Preoperative Glycemic Status Affects the Risk for Acid Aspiration Pneumonia in Elective Cesarean Delivery

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**Background:** Although there are many studies of hypo- or hyperglycemia on gastric function, no studies have been conducted to determine the effect of glycemic status on preoperative gastric contents especially in pregnant women. We investigated the effect of dextrose infusion on preoperative gastric contents and serum gastrin in overfasting pregnant patients.

**Methods:** After six hours of fasting, forty pregnant patients scheduled for elective cesarean section were randomly assigned to one of two groups to receive either 120 ml/h of 5% dextrose fluid (Dextrose group, n = 20) or same rate of normal saline (Control group) until the induction of anesthesia. Before the start of combined spinal-epidural anesthesia, gastric contents were gently aspirated using a 14-F multiorifice nasogastric tube (Levin tube, Yushin Medical, Shilheung, Korea). Blood samples for the serum gastrin and glucose concentrations were taken.

**Results:** Aspirated gastric pH (2.7 vs. 2.9) and volumes (28.5 vs. 26.5 ml) were similar in the two groups. However, significantly more patients (40%) in the control group were found to be at risk of aspiration syndrome, pH < 2.5 and volume > 25 ml, than in the dextrose group (20%). The serum gastrin concentrations of the two groups were not significantly different (32.8 vs. 27.1 pg/ml). Preoperative glucose concentration did not correlate with gastric pH or volumes, but with serum gastrin concentration (tau-b = -0.347, vs. -0.466, P = 0.02).

**Conclusions:** Preoperative dextrose infusion can decrease the number of patients at risk for pulmonary acid aspiration in overfasting pregnant women undergoing cesarean delivery. (Korean J Anesthesiol 2005; 48: S26–9)

**Key Words:** cesarean delivery, dextrose, gastric contents, gastrin.

**INTRODUCTION**

Recent studies have emphasized the importance of serum glucose in the regulation of gastrointestinal function.1-7 Larger volume and more acidic gastric residue secondary to the delayed gastric emptying resulting from hormonal and mechanical factors and the high levels of placentally derived gastrin have been documented in late pregnancies.5-10 Pulmonary aspiration syndrome continues to be a major concern in obstetric anesthesia because the morbidity and mortality associated with this complication increase with the volume and acidity of the gastric aspirate. In contrast to the many studies about the effects of hypoglycemia or hyperglycemia on gastric acid secretion and motor function, no studies have been conducted to determine the effects of glycemic status on the gastrin release and actual preoperative gastric contents especially in pregnant women.

The purpose of this study was to investigate the effects of prophylactic 5% dextrose infusion during overfasting period without inducing hyperglycemia on preoperative serum gastrin concentration, gastric pH and volume in pregnant women undergoing elective cesarean delivery.

**MATERIALS AND METHODS**

The study protocol was approved by the hospital ethics committee and informed consent was obtained from all patients. Forty healthy women with uncomplicated singleton pregnancy scheduled for elective cesarean delivery participated in the study. Patients with a history of any acid-related
gastrointestinal disease, recent gastric antisecretory drug therapy or any other medication that would interfere with gastrointestinal functions were not included in the study. After six hours of fasting, patients were randomly assigned to one of two groups to receive either 120 ml/h of 5% dextrose fluid (Dextrose group, n = 20) or same rate of normal saline (Control group, n = 20) during over fasting period until the induction of anesthesia. No premedication was administered. All patients were asked to complete a visual analogue scale in regard to the level of anxiety (range 0 = no anxiety at all, to 10 = extremely anxious) during the preloading of another 500 ml of lactate Ringer’s solution. Before the start of combined spinal epidural anesthesia, a 14-F multiorifice nasogastric tube (Levin tube, Yushin Medical, Shihung, Korea) was inserted to the depth of 60 cm by another anesthesiologist who was blinded to the grouping. Placement of the nasogastric tube was verified by auscultation over the epigastrium by injecting 10 ml of air. Subsequently, gastric fluid was aspirated gently to a syringe using mild negative pressure. This maneuver was repeated in both slightly side tilting positions and in the Trendelenburg and reverse Trendelenburg position to ensure maximum emptying of the stomach. After the aspiration of gastric content, nasogastric tube was removed. The volume of gastric fluid and pH were measured using a metered cylinder and a double-checked pH meter (model- 920A, Orion Research, Inc., Beverly, Massachusetts, USA), respectively. Blood samples taken from the arm without the intravenous infusion were collected and centrifuged; the plasma was separated and stored at -70°C. Double Antibody Gastrin Method is [12] radioimmunoassay technique for gastrin designed for quantitative measurement of gastrin in serum, which utilized labeled synthetic iodinated human gastrin. [11] Blood concentration of glucose was measured at the same time by using a blood glucose meter (SureStep, Lifescan inc. Milpitas, USA). Combind spinal-epidural anesthesia was performed in left lateral decubitus position at the L3-4 interspace with a midline approach. Spinal anesthesia consisted of 0.5% bupivacaine 8-10 mg, and patient-controlled analgesia was started at the peritoneal closure using diluted morphine and lidocaine via epidural catheter.

Results are given as means with standard deviation or median with percentile where appropriate. Statistical analysis was performed using Mann-Whitney rank sum test and t-test for parametric values, and Chi-square analysis to compare proportions of patients in the two groups. Kendall rank correlation was used to compare preoperative blood glucose level with gastric pH, volume, and serum gastrin concentration. The values were considered to be statistically significant at P < 0.05.

RESULTS

The two groups were comparable in respect to age, weight, height, gestational age, parity, fasting time, and preoperative anxiety (Table 1). Preoperative baseline blood pressures and heart rates of two groups were similar. In the dextrose group, the amount of infused 5% dextrose fluid was 592.0 ± 263.7 ml (mean ± SD), and total infused dextrose was 29.6 ± 9.2 mg. Aspirated gastric pH and volumes were comparable between the groups (Table 2). However, eight patients (40%) in the control group were found to be at risk of aspiration syndrome, pH < 2.5 and volume > 25 ml, and 4 patients (20%) in the dextrose group, the values were statistically significant (Fig. 1). The mean preoperative gastric level in the control group was significantly lower than the dextrose group, but the serum gastrin concentrations of two groups were not significantly different (Table 2). Preoperative glucose concentration did not correlate with gastric pH (tau-b = 0.217 vs.

Table 1. Patients Data

<table>
<thead>
<tr>
<th></th>
<th>Control group (n = 20)</th>
<th>Dextrose group (n = 20)</th>
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</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>33.1 ± 3.8</td>
<td>31.2 ± 3.3</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>66.0 ± 10.1</td>
<td>71.0 ± 6.5</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>160.1 ± 5.9</td>
<td>160.6 ± 5.4</td>
</tr>
<tr>
<td>Gestation (wks)</td>
<td>38.5 (36.9-41.2)</td>
<td>39.1 (37.1-40.4)</td>
</tr>
<tr>
<td>Fasting time (hrs)</td>
<td>13.3 ± 2.6</td>
<td>14.9 ± 2.7</td>
</tr>
<tr>
<td>Anxiety (VAS)</td>
<td>4.6 ± 1.2</td>
<td>4.1 ± 3.1</td>
</tr>
</tbody>
</table>

Values are mean ± SD (range).

Table 2. Gastric Contents and Serum Gastrin

<table>
<thead>
<tr>
<th></th>
<th>Control group (n = 20)</th>
<th>Dextrose group (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastric pH</td>
<td>2.7 ± 1.8</td>
<td>2.9 ± 1.8</td>
</tr>
<tr>
<td>Gastric volume (ml)</td>
<td>28.5 ± 22.7</td>
<td>26.5 ± 25.3</td>
</tr>
<tr>
<td>Gastrin conc. (pg/ml)</td>
<td>32.8 ± 12.2</td>
<td>27.1 ± 17.5</td>
</tr>
<tr>
<td>Glucose conc. (mg/dl)</td>
<td>78.2 ± 53.3</td>
<td>118.6 ± 33.9*</td>
</tr>
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|                | (range: 53-109)        | (range: 85-130)          |

Values are shown as mean ± SD. Conc.: concentration, *: P < 0.05 compared to control group.
0.284) or volumes (tau-b = -0.194 vs. -0.255), but with serum gastrin concentration (tau-b = -0.347 vs. -0.466, P = 0.02).

There were no cases of aspiration of gastric contents or any serious maternal and fetal side effects.

**DISCUSSION**

It is advised to continue the practice of preoperative fasting of pregnant patients for 6 hours in our hospital as the practical guideline of American Society of Anesthesiologist. However, many patients undergoing elective cesarean delivery fasted much longer than the recommended period as shown in the results of the present study. This may be due to the environmental factors including unpredictable delayed operation, or patient factors such as skipping meal of the previous evening due to preoperative anxiety and tension.

During pregnancy, fetal glucose uptake results in acceleration in the mother of normal metabolic response to starvation while the increased lipolysis diminish carbon dioxide combining power and the elevated metabolic rate of the gravida increase the tendency toward acidosis. Thus, the pregnant women, even in the absence of diabetes, can appear much more likely to develop metabolic acidosis. In the present study, none of the two groups showed hypoglycemic symptom, although 3 pregnant women in the control group had blood glucose concentration less than 60 mg/dl (range; 53-109). Kenep et al. have recommended intravenous administration of 6 g/h of dextrose before cesarean section. Marx et al. have found that gravida with fasting glucose concentration of about 60 mg/dl required 12-15 g of dextrose. We believe that individualization with monitor is more rational.

Infusion of insulin, with subsequent hypoglycemia, stimulates acid secretion, whereas infusion of glucose to induce hyperglycemia inhibits basal gastrin, tram feeding, and meal-stimulated acid output. Gulkekin et al. suggested that modulatory effect of glucose on acid secretion could be mediated by possible regulation of gastrin release directly or indirectly through hormonal or neural changes, especially in non-pregnant women. However, in their study, blood glucose level did not affect the gastrin release in pregnant women. In our study, preoperative blood glucose concentration had moderate correlation with serum gastrin concentration, although serum gastrin concentrations in the two groups were not statistically different. These discrepancies between two studies may result from the different selection of subjects and study design. There are also differences in hormonal responses following intravenous dextrose and oral glucose. Although the mechanism appears to have been unfounded in this study, there is no doubt that preoperative normoglycemia by using dextrose can decrease the number of patients at risk for the acid aspiration syndrome significantly in the overfasting pregnant women.

Meanwhile, maternal hyperglycemia may also increase fetal acidemia. Swanson and Bratteby observed significant correlation between blood glucose concentrations and base deficits in infants. In a randomized-controlled study of maternal intravenous fluid administration in healthy patients undergoing cesarean delivery, Kenep et al. found significantly lower umbilical arterial pH values in glucose-loaded infants. Fetal acidemia might occur as a result of hypoxia (secondary to maternal hypotension) in the presence of hyperglycemia after acute volume loading with solutions containing dextrose. Unfortunately, we did not check the maternal and fetal acid-base state.

The present study was conducted in normal pregnant women. So, whether any of the results can be extrapolated to diabetic mother with chronic hyperglycemia remains speculative. Furthermore, there were some hormonal and metabolic differences between insulin-induced hypoglycemia in majority of the above references and hypoglycemia due to prolonged
fasting time in our clinical settings. Further investigation is also necessary to determine the full nature of the inter-
relationship between blood glucose and insulin level, oxygen content, and pH in mother and fetus complicated by hypo-
or hyperglycemia. If we had used a cut-off point of a volume of 40 ml for the risk of aspiration pneumonia (that has been used) instead of a volume of 25 ml, there would have been no difference between the two groups. Gastric fluid volumes > 25 ml with pH < 2.5 have been widely used critical indicators for high risk of aspiration pneumonitis, although maximal pulmonary damage is achieved at an aspirate pH value of 1.5.18-20

Another limitation of this study was that the pregnant women enrolled here were not in labor, so the results cannot be transferred to the emergency population, which is where higher risk really applies.

A number of pharmacologic approaches have been suggested to prevent pulmonary aspiration and pneumonitis. Although helpful, no approach is completely effective or should be solely relied upon to prevent them. Therefore, after this study, we determine the blood glucose concentrations before induction of anaesthesia even in non-diabetic pregnant women scheduled for cesarean delivery, and we try to make them normoglycemia of at least 80 mg/dl as possible.

In conclusion, the results of our study suggest that pro-
phylactic dextrose infusion preventing hypoglycemia in over fasting patients undergoing cesarean delivery can decrease the number of patients at risk for pulmonary acid aspiration. Therefore, praanaesthetic blood glucose determination and keeping normogly-
ecemia can facilitate maternal and fetal safety in obstetric anesthesis.

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