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GASTRIC ULTRASOUND ASSESSMENT OF THE ANTRUM IN DIABETIC AND NON-DIABETIC PATIENTS: AN OBSERVATIONAL STUDY ON PERIOPERATIVE ASPIRATION RISK

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ABSTRACT

Background: Pulmonary aspiration of gastric contents is a rare but serious perioperative complication. Diabetic patients are considered at higher risk due to potential delayed gastric emptying. To compare gastric residual volume and aspiration risk between diabetic and non-diabetic patients using ultrasound measurement of the gastric antrum. **Methods**: This observational cross-sectional study included 86 adult patients (38 diabetics, 48 non-diabetics) assessed via abdominal ultrasound in supine and right lateral decubitus positions. Antral cross-sectional area was measured, and gastric volume calculated using validated mathematical models. Statistical analyses compared body mass index (BMI), age, fasting duration, and gastric volume between groups. **Results**: Diabetic patients had a higher mean BMI (26.46 ± 1.78 vs. 24.69 ± 3.38, p = 0.004) and were older (58.74 ± 8.46 vs. 47.71 ± 16.21 years, p < 0.001). Fasting times did not differ significantly (p = 0.243). No statistically significant difference was found in gastric emptying status or aspiration risk between groups (p = 0.266). **Conclusion**: Diabetes mellitus alone did not significantly impact gastric emptying in this sample. Standard fasting protocols appear adequate for most diabetic patients without gastroparesis symptoms.

Keywords: aspiration; diabetes mellitus; abdominal point-of-care ultrasound; preoperative care.

INTRODUCTION

Pulmonary aspiration of gastric contents during anesthesia is an infrequent yet potentially life-threatening event, leading to complications such as chemical pneumonitis, acute respiratory distress syndrome, and increased perioperative morbidity and mortality[1]. While adherence to fasting guidelines reduces this risk, certain populations, notably diabetic patients, may have delayed gastric emptying due to autonomic neuropathy, increasing their susceptibility to aspiration[2].

METHODS

Study design and settings

This cross-sectional observational study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [4] and it was conducted at a tertiary care hospital from February 2023 to November 2024. The study was approved by the institutional Research Ethics Committee (CAAE number 50631421.1.0000.5292).

Participants

Inclusion criteria were: age ≥18 years, scheduled for elective surgery, and provision of informed consent. For diabetic patients, a confirmed diagnosis of diabetes mellitus was required. Exclusion criteria included: known gastrointestinal disorders, history of gastric surgery, use of prokinetic or anti-motility agents, and critically ill or mechanically ventilated status.

Variables

All examinations were performed by a single radiologist in the preoperative admission room. Gastric ultrasound was performed using a PHILIPS HD11 system equipped with a 2–5 MHz curvilinear transducer. Examinations were carried out in both the supine and right lateral decubitus (RLD) positions.

The antral cross-sectional area (CSA, in cm^2) was measured in the sagittal plane using the formula: $CSA = (AP \times CC \times \pi)/4$, where AP is the anteroposterior diameter and CC is the craniocaudal diameter. Gastric volume (GV, in milliliters) was estimated using a validated mathematical model for the RLD position: $GV = 27 + 14.6 \times CSA\ (cm^2) - 1.28 \times$ age (years). Patients were classified into three groups based on ultrasound findings: Empty stomach; Low risk of aspiration (Gastric fluid volume < 1.5 mL/kg); High risk of (Gastric fluid volume > 1.5 mL/kg) [5].

Statistical Analysis

Data were analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation and compared using Student's t-test or

Mann-Whitney U test, as appropriate. Categorical variables were compared using Chi-square or Fisher's exact test. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 86 adult patients scheduled for elective surgeries were enrolled, including 38 diabetic and 48 non-diabetic individuals. Diabetic patients had a higher mean BMI (26.46 ± 1.78 kg/m²) compared to non-diabetics (24.69 ± 3.38 kg/m²), with a p-value of 0.004. They were also older (58.74 ± 8.46 years vs. 47.71 ± 16.21 years, p < 0.001). No significant differences were found between the groups in terms of sex distribution and mean fasting time. Demographic characteristics are summarized in Table 1.

Ultrasound assessment showed that 20 patients (23.3%) had a gastric volume ≤1.5 mL/kg and were classified as low risk for aspiration, while 66 patients (76.7%) had an empty stomach across the entire study population. No patients were classified as high risk for aspiration based on the ultrasound findings. There were no significant differences in the proportion of patients with an empty stomach or low aspiration risk between diabetic and non-diabetic individuals (Table1).

Table 1 – Demographic characteristics of the study population and gastric ultrasound assessment.

Characteristic	No Diabetes	Diabetes	p value
Age (years)	47.71 ± 16.21	58.74 ± 8.46	**< 0.001**[a]
Gender male	28 (58.3%)	20 (52.6%)	0.597[b]
Mass Body Index (kg/m^2)	24.69 ± 3.38	26.46 ± 1.78	**0.004**[a]
Fasting (hours)	9.27 ±1.85	9.84 ± 2.58	0.243[c]
Gastric ultrasound			
Empty stomach	39 (81.2%)	27 (71.1%)	
Low risk of aspiration	9 (18.8%)	11 (28.9%)	0.266[b]
High risk of aspiration	0	0	

Data shown as mean ± SD or absolute value (percentile). [a] Test t-student; [b] qui-squared test; [c] Mann-Whitney test

DISCUSSION

This study was conducted as an observational investigation using ultrasonography to assess gastric residual volume in diabetic and non-diabetic individuals, including comparisons across defined risk groups.

Gastric ultrasonography represents a significant advancement in point-of-care assessment, allowing anesthesiologists to evaluate gastric content and volume at the bedside. This is essential for determining aspiration risk and informing anesthetic and airway management decisions. Ultrasound is the first validated non-invasive method capable of providing both qualitative and quantitative information about gastric contents at the bedside[3-6].

The diabetic population is particularly relevant for this type of research for several reasons. First, diabetes mellitus currently affects between 10% and 15% of surgical patients worldwide—a proportion that continues to grow. It is estimated that over 382 million people live with diabetes globally, a number projected to rise to 592 million by 2035[7]. Second, delayed gastric emptying is observed in nearly 50% of patients with long-standing diabetes. Therefore, some studies have categorized these individuals as being at high risk for pulmonary aspiration during the perioperative period—a complication that remains a major cause of mortality. Consequently, the development of a non-invasive, accessible method to assess gastric contents is both urgent and necessary, enabling anesthesiologists to individualize aspiration risk assessments and enhance perioperative safety[2].

It is worth noting that in this study, the diabetic group had a significantly higher mean age, which is consistent with existing literature indicating that diabetes is more prevalent among older adults. However, there was no statistically significant difference in mean fasting times between the two groups, suggesting that diabetes did not significantly affect the required fasting duration.

Nevertheless, it is important to highlight that the mean fasting time in our study was over nine hours, which may have contributed to this finding. Despite current protocols[8] recommending reduced preoperative fasting times, our institution has experienced prolonged fasting periods, mainly due to frequent changes in surgical scheduling, as is common in university hospitals.

Comparison across aspiration risk groups revealed no significant differences in BMI or age. Although the mean fasting time was slightly shorter in the low-risk group, this difference did not reach statistical significance. It is important to note that the current literature is not unanimous on this issue, and several studies diverge from the present findings. For example, a study by Sabry et al. reported higher gastric volumes in diabetic patients compared to non-diabetics (177 mL vs. 83 mL). However, without weight-adjusted volume calculations, it is difficult to determine whether those values fall within the currently accepted safe range[9]. Zhou et al. examined 52 diabetic patients and found a 48% incidence of full stomachs compared to 8% in non-diabetics. However, this classification was based solely on qualitative sonographic criteria (e.g., Perlas grade 2 antrum), a good screening method but less precise than actual volumetric assessment [10].

Our findings are supported by a recent study by Perlas et al., who evaluated 180 fasting patients scheduled for elective surgery using gastric ultrasound to estimate baseline gastric volume. This prospective noninferiority study demonstrated that diabetic patients did not have significantly higher gastric volumes than nondiabetic patients after appropriate fasting, with a mean difference of -0.07 mL/kg (95% CI: -0.24 to 0.10 mL/kg). Additionally, the proportion of patients with a “full stomach” (>1.5

mL/kg) was similar between groups (15.5% vs. 11.5%). These results reinforce the evidence that diabetes alone does not necessarily imply delayed gastric emptying, particularly in the absence of clinical symptoms suggestive of gastroparesis[11].

This study has some limitations. It was conducted in a single center with a relatively small sample size, which may reduce the generalizability of the results. Additionally, the cross-sectional design prevents causal inference, and ultrasound estimates may not fully reflect individual variations in gastric emptying, especially in diabetic patients.

CONCLUSION

This observational study concludes that the majority of diabetic patients exhibit normal gastric emptying behavior, presenting with an empty stomach after the recommended fasting period. This observation carries significant clinical relevance, as it suggests that standard preoperative fasting practices are likely safe for most diabetic individuals, reducing the need for more stringent measures or additional assessments in the absence of symptoms suggestive of gastric dysfunction.

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