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PREOPERATIVE GASTRIC VOLUME ASSESSMENT IN FULL-TERM PREGNANT AND NON-PREGNANT FEMALES: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Introduction: Perioperative pulmonary aspiration (PA) of gastric contents is a serious anesthetic complication that can lead to significant morbidity and mortality. Obstetric patients, due to substantial anatomical and physiological changes, face a significantly higher risk of PA compared to non-pregnant individuals undergoing planned gynecological or other procedures.
Objective: The objective of this study is to compare gastric contents and volume through point-of-care gastric ultrasound (PoCUS) in full-term pregnant women and non-pregnant females scheduled for elective surgeries.
Methods: This single-center, prospective, observational study included 140 patients who underwent surgery between March 2022 and July 2023. Quantitative and qualitative measurements of the stomach were performed using PoCUS.
Results: The study included 140 patients with a mean age of 25±2.5 years (pregnant, range: 22-31 years) and 29±6 years (non-pregnant, range: 21-30 years), respectively. Patients in the pregnant group are classified as ASA II (70 (100%)), while those in the non-pregnant group (ASA I: 22 (31%); ASA II: 48 (69%)) are mixed. In Perlas, a 3-point grading system was used to classify the antrum based on the presence or absence of clear fluid in the supine position. The majority of the pregnant patients' antrum levels were reported to contain clear fluid (37 (53%)), while in non-pregnant patients, they were empty (45 (64%)). The average gastric antrum cross-sectional area (302.63±4.87 cm^2) and gastric volume (1.85±0.5 mL) were found to be high in pregnant females.
Conclusion: PoCUS was proven to be a simple, non-invasive method that can evaluate and offer a more precise bedside measurement of gastric volume, both qualitatively and quantitatively, in patients at risk for PA.

Keywords: Gastric volume; Non-pregnant women; Pregnant women; Pulmonary aspiration; Qualitative and quantitative assessment

ABSTRAK

Pendahuluan: Aspirasi paru perioperatif (PA) pada isi lambung merupakan komplikasi anestesi serius yang dapat menyebabkan morbiditas dan mortalitas yang signifikan. Khususnya pada pasien obstetri, yang menghadapi risiko PA yang jauh lebih tinggi dibandingkan dengan pasien tidak hamil yang menjalani prosedur ginekologi atau prosedur lain yang direncanakan karena perubahan anatomi dan fisiologis yang substansial.
Tujuan: Tujuan dari penelitian ini adalah untuk membandingkan isi dan volume lambung melalui USG lambung di tempat perawatan (PoCUS) pada wanita hamil cukup bulan dan wanita tidak hamil yang dijadwalkan untuk operasi elektif.
Metode: Penelitian observasional prospektif dengan pusat tunggal ini melibatkan 140 pasien, yang menjalani operasi antara Maret 2022 hingga Juli 2023. Dimana pengukuran lambung secara kuantitatif dan kualitatif dilakukan menggunakan PoCUS.
Hasil: Penelitian ini melibatkan 140 pasien dengan usia rata-rata 25±2.5 tahun (hamil, kisaran: 22-31 tahun) dan 29±6 tahun (tidak hamil, kisaran: 21-30 tahun). Seluruh pasien kelompok hamil adalah ASA II (70 (100%)), dan pada kelompok tidak hamil (ASA I: 22 (31%); ASA II: 48 (69%)) adalah campuran. Sistem penilaian 3 poin Perlas digunakan untuk mengklasifikasikan antrum berdasarkan ada tidaknya cairan bening pada posisi terlentang. Mayoritas kadar antrum pasien hamil dilaporkan terdapat cairan bening (37 (53%)) dan pada pasien tidak hamil, cairan kosong (45 (64%)). Rata-rata luas penampang antrum lambung (302,63±4,87 cm^2) dan volume lambung (1,85±0,5 mL) ditemukan tinggi pada wanita hamil.
Kesimpulan: PoCUS terbukti menjadi metode sederhana dan non-invasif yang dapat mengevaluasi dan menawarkan pengukuran volume lambung yang lebih tepat, baik secara kualitatif maupun kuantitatif, pada pasien yang berisiko terkena PA.

Kata Kunci: Volume lambung; Wanita tidak hamil; Ibu hamil; Aspirasi paru; Penilaian kualitatif dan kuantitatif

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INTRODUCTION

Perioperative pulmonary aspiration (PA) of stomach contents is a rare event; its consequences can be catastrophic, especially in obstetrics, causing anesthesia-related morbidity and mortality (1). Major morbidity events include conditions like acute respiratory distress syndrome, aspiration pneumonitis, aspiration pneumonia, brain damage, multiple organ dysfunction, and subsequent bacterial infections (2). The degree of PA-related morbidity is also largely dependent on pH, volume, and nature of the aspirated contents (3).

Incidents of PA are largely varied and highly dependent on the area of work or department. In a clinical setting, the general incidence of PA was reported at 2-7 per 20,000 anesthetic cases. However, its incidence was reported to be increased from 0.5% to 3% in emergency situations in the hospitals that were not within the operating room (4). To avoid any such instances and given patients' safety, preoperative fasting guidelines were designed by anesthesiology societies and the American Society of Anesthesiologists (ASA), providing direction for clinical practice in healthy patients undergoing elective surgeries (5). Even after considering all the set guidelines, fasting intervals are not reliable or applicable in emergency surgeries. Changes in anatomical and physiological conditions particularly affect obstetric patients.

Advanced technologies have emerged, yet there are no validated non-invasive tests available to assess the contents of the stomach. The application of point-of-care gastric ultrasound (PoCUS) as a diagnostic tool for assessing gastric volume was deemed straightforward and practical in clinical environments, particularly when gastric contents are unclear or uncertain (4,6–10). In these situations, clinicians evaluate the gastric antrum with strong intra- and inter-rater reliability and simultaneously obtain real-time data on the amount and type of gastric contents (solid, thick liquid, clear liquid, or none) utilizing PoCUS.

In this study, we aimed to compare gastric contents and volumes between fasting term pregnant patients and fasting non-pregnant surgical women posted for elective surgeries using PoCUS.

METHODS

Study Design

Ethical permissions were obtained from Saveetha College of Allied Health Sciences (SCAHS/IRB/2021/MARCH/060) on March 25, 2021 and from the Clinical Trials Registry - India (CTRI/2022/06/043329). This observational, prospective, comparative single-center study was conducted at a tertiary medical center from March 2022 to July 2023. Consent from all study participants was obtained before the start of the research.

Study Sample and Eligibility Criteria

A total of 140 eligible patients participated and were grouped as group A (n=70), representing the term pregnant females undergoing elective lower segment caesarean section (LSCS), and group B (n=70), representing non-pregnant female patients undergoing elective surgeries.

Patients aged between ≥18 and ≤45 years, with ASA scores of 1 and 2, and pregnant/non-pregnant female patients posted for elective surgeries were included. Whereas, patients of ASA score of 3 and 4, with multiple gestations, pre-existing abnormalities of the upper GI anatomy (previous surgery of the lower esophagus or stomach, hiatal hernia, and gastric malignancy), and who refused to give consent were excluded.

Fasting guidelines

Before going for elective surgery, all the patients have followed the recommended ASA fasting guidelines as presented: a minimum of two hours for consuming clear liquids, six hours for consuming light meals, and a minimum of eight hours for meals that include fried or fatty foods.

Preoperative procedures

A day prior to surgery, preoperative visits and thorough clinical evaluations were conducted by a multidisciplinary team, as required. All the patients

were kept nil oral prior to surgery for 8 hours, and as a pre-medication, H2 blockers were given at night. On the next day after shifting to the operating theater, all the vital parameters were checked and recorded. Preoperatively, all the patients were examined using PoCUS (both qualitatively and quantitatively) by staff anesthesiologist.

Qualitative assessment of the antrum and patient's classification as per the Perlas grading system

As per the Perlas' grading system (11,12) a 3-point grading system was used to classify the antrum according to the detection of clear fluid while in the right lateral decubitus (RLD) and supine positions.

Grade 0 – the antrum is empty in both RLD and supine.

Grade 1 – antrum with appreciable clear fluid in the RLD.

Grade 2 – antrum with clear fluid in both RLD and supine.

From the third trimester, instead of supine, semi-recumbent positions are preferred.

Quantitative assessment

The quantitative assessment was based on evaluating gastric volume by measuring the gastric cross-sectional area (GCSA). Whereas the gastric fluid volume was calculated using the formula by Schmitz:

$$Gastric\ volume\ (ml/kg) = [0.0093\ X\ gastric\ central\ area\ (sq.mm) - 0.9]$$

Where gastric fluid volume ≤1.5 ml is considered safe, and more than >1.5 ml is considered higher risk.

Statistical Analysis

Data was descriptively analyzed using SPSS (Version 24.0, USA). The data is presented in frequency and percentation for each parameter.

RESULTS AND DISCUSSION

All 140 patients were divided into two groups with 70 patients each (group A for pregnant and group B for non-pregnant) to study the gastric volume. All participants were female, with a mean age of 25±2.5 years for group A (range: 22-31 years) and 29±6 years for group B (range: 21-30 years), respectively. All the patients of group A are of ASA II (70, 100%), and group B (ASA I: 22, 31%; ASA II: 48, 69%) is mixed.

Table 1. Qualitative and quantitative assessments of the study population

Parameters	Pregnant (n=70)	Non-pregnant (n=70)
Qualitative		
Age (years) [mean±SD]	25±2.5	29±6
Height (cm) [mean±SD]	157±6	158±6
Weight (kg) [mean±SD]	63±6	58±7
ASA Score [n (%)]		
ASA I	--	22 (31)
ASA II	70 (100)	48 (69)
Perlas grading [n (%)]		
0	26 (37)	51 (73)
1	44 (63)	19 (27)
Quantitative		
Antrum level [n (%)]		
Empty	26 (37)	45 (64)
Clear fluid	37(53)	18 (26)
Solid	7 (10)	7 (10)
Anteroposterior diameter (cm) [mean±SD]	13.63±1.02	11.78±1.94
Transverse diameter (cm) [mean±SD]	22.16±1.24	21.83±1.61
Gastric cross-sectional area (cm^2) [mean±SD]	302.63±4.87	257.85±3.42
Gastric volume (mL) [mean±SD]	1.85±0.5	1.44±0.4

ASA: American Society of Anesthesiologists; SD: Standard deviation.

The majority of the pregnant patients' antrum level was reported as clear fluid (37, 53%), and in non-pregnant patients was empty (45, 64%). The mean GCSA of the antrum (302.63±4.87 cm^2) and gastric volume (1.85±0.5 mL) was found to be high in pregnant women. Other qualitative and quantitative parameters were presented in Table 1.

Literature has already proven the PA as a severe condition, where patients have died or suffered severely from its consequences (13). However, as of this date, no treatment protocols were available to intervene in the PA except for its management or support. Given the patient's safety, identifying and mitigating such PA-related risks preemptively, preoperative fasting guidelines were introduced. Until recently, in the acute settings, there were no non-invasive diagnostic tools to assess the gastric content. The only available methods, such as gastric content aspiration, polyethylene glycol dilution, radiolabeled diet, electrical impedance tomography, and paracetamol absorption, were all invasive and practically not applicable in the perioperative period, and they are the only options left for all the patients who are going to undergo sedation and anesthetic care perioperatively.

However, it was only recently that along with recommended preoperative fasting guidelines, PoCUS has been used as a diagnostic method for the examination of stomach contents. In a study conducted by Richelle et al. (3) the qualitative and quantitative accuracy and sensitivity of PoCUS in detecting the gastric contents and its volume were proven highly effective. Considering PA and its related risks in uncertain and emergency cases, PoCUS was often recommended over unnecessary airway interventions, cancellations, or surgical delays. Recent editorials by Lucas and Elton (14), Mahmood et al. (15), and Benhamou (16) have also suggested including the PoCUS as a curriculum for anesthesiologists to make it a basic armamentarium of their daily clinical practice.

Even though the use of PoCUS in clinical anesthesia has existed over the last forty years, its role in obstetric anesthesia was developed very recently (14,17). In the present study, the same PoCUS was used to assess and compare qualitatively and quantitatively the parameters in both non-pregnant and pregnant women undergoing selective surgery. All participants in this study were females with ASA grades I and II. In the present study, H2 blockers were used in contrast to proton-pump inhibitors (PPIs) 8 hours prior to surgery (18,19). This might be one of the reasons why we have observed a lesser volume of gastric aspiration in our patients, affecting their overall gastric residual volume in the end. This could be because PPIs target terminal receptors and exert a more immediate effect than histamine antagonists (18). Our results are consistent with Arzola et al. (20), where the GCSA has a positive correlation with weight and BMI but not with the fasting time. However, multiple studies have validated the strong linear relationship between GCSA and gastric volume in both pregnant and non-pregnant populations (3,11,12,21). Animal studies suggested that a stomach volume greater than 0.8 mL/kg is associated with a high risk of PA (22). However, recent studies have shown that up to 1.5 mL/kg of gastric residue is considered safe and does not indicate an increase in the risk of PA (23).

Whereas with the gastric volume, studies have reported no significant difference between fasting non-pregnant women and post-term pregnant women (24,25). In a cross-sectional observational study conducted by Riveros et al. (26), results have suggested a need to adjust the perioperative fasting guidelines in pregnant patients, especially those who fall under the obese and morbidly obese pregnant category, to avoid PA. In our study cohort, a minor difference in gastric CSA and gastric volume was observed. Such discrepancy in our data can be attributed to the obese patients presented in our cohort or it can be a poor correlation and agreement between gastric CSA and gastric volume measurements of different assessors. Such poor inter-assessor correlation and agreement were reported earlier too. In a randomized study conducted by Jeson et al. (7),

inter-assessor variability was evident, confirming the need for more training for the assessors to attain proficiency.

Outcomes from our study also highlight the need to take preventive measures against PA in laboring females regardless of overnight fasting, as fasting alone cannot be a confirmation for an empty stomach. In such instances, bedside PoCUS was proven to be an efficient diagnostic tool in assessing the gastric volume.

The small sample size, single-center nature, and inability to assess inter-observer agreement as determined in PoCUS are the primary limitations of this study.

CONCLUSION

To conclude, PoCUS was proven to be simple, life-saving, readily accessible, non-invasive, and capable of evaluating and providing more accurate gastric volume assessment at the bedside, both qualitatively and quantitatively, in patients at risk for PA. To confirm and validate the current results, more research would probably be needed, most likely a multi-center, prospective, observational study.

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Conflict of Interest

All other authors declare no competing interests.

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Author Contributions

NDG contributes in concepting, designing, supervision, materials' preparation, collecting and processing data, analysis and interpretation, literature search, manuscript writing, and critical review.

RK contributes in materials' preparation, analysis and interpretation.

RP contributes in materials' preparation, analysis and interpretation.

LR contributes in supervision, materials' preparation, analysis and interpretation.

MS contributes in concepting, designing, supervision, materials' preparation, collecting and processing data, analysis and interpretation, literature search.

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