml) was 73% in Group 1, 40% in Group 2, 67% in Group 3, and 60% in Group 4 (table 3); the groups did not differ statistically.

DISCUSSION

Our study does not address the incidence of aspiration. Rather it addresses the potential for serious aspiration pneumonitis, should the patient aspirate. Risk customarily is defined in terms of pH and volume of gastric contents. We were unable to demonstrate significant differences in gastric pH or volume between early (1–8 h) and late (9–45 h) postpartum groups. Unexpectedly, neither were we able to demonstrate differences between postpartum patients and elective surgical patients. Therefore, pH and volume of stomach contents cannot be cited as factors that increase the risk of pneumonitis to the postpartum patient, should aspiration occur.

The accepted criterion for defining the risk of pneumonitis should aspiration occur is a critical combination of pH less than 2.5 and volume greater than 25 ml of stomach contents.[4] Although substantial evidence supports the pH value,[5,6] the 25-ml value is less established because it is based on unpublished data obtained from Rhesus monkeys that aspirated highly acidic liquid (pH

TABLE 2. Volume and pH of Gastric Contents

	Mean Volume (range) (ml)	Volume > 25 ml (%)	Mean pH (range)	pH < 2.5 (%)	pH < 1.4 (%)
Group 1 (1–8 h)	39.1 (7–73)	73	1.53 (1.27–2.24)	100	33
Group 2 (9–23 h)	24.0* (6–56)	40	1.48 (1.14–2.07)	100	40
Group 3 (24–45 h)	40.9 (8–73)	73	1.40 (0.98–2.80)	80	46
Group 4 (control)	38.1 (10–82)	67	1.56 (1.08–6.47)	80	26

* $P < 0.05$ compared with Groups 1 and 3.

TABLE 3. Gastric Contents with pH < 2.5 and Volume > 25 ml

	Percentage of Patients
Group 1 (1–8 h)	73
Group 2 (9–23 h)	40
Group 3 (24–45 h)	67
Group 4 (control)	60

1.2).[7] A recent study of mortality rates in rats that aspirated liquid of various pH and volume combinations revealed high mortality from solutions with extremely low pH (1.0), even at low volumes (0.3 ml/kg) and lower mortality with solutions with higher pH (≥1.8) and much higher volumes (≥1ml/kg).[8] This study strongly suggests that no single volume is critical but the pH of the aspirate is.[8] The pH values we recorded in the present study were lower than in previous reports on postpartum patients[1,2] but comparable to those in a study of obese patients undergoing elective surgery reported by Vaughan *et al.*[9] Moreover, many of our patients had gastric contents of pH < 1.4, which suggests an even greater risk from aspiration pneumonia. The lower pH of gastric contents in our patients cannot be explained. There was no correlation between the preoperative medication and gastric pH among the control patients.

If one accepts the current criteria for risk of pneumonitis should aspiration occur,[4] 60% of all our patients were at risk. In fact, 36% had gastric contents with very low pH (<1.4), which has implications for perioperative management.

Regarding postpartum patients, regardless of delivery-to-surgery interval, precautionary measures seem indicated. Whenever possible, regional anesthesia should be used. Surgery should be delayed when solid or liquid material recently has been ingested. Preoperatively, an oral nonparticulate antacid, such as sodium citrate, should be given.[10–12] Such measures are benign, simple, and relatively inexpensive. The addition of H_2-receptor antagonists (cimetidine, ranitidine) and upper gastrointestinal stimulants (metoclopramide, domperidone) is also an option. However, potential side effects, drug interactions, and a slow onset of action may make these measures less desirable.[13–16]

Other measures such as rapid-sequence induction and endotracheal intubation or awake intubation require further discussion, because hypoxia resulting from inability to intubate the trachea is a complication that may be more devastating than aspiration. This is particularly true for the patient who has been prepared properly and whose stomach contains only nonacidic liquid. Nevertheless, because there are factors intrinsic to pregnancy that increase the risk of aspiration, these additional measures may be appropriate. Factors peculiar to pregnancy include increased gastrin and decreased motilin levels[17,18] as well as a distorted cardioesophageal junction[19] and increased gastric pressure.[20] Although some are alleviated after delivery, residual hormonal and mechanical factors may continue for an indefinite time in the postpartum period. Cricoid pressure should be used because it is effective and essentially without risk.[21,22] Whether or not rapid-sequence induction is indicated routinely for these postpartum patients depends on the condition of the airway. Patients in whom a difficult intubation is anticipated may require awake endotracheal intubation.

In contrast to pregnant and postpartum patients, elective surgical patients are also at risk from pneumonitis should aspiration occur, but only because of the volume and pH of their stomach contents. Thus, preoperative antacids, H_2-receptor antagonists, or both, and, if endotracheal intubation is performed, properly applied cricoid pressure should protect these patients from serious sequelae of aspiration.

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Bronchospasm Following Interscalene Brachial Plexus Block

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Complications from an interscalene brachial plexus nerve block[1] range from Horner's syndrome, hoarseness,[2] carotid bruit,[3] to more serious complications, such as subarachnoid, epidural, or phrenic nerve blocks.[4–6] Permanent neurologic damage and cardiac arrest also have been reported.[7,8] We observed two cases of bronchospasm that occurred in nonasthmatic patients immediately following the use of this technique.

REPORT OF TWO CASES

Patient 1: A 43-year-old, 62-kg man with a tentative diagnosis of sarcoidosis was scheduled for a diagnostic right axillary lymph node biopsy. History revealed a progressive shortness of breath during mild exertion, but no history of bronchial asthma was evident. On physical examination he had generalized lymphadenopathy. Lungs were clear to auscultation. Chest roentgenogram revealed bilateral mid and lower zonal infiltrates and extensive pleural disease. The pulmonary function studies indicated moderate restrictive and obstructive airway disease.

After receiving diazepam, 5 mg iv, an interscalene brachial plexus block was performed. He was placed in a 20-degree head-up position. After identification of the interscalene groove with a #25 gauge 1.5-inch needle, a paresthesia (midarm area) was elicited with the first attempt. Twenty milliliters 1.5% lidocaine and 15 ml 0.5% bupivacaine were injected. Within the next 10 min, analgesia of the operative site resulted. His vital signs remained stable, and after the operative site was draped, surgery began. At this time the patient experienced difficulty in breathing and was using the accessory muscles of respiration. Surgery was stopped. A right Horner's syndrome was evident, and the extent of the nerve block was limited to the right side. On auscultation of the chest bilateral expiratory wheezing was heard. The chest roentgenogram was negative for pneumothorax, and the diaphragm was not elevated. Arterial BP and HR were stable. Aminophylline 300 mg in 100 ml 5% dextrose was given iv with diminution of the expiratory wheezing. The diagnosis at that time remained elusive and, since the drapes covered the chest and airway, the trachea was intubated following the administration of thiopental 150 mg and succinylcholine 60 mg iv. Anesthesia subsequently was maintained with halothane and oxygen. pH_a was 7.36, Pa_{O_2} 212 mm/Hg, Pa_{CO_2} 44 mm/Hg. Forty minutes after completion of surgery, the patient was awake and breathing without evidence of respiratory distress; his lungs were clear. pH_a was 7.46, Pa_{O_2} 67 mm/Hg, Pa_{CO_2} 37 mm/Hg, with an FI_{O_2} of 0.24. Recovery from sensory and motor paralysis occurred gradually over the next 2 h with no sequelae.

Patient 2: A 52-year-old nonasthmatic male, with an unremarkable medical history, presented for repair of a severed tendon of his right hand. Anesthesia for the tendon repair was achieved with an interscalene brachial plexus block performed as noted above for the first patient. Within 10 min of the onset of anesthesia the patient complained of difficulty in breathing, although respiratory distress was not noted clinically; a right-sided Horner's syndrome was evident, and the analgesia was limited to the right arm. On auscultation, however, mild expiratory wheezing was heard. The operation was postponed. The chest roentgenogram was negative for pneumothorax or elevation of the diaphragm and the bronchospasm resolved without treatment.

DISCUSSION

Several factors may cause respiratory distress following an interscalene nerve block. Examples are the occurrence of unilateral and bilateral phrenic nerve paralysis, pneumothorax, or bronchial spasm. The local anesthetics when injected into the sheath of the brachial plexus not

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