

# Gastric pH and volume after oral fluids in the postpartum patient

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*The aim of this study was to investigate the relationship between preoperative oral fluids and gastric pH and volume in women undergoing sterilization between one and five days postpartum. Fifty postpartum patients received 150 ml water approximately two to three hours before surgery while 50 postpartum and 50 non-pregnant women were fasted from midnight. After induction of anaesthesia, gastric contents were aspirated using a Salem sump tube and the gastric pH and volume were measured. There were no differences in intragastric pH and volume, median (range), among the postpartum fasted group, 1.19 (0.74–4.57), 22 (1–78) ml, postpartum water group 1.18 (0.70–6.4), 25.5 (3–66) ml and the non-pregnant group 1.27 (0.51–6.63), 25 (3–69) ml. There was no correlation between postpartum interval, 60 (12–120) hr, and intragastric pH or volume. It is concluded that oral water may be given safely two to three hours preoperatively to patients more than one day postpartum. Intragastric volume and acidity were not increased and the findings in postpartum patients were similar to those found in non-pregnant patients.*

*Cette étude vise à évaluer la relation entre l'hydratation orale préopératoire et le volume gastrique et son pH, chez des femmes programmées pour stérilisation entre le premier et le cinquième jour qui suivent l'accouchement. Cinquante accouchées ont reçu 150 ml d'eau à environ deux à trois heures avant la chirurgie alors que 50 accouchées et 50 non-parturientes sont gardées à jeun compter à de minuit. Après l'induction de l'anesthésie,*

## Key words

ANAESTHESIA: obstetric;  
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*on aspire le contenu gastrique avec un tube de drainage Salem et mesure son pH et son volume. Les résultats montrent qu'il n'y a pas de différences de médiane (et d'écart) entre pH gastrique et volume entre les groupes post-partum à jeun, 1,19 (0,74–4,57), 22 (1–78) ml; groupe post-partum hydraté 1,18 (0,70–6,4), 25,5 (3–66) ml et le groupe des non-parturientes 1,27 (0,51–6,63), 25 (3–69) ml. Il n'y a pas de corrélation entre l'intervalle post-accouchement, 60 (12–120) heures et le volume et le pH gastrique. On en conclut que les patientes peuvent boire de l'eau deux à trois heures avant une intervention prévue le lendemain ou plus tard après l'accouchement. Le volume intragastrique et l'acidité n'augmentent pas et on constate que les valeurs mesurées sont indépendantes de la parturition.*

The risk of acid aspiration is believed to be increased in pregnant women at term.<sup>1</sup> One of the contributing factors is an increased gastric volume because of delayed gastric emptying and precautions against acid aspiration are taken routinely before anaesthesia for Caesarean section.

Although one would expect that the increased risk of aspiration persists for some hours after delivery, there are no recommendations regarding the time period after which these postpartum patients need not be treated as emergency cases with full stomachs. Several recent studies have suggested that gastric emptying of clear fluids is rapid in the postpartum period.<sup>2–4</sup> There has also been recent interest in appropriate fasting guidelines for elective surgery.<sup>5</sup> It would be valuable to know if revised fasting guidelines could be extended to include postpartum patients.

The aim of this study was to investigate the relationship between preoperative oral fluids and gastric pH and volume in postpartum patients between one and five days after delivery.

## Methods

The study was approved by the local research ethics committee and informed consent was given by all patients.

We studied 100 ASA class I women up to five days postpartum undergoing tubal ligation by minilaparotomy and 50 ASA class I non-pregnant women for laparoscopic procedures. Patients were excluded if they had previous gastric surgery, any nausea or vomiting on the morning

before surgery or had taken in the previous 24 hr any opioid drugs or other medications that were known to affect gastric emptying and acidity.

No premedication was given and oral intake was restricted from the midnight before surgery. Half the postpartum women were allocated at random to receive 150 ml water, approximately two to three hours before surgery. In the operating theatre, all women were asked to grade their hunger and thirst on a simple three-point scale (none, slight, severe).

Anaesthesia was induced with propofol  $2 \text{ mg} \cdot \text{kg}^{-1}$  and fentanyl  $100 \text{ } \mu\text{g}$  and neuromuscular block was produced with atracurium  $0.5 \text{ mg} \cdot \text{kg}^{-1}$ . The lungs were inflated manually using a Magill circuit for two minutes before the trachea was intubated. Anaesthesia was maintained with 70% nitrous oxide and 0.5% isoflurane in oxygen. At the end of surgery, atropine 1.2 mg and neostigmine 2.5 mg were given to antagonize residual neuromuscular block.

Intragastric pH and volume were measured after induction of anaesthesia. A 16-French gauge Salem sump tube was inserted orally and its correct position in the stomach checked by auscultation of injected air. We attempted to maximize returned volume by repeated aspiration with the tube rotated and withdrawn 10 cm and readvanced. Aspiration was performed in the supine, left lateral and head down positions. The volume of aspirate was recorded and pH measured with a Corning 240 pH meter that was calibrated before each sample.

Analysis of variance was used to compare demographic data among groups and the Kruskal Wallis test was used to compare the pH and volume data. Kendall rank correlation was used to evaluate associations among pH and volume data, fasting times and post-delivery times. Chi-square analysis was used to compare the incidence of hunger and thirst among groups. *P* values less than 0.05 were considered significant.

## Results

Demographic data are given in Table I. As expected, the postpartum women were younger and heavier than the women undergoing laparoscopy. Fasting time before anaesthesia was similar in all groups and there were no differences in the time after delivery between the two postpartum groups (Table I). The median (range) time from drinking 150 ml of water until anaesthesia was 150 (90–210) min. There were no differences in pH and volume between groups (Table I, Figure 1) with 60% of laparoscopy patients and 45% of postpartum patients having both a pH < 2.5 and a volume >  $0.4 \text{ ml} \cdot \text{kg}^{-1}$  (Table I). Retrospective power analysis ( $\alpha = 0.05$ ,  $\beta = 0.05$ ) indicated that the study was adequate to detect a difference of at least 13 ml and 0.65 pH units between

TABLE I Demographic data, time after delivery, fasting time before anaesthesia and gastric pH and volume

	Laparoscopy	Postpartum water	Postpartum fasted
Age (yr)	35.8 ± 5.4*	32.4 ± 2.9	32.6 ± 3.6
Weight (kg)	54.2 ± 7.7*	60.9 ± 8.5	61.2 ± 9.4
Time after Delivery (hr)		57 (16–120)	60.5 (12–104)
Fasting time (hr)	12 (9–20)	12 (9–17)	11.5 (9–25)
Gastric volume (ml)	25 (3–69)	25.5 (3–66)	22 (1–78)
Gastric pH	1.27 (0.51–6.63)	1.18 (0.70–6.4)	1.19 (0.74–4.57)
Number of patients with pH < 2.5 and volume > $0.4 \text{ ml} \cdot \text{kg}^{-1}$	30	27	18

Values are given as mean ± SD or median (range).

\**P* < 0.01 compared with postpartum groups.

*n* = 50 for all groups.

TABLE II Incidence of preoperative thirst

Thirst	Laparoscopy	Postpartum water*	Postpartum fasted
None	24	29	15
Slight	18	20	26
Severe	8	1	9

\*The postpartum water group were less thirsty than the postpartum fasted group (*P* < 0.01).

*n* = 50 for all groups.

the postpartum groups. Gastric pH and volume were not related to the fasting time or the postpartum interval (Figure 2).

The postpartum patients that received water were less thirsty than the fasted patients (Table II, *P* < 0.01) but there were no differences in hunger.

## Discussion

Our postpartum gastric pH and volume data are in agreement with that found by previous workers. Blouw *et al.*<sup>6</sup> found no differences between gastric pH and volume in 21 patients, 9 to 42 hr postpartum, and 11 non-pregnant patients, with 75% of pH values less than 2.5 in both groups. Rennie *et al.*<sup>7</sup> found that 27 of 50 postpartum patients undergoing sterilization had a pH less than 2.5 although the interval between delivery and surgery was not specified. Uram and others measured gastric pH and volume from 2–48 hours postpartum in 40 patients and concluded that the risk of aspiration was not decreased by delaying general anaesthesia past two hours. Their original manuscript (Abstracts of Scientific Papers, Annual Meeting, Society for Obstetric Anesthesia and Perinatology, Jackson Hole, WY, USA, 1982, p. 2) was not available for confirmation but these results have been re-

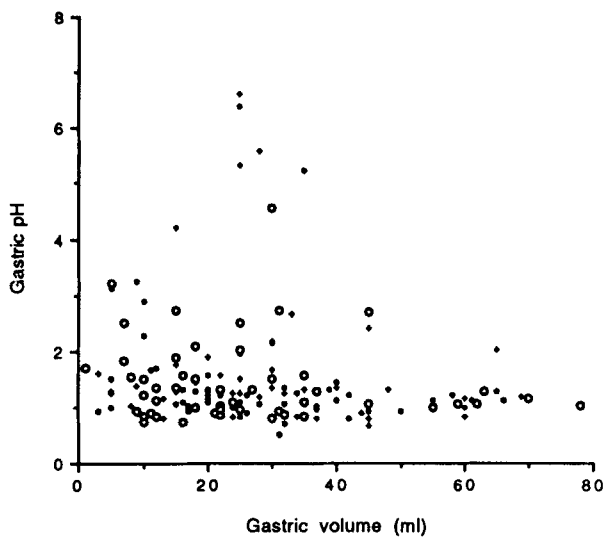


FIGURE 1 Gastric volume and pH in postpartum fasted (o), postpartum water (●) and laparoscopy (+) groups.

ported elsewhere.<sup>8,9</sup> James *et al.*<sup>10</sup> found no differences in gastric pH and volume among early (1–8 hours), intermediate (9–23 hours) and late (24–45 hours) postpartum patients and non-pregnant elective surgical patients. Sixty percent of these patients had an intragastric pH < 2.5 and volume > 25 ml.

Based on these results, it has been recommended that prophylactic measures against acid aspiration, including rapid sequence induction, were necessary in postpartum patients.<sup>7,9</sup> Classically, an intragastric pH less than 2.5 and volume greater than  $0.4 \text{ ml} \cdot \text{kg}^{-1}$  (approximately 25 ml) were regarded as being particularly dangerous.<sup>11</sup> These criteria have been questioned recently because the majority of elective patients fail this criteria yet the actual incidence of aspiration has been very low.<sup>12,13</sup> More recent work has suggested that at least  $0.8 \text{ ml} \cdot \text{kg}^{-1}$  of pH 1 fluid is required to cause severe aspiration.<sup>12</sup> The critical intragastric volume may be higher still because not all the gastric volume will be aspirated.<sup>14</sup>

The technique of blind gastric aspiration will underestimate intragastric volume by an average of 15 ml.<sup>15</sup> Dye dilution measurement of gastric volume may not be superior in anaesthetized patients<sup>16</sup> and extra complexity is added to the procedure.

There were no differences in intragastric volume between the two postpartum groups. This implied that gastric emptying of water was normal early in the postpartum period. Postpartum gastric emptying has been measured indirectly using a gastric impedance method. The half time for emptying of 400 ml water was 11 min at two to three days postpartum<sup>4</sup> and the half time for emp-

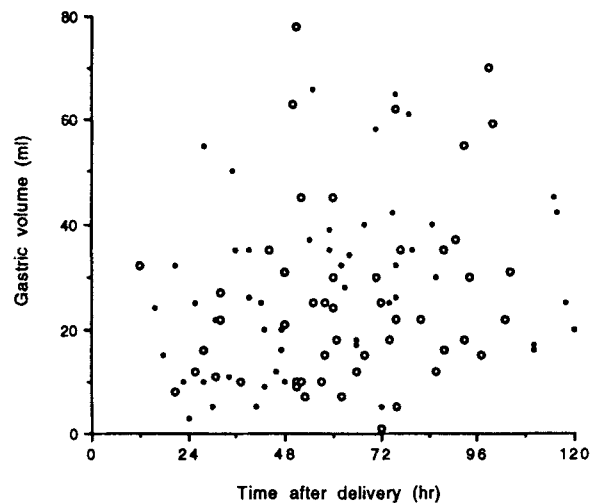


FIGURE 2 Gastric volume in postpartum fasted (o) and postpartum water (●) groups was not correlated with time after delivery.

tying 500 ml was 13 min within only one hour of delivery.<sup>3</sup>

Although the classical gastric volume and pH criteria may be too conservative and gastric emptying is normal there are other factors thought to predispose to an increased risk of acid aspiration. Progesterone concentrations are increased during pregnancy and this may cause relaxation of the lower oesophageal sphincter and decreased intestinal motility. However, within one hour of delivery, progesterone concentrations are less than half those during labour and by 24 hr, concentrations are similar to those found in the luteal phase of the menstrual cycle.<sup>17</sup> Increased gastrin causes gastric hypersecretion during pregnancy but gastrin concentrations have started to decrease at 30 min after delivery.<sup>18</sup> Decreased concentrations of motilin during pregnancy may contribute to intestinal hypomotility. Motilin has not been measured immediately postpartum but is normal at one week.<sup>19</sup> Gastro-oesophageal reflux is an important prerequisite for aspiration pneumonia<sup>13</sup> but the high incidence of reflux at term approaches normal by the second day after delivery.<sup>20</sup>

There do not appear to be any differences in gastric emptying, oesophageal reflux or gastric pH and volume between non-pregnant patients and postpartum patients by the second day after delivery. Additional measures to protect against acid aspiration, such as rapid sequence induction and preoperative  $\text{H}_2$ -receptor antagonists, are not usually advocated for healthy non-pregnant patients.<sup>21</sup> We suggest that the approach to prophylaxis against acid aspiration should be more consistent between

non-pregnant and postpartum patients. Each patient should be assessed individually for risk factors and we do not believe that being postpartum places the patient at additional risk. The occurrence of gastroesophageal reflux may also depend more on the conduct of anaesthesia than traditionally believed risk factors.<sup>22, 23</sup>

Nevertheless, one viewpoint is that the consequences of aspiration can be severe yet prophylaxis against acid aspiration simple. Studies of pulmonary aspiration in rats have shown that pH is a more important factor than volume in determining lung injury<sup>24</sup> and mortality.<sup>25</sup> A non-particulate antacid such as 0.3 mol · L<sup>-1</sup> sodium citrate is simple and inexpensive to administer. Fifteen to 30 ml would be effective immediately for the gastric volumes found in our patients but sodium citrate is emptied from the stomach rapidly<sup>26</sup> so that the duration of action is short.

In conclusion, the gastric emptying of water in postpartum patients is rapid and 150 ml water taken two to three hours before operation did not increase intragastric volume or acidity.

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