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ULTRASONOGRAPHIC ASSESSMENT AND QUANTIFICATION OF GASTRIC CONTENTS- A COMPARISION BETWEEN PREGNANT PATIENTS POSTED FOR ELECTIVE LSCS VS NON PREGNANT PATIENTS

Anaesthesiology

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ABSTRACT

Background and Aims: Pulmonary aspiration remains a major concern during anaesthesia, particularly in pregnant women. Preoperative fasting does not reliably predict residual gastric volume. This study aimed to compare gastric content, antral cross-sectional area (CSA) and estimated gastric volume between pregnant women undergoing elective lower segment caesarean section (LSCS) and non-pregnant women undergoing elective surgery, and to evaluate the effectiveness of pharmacological intervention in patients with high-risk gastric antrum.**Methods:** This prospective comparative study included 70 women (35 pregnant, 35 non-pregnant), aged 18–40 years, ASA physical status I–II enrolled according to inclusion and exclusion criteria. Gastric ultrasonography was performed in supine and right lateral decubitus (RLD) positions. Gastric content was assessed qualitatively, CSA measured, and gastric volume estimated using validated equations. High-risk gastric antrum was defined as estimated gastric volume >1.5 mL/kg.**Results:** High-risk gastric antrum was significantly more common in pregnant women than non-pregnant women (34.3% vs 2.9%; P = 0.001). Median gastric volume was higher in pregnant women [48 (0–115.5) mL] compared with non-pregnant women [30 (0–51) mL] (P = 0.050). Antral visibility was significantly reduced in pregnant women in both supine and RLD positions (P < 0.05). All high-risk patients showed improvement following Inj. ranitidine and Inj. metoclopramide, allowing surgery without postponement.**Conclusion:** Ultrasonographic assessment of gastric contents reveals important differences between pregnant and non-pregnant women despite similar fasting durations. Gastric ultrasound is a valuable adjunct for individualized aspiration risk assessment in obstetric anaesthesia.

KEYWORDS

Gastric ultrasound, aspiration, pregnancy, caesarean section, gastric volume

INTRODUCTION

Pulmonary aspiration of gastric contents is a serious complication during anaesthesia and remains an important cause of perioperative morbidity and mortality. Although the overall incidence is relatively low, the consequences may be severe and include aspiration pneumonitis, respiratory failure, prolonged hospitalization and death. Large observational studies have demonstrated that pulmonary aspiration contributes significantly to anaesthesia-related complications during the perioperative period.[1] In addition, the Fourth National Audit Project of the Royal College of Anaesthetists identified pulmonary aspiration as one of the leading causes of major airway-related complications during anaesthesia.[2] These findings highlight the importance of accurately identifying patients at increased risk of aspiration and adopting strategies to prevent this complication.

Obstetric patients are traditionally considered to be at higher risk of pulmonary aspiration during anaesthesia. The risk was first emphasized by Mendelson, who described aspiration pneumonitis occurring during obstetric anaesthesia due to regurgitation of gastric contents.[3] Pregnancy is associated with several physiological and anatomical changes that predispose patients to gastro-oesophageal reflux and regurgitation. Hormonal changes during pregnancy, particularly increased progesterone levels, reduce lower oesophageal sphincter tone, while the enlarging uterus increases intra-abdominal pressure and displaces abdominal organs.[4,5] These changes may increase gastric volume and facilitate reflux of gastric contents during induction of anaesthesia.

Airway management in obstetric patients may also be more difficult compared with the general surgical population. Pregnancy-related airway changes such as mucosal oedema, weight gain and breast enlargement may contribute to difficult laryngoscopy and tracheal intubation. Failed intubation has been reported to occur more frequently in obstetric patients compared with non-pregnant surgical patients.[6] Several factors associated with difficult intubation during obstetric anaesthesia have also been described, further emphasizing the importance of minimizing aspiration risk in this patient population.[7]

Preoperative fasting guidelines have been widely adopted in anaesthetic practice to reduce the risk of aspiration. Current recommendations generally advise fasting for at least six hours for solid foods and two hours for clear fluids prior to elective surgery. These guidelines are based on the assumption that adequate fasting results in gastric emptying and reduction of residual gastric volume.[8] However, increasing evidence suggests that fasting duration alone may not reliably predict gastric contents or gastric volume. Variability in gastric emptying can occur despite adherence to fasting guidelines, particularly in certain patient populations including pregnant women.

Point-of-care gastric ultrasonography has emerged as a useful bedside technique for evaluating gastric contents and estimating gastric volume in the perioperative setting. Ultrasound visualization of the gastric antrum allows qualitative assessment of gastric contents and quantitative estimation of gastric volume by measuring the gastric antral cross-sectional area.[9] Measurement of antral cross-sectional area in the supine and right lateral decubitus positions has been shown to correlate with gastric volume using validated mathematical models.[10]

The use of gastric ultrasonography has gained increasing interest in obstetric anaesthesia. Ultrasonographic assessment of the gastric antrum has been shown to be feasible in term pregnant women undergoing elective caesarean delivery.[11] Ultrasound measurement of the gastric antral area can also provide an estimation of gastric fluid volume in parturients.[12] Studies comparing ultrasound measurements with magnetic resonance imaging have demonstrated good correlation between antral area and gastric volume in pregnant women.[13]

Despite adherence to fasting guidelines, studies have shown that a proportion of fasting pregnant women may still have detectable gastric contents. Ultrasonographic evaluation of term parturients has demonstrated the presence of residual gastric contents even after recommended fasting periods.[14]Furthermore, comparisons between pregnant and non-pregnant women have shown that although median gastric volumes may be similar, the upper percentile gastric volumes may be higher in pregnant patients, suggesting that some parturients may remain at increased risk of aspiration.[15]

AIMS AND OBJECTIVES

Primary Objectives

1. To assess the type of gastric content using ultrasonography.
2. To measure gastric antral cross-sectional area.
3. To estimate gastric volume using validated ultrasonographic formulas.

Secondary ObjectivesTo evaluate the effectiveness of postponement of surgery, additional use of prokinetics and re-assess the gastric volume and content

Materials and Methods

Study Design and Participants

This prospective observational study was conducted at a tertiary care hospital.

- Seventy (70)female patients were enrolled and allocated into two groups:
- **Group P:** Pregnant women posted for elective LSCS (n=35)
- **Group NP:** Non-pregnant women undergoing elective surgery (n=35)

Inclusion Criteria
- Female patients aged 18–40 years
- ASA physical status I or II
- Posted for elective LSCS or elective surgery

Exclusion Criteria
- History of previous gastric surgery
- Hiatus hernia

METHODOLOGY.
After obtaining institutionalethical committee approval and informed consent, patients scheduled for elective surgery were enrolled. All participants followed standard preoperative fasting guidelines (6 hours for solids and 2 hours for clear fluids) in accordance with established recommendations [24].Preoperative gastric ultrasonography was performed using a low-frequency (2–5 MHz) curvilinear probe (GE Healthcare Versana/Sonosite). Ultrasound assessment was conducted in both supine and right lateral decubitus (RLD) positions to optimize visualization and improve volume estimation accuracy [7,20].

Measurement of Gastric Antral Cross-Sectional Area
The gastric antrum was identified in the epigastric region between the left lobe of the liver anteriorly and the pancreas posteriorly, with the aorta or inferior vena cava and superior mesenteric vessels serving as vascular landmarks [7,12,30]Antral visibility was recorded, followed by qualitative assessment using the Perlas grading system (Grade 0–2) [7,23]. Quantitative assessment included measurement of anteroposterior (AP) and craniocaudal (CC) diameters . The antral cross-sectional area (CSA) was calculated using the ellipse formula: CSA= $\pi \times (AP \times CC)/4$ [28,35]. Gastric volume (GV) was estimated using validated predictive models:

Gastric volume (mL) = 27.0 + 14.6 × CSARLD – 1.28 × age [7,28].

A high-risk gastric antrum was defined as estimated GV >1.5 mL/kg, consistent with aspiration risk thresholds reported in previous studies [13,23]. Patients identified as high risk received intravenous ranitidine (50 mg) and metoclopramide (10 mg), followed by repeat ultrasonographic assessment 2hours prior to anesthesia induction.All ultrasound examinations were performed by trained anesthesiologists experienced in gastric ultrasonography to ensure reproducibility and reliability [29,37]

OUTCOME MEASURES
The age, body mass index (BMI) and fasting interval were noted. The image of gastric antrum, when visible, was evaluated qualitatively and 'classified as follows

Grade 0the antrum appears empty on both casecontrol study supine and RLD positions;

Grade 1gastric fluid is visible on the RLD position only, suggesting a small fluid volume;

Grade 2gastric fluid is observed in the antrum in both supine and RLD, suggesting a larger fluid volume

STATISTICALANALYSIS
Continuous variables were expressed as mean ± SD or median (IQR), while categorical variables were expressed as frequency and percentage. Normality was assessed using the Shapiro–Wilk test. Intergroup comparisons were performed using independent t-test or Mann–Whitney U test as appropriate. Categorical data were analyzed using Chi-square or Fisher's exact test. A p-value <0.05 was considered statistically significant. Statistical analysis was performed using SPSS software.

$$n = \frac{2(Z_{\alpha/2}+Z_{\beta})^2\sigma^2}{d^2}$$

SAMPLE SIZE ESTIMATION
where,
$Z_{\alpha/2}$:The critical value of normal distribution at 5% level of significance with 95% confidence level=1.96
Z_{β}: The critical value of normal distribution at β(for power of 80%, β=0.2 and the critical value is 0.84)
σ^2: Average standard deviation =1.49cm^2*
d: minimum expected mean difference=0.75cm^2
n =61.88≈ 62
divided into two groups of size 35 each.[1]

Results
1.Baseline Characteristics
Baseline demographic characteristics were comparable between the two groups with respect to body mass index and duration of -fasting (Table 1). Pregnant women were marginally younger and had a shorter clear-fluid fasting interval compared with non-pregnant women.

2.Gastric Antral Visibility
Gastric antrum visibility was reduced in pregnant women compared with non-pregnant women in both supine and RLD positions (Table 2). Non-visualization of the antrum occurred exclusively in pregnant women, particularly in the supine position.

3.Antral Cross-Sectional Area
There was no significant difference in supine antral CSA between the two groups. However, RLD CSA was significantly higher in pregnant women compared with non pregnant women (Table 3).

4.Estimated Gastric Volume
Estimated gastric volume was higher in pregnant women than in non-pregnant women (Table 4). The distribution of gastric volume demonstrated a wider range among pregnant women, with higher median values.

5.High-Risk Gastric Antrum
A significantly higher proportion of pregnant women met criteria for high-risk gastric antrum (gastric volume >1.5 mL/kg) compared with non-pregnant women (34.3% vs 2.9%, P = 0.001) (Table 5).

6.Effect of Pharmacological Intervention
All patients identified as having high-risk gastric antrum demonstrated a reduction in gastric volume following administration of Inj ranitidine and Inj metoclopramide.after 2 hours repeat ultrasonographic assessment was done. Surgery was subsequently performed without postponement in all cases.

Table 1. Baseline demographic and fasting characteristics

Variable	Pregnant (n=35)	Non-pregnant (n=35)	P value
Age (years)	28.4 ± 5.4	30.9 ± 4.8	0.045
BMI (kg/m²)	24.7 ± 3.6	24.5 ± 4.2	0.852
fasting for solids (h)	7.42 ± 0.38	7.48 ± 0.41	0.512
fasting for clear fluids (h)	3.06 ± 0.68	3.74 ± 1.07	0.006

Table 2. Gastric antrum visibility

Position	Pregnant (%)	Non-pregnant (%)	P value
Supine visible	82.9	100	0.025
RLD visible	77.1	97.1	0.028

Table 3. Antral cross-sectional area

CSA	Pregnant	Non-pregnant	P value
Supine (cm²)	3.41 ± 1.01	3.45 ± 1.19	0.899
RLD (cm²)	5.07 ± 1.92	4.08 ± 1.07	0.020

Table 4. Estimated gastric volume

Parameter	Pregnant (n=27)	Non-pregnant (n=34)	P value
Gastric volume (mL), median (IQR)	48 (0–115.5)	30 (0–51)	0.050

Table 5. High-risk gastric antrum (>1.5 mL/kg)

Group	High-risk n (%)	P value
Pregnant	12 (34.3)	
Non-pregnant	1 (2.9)	0.001

DISCUSSION
The present study aimed to ultrasonographically assess and quantify gastric contents in pregnant women scheduled for elective caesarean section and to compare these findings with non-pregnant women

undergoing elective surgery. The principal findings were significantly reduced gastric antral visibility, greater variability in qualitative assessment, and a higher proportion of high-risk gastric antrum (>1.5 mL/kg) in pregnant women despite adherence to standard fasting guidelines. These observations highlight the limitations of fasting-based aspiration risk assessment and support the use of point-of-care gastric USG for individualized perioperative decision-making.

Pulmonary aspiration is a potentially catastrophic complication of anaesthesia. Large audits and observational studies demonstrate that aspiration contributes disproportionately to anaesthesia-related morbidity and mortality [3,4]. Obstetric patients are traditionally considered high risk because of pregnancy-related physiological changes, including increased intra-abdominal pressure and reduced lower oesophageal sphincter tone [25,26]. Mendelson's original description of aspiration pneumonitis emphasized the severity of this complication in obstetric anaesthesia [2]. Despite advances in airway management and standardized fasting protocols, aspiration continues to occur, underscoring the need for more precise risk stratification [4,22].

In the present study, gastric antral visibility was significantly lower in pregnant women in both supine and right lateral decubitus (RLD) positions. This finding is consistent with prior studies Arzola et al. reported that although gastric ultrasound is feasible in term pregnancy, visualization of the antrum may be technically more difficult because the gravid uterus displaces abdominal structures and alters gastric anatomy [10][10]. Similarly, Roukhomovsky et al. demonstrated that the enlarged uterus in the third trimester may compress and displace the stomach, affecting the sonographic window and reducing the ease of antral visualization [12]. These anatomical changes may hinder sonographic visualization. Reduced visibility has important clinical implications, as it may limit qualitative interpretation and necessitate greater reliance on quantitative measurements.

Qualitative grading using the Perlas classification revealed greater heterogeneity among pregnant women, with a higher incidence of Grade 2 or equivocal findings. Previous investigations have similarly shown that a proportion of fasting parturients have gastric volumes exceeding 1.5 mL/kg, questioning the reliability of fasting alone to ensure an empty stomach. Hakak et al. demonstrated that even after six hours of fasting, a subset of term pregnant women had significant residual gastric contents on ultrasound assessment [17]. Wong et al. showed that gastric emptying of water in term pregnancy is generally preserved but demonstrates substantial variability between individuals [15]. In a subsequent study, Wong et al. also reported that obese pregnant women at term exhibit variable gastric emptying patterns despite standard fasting, further supporting individualized assessment [16].

Quantitative analysis demonstrated comparable supine antral cross-sectional area (CSA) values between groups, reinforcing the importance of RLD positioning for improved sensitivity and volume estimation [7,28,36]. Accurate measurement requires standardized technique and operator expertise [29,37].

A key finding was the significantly higher proportion of pregnant women classified as high risk (>1.5 mL/kg), a threshold widely accepted for aspiration risk stratification [18,23]. Similar observations have been reported by by Van de Putte et al., who found that although median gastric volumes in term pregnant and non-pregnant women were comparable, the upper percentile gastric volumes were higher among pregnant women, suggesting that some parturients may remain at increased aspiration risk despite fasting [11]. These data suggest that fasting guidelines alone may not reliably identify high-risk individuals.

Gastric ultrasonography also demonstrated dynamic clinical utility, as high-risk patients underwent prophylaxis followed by reassessment, enabling safe continuation of surgery. This individualized strategy is particularly valuable in obstetric anaesthesia, where unnecessary rapid sequence induction may increase airway-related complications [5,6]. Overall, these findings support a shift toward precision-based perioperative care, integrating gastric ultrasound as an adjunct to clinical judgment rather than relying solely on uniform risk assumptions [21,23]

CONCLUSION

Gastric ultrasound is a valuable adjunct for individualized aspiration risk assessment and should be considered in obstetric anaesthesia practice.

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