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Original Article

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CONSISTENCY OF SONOGRAPHIC ESTIMATIONS OF GASTRIC RESIDUAL VOLUME AMONG NON RADIOLOGISTS WITH LIMITED EXAMINATION PERIOD.

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Abstract:

Background: Pulmonary aspiration is a constant risk in patients planned for anesthesia and those who are critically ill. Ultrasonic examination of the stomach gives a valuable assessment opportunity to predict gastric residual volume. Involvement of non-radiologists for its estimation can potentially prevent lots of incidences of aspiration and consequently pulmonary complications and even deaths. Both the duration required for the training and the examination period for estimation, are still to be studied.

This study tries to illustrate the consistency of measurements of gastric antral area among three anesthesia trainees as novice sonographic readers with a short training course and to measure the applicability of lowering the examination time to two minutes in both semi sitting (Fowler`s) position and right lateral recumbent position.

Patients and Methods: Prospective study at a tertiary teaching hospital. Patients included are in intensive care unit with a nasogastric feeding tube. Three anesthesia trainees with equal training courses in the subject were recruited and have their sonographic evaluation compared in two patients positions. They all are blinded to time, type, and volume of last enteral intake.

Results: The readings reported by the three doctors in either lateral or supine position did not show significant statistical differences (P value >0.05). Consistency of the readings among the three doctors was high (Cronbach's alpha = 0.926).

Conclusion: Anesthesiologists with short term appropriately performed courses can uncover the risk of gastric contents regurgitation and aspiration with only a two minute bedside gastric sonographic examination.

Keywords: Pulmonary aspiration, gastric ultrasound, point of care ultrasound, gastric residual volume.

Introduction

General anesthesia is considered much safer today due to increased awareness of potential risks, as well as advancements in technology and pharmacology. However, one constant risk factor is the potential for aspiration of gastric contents, which may cause airway blockade, bacterial pneumonia, bronchospasm, or, most hazardously, aspiration pneumonitis, also known as Mendelson's syndrome- a chemical pneumonitis caused by the aspiration of gastric contents. [1,2]

To minimize the risk of aspiration during general anesthesia, several guidelines have been developed focusing on preoperative fasting and pharmacological interventions. [3,4] Despite these guidelines, aspiration occurs in approximately 1 in 7,000 instances, with associated morbidity affecting 1 in 16,500 cases and mortality occurring in 1 out of every 100,000 cases. The most common risk factors include obesity, gastroesophageal reflux disease, and emergency surgery. [5,6] Pharmacological interventions, such as the use of antacids, histamine-2 blockers, proton pump inhibitors, and metoclopramide, can help reduce gastric acidity and volume, further decreasing the risk of aspiration. However, these medications should not be routinely administered to patients with no apparent increased risk for pulmonary aspiration. [7-9]

The exact percentage of patients who, despite fasting adequately, still have significant residual gastric volumes that increase their risk of aspiration remains unclear.

The impact of pulmonary aspiration can also differ significantly; it may have no serious effects or lead to severe complications, such as acute respiratory distress syndrome (ARDS). [10,11]

Anesthesia management techniques, such as rapid sequence induction, can also help minimize the risk of aspiration during general anesthesia. This method involves the rapid administration of an induction agent and a neuromuscular blocking agent, followed by immediate intubation to secure the airway. However, the risk remains a concern, particularly in emergency cases and among specific patient populations. [12,13]

There is no compelling evidence to indicate that consuming clear fluids up to two hours before surgery increases the risk of

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regurgitation or subsequent aspiration. As a result, the traditional "nil by mouth from midnight" rule is considered outdated. In fact, drinking water up to two hours before the procedure may even lead to lower gastric volumes. Updated guidelines now endorse the consumption of clear fluids, such as coffee, tea, and non-residual juices, which could also help reduce the risk of hypoglycemia, ketosis, dehydration, and postoperative nausea and vomiting (PONV). [3, 14]

Estimating gastric residual volume can be achieved through various methods, such as using a nasogastric tube, gastric MRI, or gastric CT scan. [15-17] Recently, sonography has emerged as a highly accurate alternative for this purpose. Ultrasonic assessment of the gastric antrum has been shown to closely correlate with the actual volume, offering high levels of sensitivity and specificity. [18-20]

Gastric ultrasound is recommended as part of non-invasive point-of-care ultrasound examinations to provide thorough preoperative insights, particularly for emergency cases or patients with risk factors. It is also utilized in critical care settings where the risk of regurgitation and pulmonary aspiration is ongoing. Beyond quantitative measures, this tool can qualitatively identify different types of gastric contents. This technique holds significant value for special patient populations, such as pediatrics, the obese, and pregnant individuals. [21,22]

Many anesthesia techniques compromise the body's natural defenses against aspiration and regurgitation. Light anesthesia or unexpected surgical stimulation can negatively impact the gastrointestinal tract, leading to gagging or swallowing, which in turn raises gastric pressure and causes reflux. The presence of multiple risk factors, such as an unprotected airway and light anesthesia, elevates the likelihood of aspiration. According to the NAP4 report, poor judgment is often the primary cause of aspiration. [23]

The gastric antrum is relatively easy to assess with ultrasound due to its superficial position, typically about 3–4 cm deep. It serves as a reliable indicator of the stomach's overall contents. By performing a sagittal scan starting at the left subcostal area and moving across the midline to the right subcostal area, the gastric antrum can be visualized. It appears as a hollow structure with a noticeable muscular wall, situated between the left liver lobe and the pancreas. [24] The antrum's appearance varies based on its contents:

1. **Empty**: When the antrum is empty, it appears collapsed and flat, featuring a thick, multilayered wall. An empty antrum in a right-lateral position essentially rules out the presence of a full stomach.
2. **Thick Fluid or Solid Food**: The antrum appears hyper-echoic and heterogeneous, with visible peristaltic movements. Shortly after eating, the presence of gastric air may create a "frosted glass" pattern that makes it difficult to see deeper structures.
3. **Clear Fluid**: The antrum appears distended with thin walls. Hyper-echoic "dots," which are actually air bubbles, can be seen within the hypo-echoic fluid-filled chamber. If clear fluid is present, its volume can be estimated based on the antrum's cross-section. This helps distinguish between baseline gastric secretions (less than 1.5 ml/kg) and higher volumes that might increase the risk of aspiration. [25]

Three main body positions are used to measure the antral cross-sectional area (CSA): supine, right-lateral recumbent, and semi-recumbent. The right-lateral recumbent position is generally considered the most effective for scanning, as the antrum is at the stomach's lowest point in this position. Additionally, the correlation between CSA and gastric volume (GV) is better in the right-lateral position compared to the supine position. A curvilinear probe with low frequency and high penetration is chosen for identifying key anatomical landmarks in adult patients. [26,27]

Gastric volume can be evaluated using either a grading system or quantitative measurements. In the grading system, Grade 0 indicates an empty stomach, observable in both the supine and right lateral decubitus positions. Grade 1 shows fluid only in the right lateral position and usually indicates less than 100 ml of gastric fluid in 77% of patients. Grade 2 reveals fluid in both positions, suggesting a fluid volume greater than 100 ml in 75% of cases and over 250 ml in 50% of cases. [28]

Quantitative methods use ultrasound to view the gastric antral area in the sagittal plane. The antral cross-

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sectional area can be calculated using either free-hand tracing or by measuring the maximum anteroposterior (AP) and craniocaudal (CC) diameters.[29] The formula used is as follows: **Antral cross-sectional area = π × AP × CC / 4**

The antral cross-sectional area is a good indicator of gastric volume, whether measured directly or indirectly. According to a study by Bouvet et al., [30]measuring the antral cross-sectional area in a semi-recumbent position can help differentiate between low- and high-risk stomach contents. They proposed a cut-off value of 340 mm² to identify gastric volumes greater than 0.8 ml per kg of body weight or the presence of solid contents.[30,31]

A formula that accounts for the patient's age has been developed for this purpose: **Volume = 27.0 + 14.6 × Right-lateral CSA - 1.28 × age**

The term "Right-lateral CSA" refers to the antral cross-sectional area (CSA) as measured in the right lateral decubitus (RLD) position. This model has been validated for non-pregnant individuals with a BMI of 40 kg/m² or less. For identifying a higher risk of aspiration, an alternative criterion suggests a calculated gastric fluid volume greater than 1.5 ml per kg of body weight or the presence of solid stomach contents.

In the supine position, patients with a CSA smaller than 340 mm² are typically considered to be in a fasting state. Conversely, a moderate gastric volume (GV) exceeding 0.8 ml/kg is likely when the CSA is above 340 mm².

This study aims to illustrate the consistency of measurements of gastric antral area among three anesthesia trainees serving as novice sonographic readers with a short training course and to evaluate the applicability of reducing the examination time to two minutes in both the semi-sitting (Fowler's) position and the right lateral recumbent position

Patients and Methods:

With approval from the Iraqi Council of Anesthesia and Critical Care, this prospective, blinded observational study was conducted in the ICU of Alsadr Teaching Hospital in Basra. The study spanned four months, from April to August 2021. Patient criteria included individuals aged 18 or older and weighing between 50 and 100 kg.

Exclusion Criteria:

1. Pregnancy.
2. Prior history of upper gastrointestinal tract conditions, such as hiatus hernia or gastric tumors.
3. Previous surgical interventions involving the stomach, lower esophagus, or other upper abdominal areas.
4. Obesity, as these individuals often have larger gastric residual volumes and antral sizes.

Training Course:

The operators for this course were three anesthesia board trainees with at least one year of experience in ultrasound for various examinations and procedures, but no prior experience in gastric ultrasonography. The training began with a 30-minute session that included written guidelines and explanations focused on the fundamentals of visualizing the gastric antrum, presented by an ICU director with four years of expertise in this area. This was followed by video demonstrations and then hands-on supervised practice on 10 real patients.

Ultrasound Equipment and Procedure: The ultrasound device utilized was a portable MTurbo™ by SonoSite®, equipped with a low-frequency curvilinear probe (2-5 MHz). The antral area was visualized in the sagittal plane, aligned with the plane of the aorta. Measurements were taken of the two largest diameters that were perpendicular to each other, aiding in the calculation of the antral area, which is generally elliptical in shape.

Procedure Steps:

1. Position the probe perpendicularly in the sagittal plane over the epigastric region.
2. Align the probe to the right and left to locate the aorta, which marks the plane for the antrum.
3. Record the maximum measurements between peristaltic movements, within a total timeframe of two minutes.
4. Measure from serosa to serosa, incorporating the full thickness of the gastric wall.

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Calculation of the gastric volume was obtained using the following formulas:

CSA = (AP × CC × π) / 4

GV = 27.0 + (14.6 × CSA) - (1.28 × Age)

Statistical Analysis:

Data for two variables—age and ultrasound-detected volume—were entered into SPSS version 22. Since both variables involved repeated measures, they were presented as means and standard deviations (SD). Repeated measures ANOVA was used to analyze differences in readings taken in the lateral and supine positions. To compare readings between the lateral and supine positions by the same examiner, a paired t-test was employed. A p-value of 0.05 was set as the threshold for statistical significance. To evaluate the consistency of readings across the three doctors in both positions, Cronbach's alpha was used. Levels above 0.6 were deemed fair, above 0.7 were considered good, and above 0.8 indicated high consistency.

Results:

Thirty patients were involved in this study with an average age of 37 years.

Table I: A- Repeated measure of lateral position

	Mean	SD	P value*
Operator1	201.8	75.0	0.181
Operator2	232.2	114.8	
Operator3	218.9	74.5	

***Repeated measure ANOVA**

Table I: B- Repeated measure of Supine position

	Mean	SD	P value*
Operator1	91.4	47.1	0.140
Operator2	107.2	63.7	
Operator3	86.6	43.3	

*Repeated measure ANOVA

The readings reported by the three doctors in either lateral or supine position did not show significant statistical difference (P value >0.05).

Each individual doctor reported significantly different measures in lateral from supine positions (P values <0.05).

Consistency of the readings among the three doctors was high (Cronbach's alpha = 0.926). Interclass Cronbach's alpha is shown in the Table II below.

Table II: Repeated measure by same operator

		Mean	SD	P value*
Operator1	Lateral	199.3	75.1	0.001
	Supine	96.0	43.7	
Operator2	Lateral	231.1	107.5	0.001
	Supine	113.9	65.3	
Operator3	Lateral	205.0	75.1	0.004
	Supine	90.3	46.2	

*Paired t-test

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Table III: Interclass

		Operator 1		Operator 2		Operator 3	
		Lateral	Supine	Lateral	Supine	Lateral	Supine
Operator 1	Lateral	1.000	0.737	0.699	0.693	0.817	0.621
	Supine	0.737	1.000	0.528	0.740	0.476	0.858
Operator 2	Lateral	0.699	0.528	1.000	0.793	0.847	0.498
	Supine	0.693	0.740	0.793	1.000	0.667	0.657
Operator 3	Lateral	0.817	0.476	0.847	0.667	1.000	0.519
	Supine	0.621	0.858	0.498	0.657	0.519	1.000

Operators` readings in supine and lateral positions were highest in agreement for operator 2 (0.793) followed by operator 1 (0.737) and was least for operator 3 (0.519). Operator 3 and operator 2 readings agreed in higher rate in lateral position (0.847) compared to supine position (0.657).

In the readings in lateral position, operator 1 was highly agreeing with operator 3 readings (0.817) and less with operator 2 (0.699). This pattern is also true for supine position.

The general trend in the study shows higher mean values for readings in the lateral position compared to the supine position for all three operators.

Discussion:

In the context of this study, the findings indicate a high level of consistency among the three operators' readings. This aligns with the initial hypothesis that this technique can be easily taught and that a test duration of 2 minutes is sufficient. It was initially thought that consistency would improve in the right lateral position, as gastric contents tend to accumulate around the antral area in this position, potentially increasing both sensitivity and specificity. However, the study results did not confirm this assumption; consistency was found to be identical in both the right lateral and supine positions.

For a diagnostic tool to be clinically useful, it needs to be accurate not only under ideal conditions but also consistent, with low levels of both interrater and intrarater variability. In this study, enhancing accuracy involves slightly elevating the chest, positioning the patient in the right lateral position, and waiting at least 2 minutes for peristalsis to occur, all while capturing the largest possible dimensions.

Gastric ultrasound has already shown promise when adequate training and supervision are provided. In one study, anesthesiologists achieved a 95% success rate after conducting roughly [32] examinations. While safeguarding against the risk of pulmonary aspiration remains challenging due to its unpredictability, routine training for anesthesiologists could be beneficial. Brief ultrasound examinations may reduce risks in a wide range of preoperative and critical cases, particularly given the ongoing aspiration risk, which contributes to ventilator-associated pneumonia.[33]

Volume estimation through ultrasound has been found to correlate well with endoscopic methods, and it also has the capability to reveal the quality of gastric contents.[34] However, in our study, we did not focus on describing the quality of gastric contents, as the primary form of enteral nutrition in ICUs for our selected patients is either liquid or semi-liquid, leaving little room for variation. The study did not involve radiologist input as an indicator, primarily due to the unavailability of a dedicated radiologist on short notice.

In practical terms, questions remain about the applicability of this study's findings to specific patient categories and its cost-effectiveness. These issues will require further, more comprehensive studies to explore fully.

Although the results have been examined in other categories, such as obese patients, pregnant women, and children, those studies often involved longer examination durations and highly trained operators. Therefore, additional research may be needed to focus on the feasibility of shorter test durations and varying levels of operator experience for these specific subgroups.

Conclusion:

Anesthesiologists who undergo short-term, appropriately designed training courses can effectively assess the risk of gastric contents regurgitation and aspiration with just a two-minute bedside gastric sonographic examination

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References

1. MENDELSON CL. The aspiration of stomach contents into the lungs during obstetric anesthesia. Am J Obstet Gynecol. 1946 Aug;52:191-205. https://doi.org/10.1016/S0002-9378(16)39829-5

2. Aspiration Pneumonitis and Aspiration Pneumonia. Paul E. Marik, M.B., B.Ch.N Engl J Med 2001; 344:665-671. https://doi.org/10.1056/NEJM200103013440908

3. Girish P. Joshi, Basem B. Abdelmalak, Wade A. Weigel, Monica W. Harbell, Catherine I. Kuo, Sulpicio G. Soriano, Paul A. Stricker, Tommie Tipton, Mark D. Grant, Anne M. Marbella, Madhulika Agarkar, Jaime F. Blanck, Karen B. Domino; 2023 American Society of Anesthesiologists Practice Guidelines for Preoperative Fasting: Carbohydrate-containing Clear Liquids with or without Protein, Chewing Gum, and Pediatric Fasting Duration-A Modular Update of the 2017 American Society of Anesthesiologists Practice Guidelines for Preoperative Fasting. __Anesthesiology__ 2023; 138:132-151. https://doi.org/10.1097/ALN.0000000000004381

4. Perioperative fasting in adults and children, guidelines from the European Society of Anaesthesiology. Smith, Ian; Kranke, Peter; Murat, Isabelle; Smith, Andrew; O'Sullivan, Geraldine; Søreide, Eldar; Spies, Claudia; in't Veld, Bas. European Journal of Anaesthesiology [28(8):p 556-569, August 2011.](https://journals.lww.com/ejanaesthesiology/toc/2011/08000) .

5. The Incidence and Outcome of Perioperative Pulmonary Aspiration in a University Hospital: A 4-Year Retrospective Analysis. Sakai, Tetsuro MD, PhD; Planinsic, Raymond M. MD; Quinlan, Joseph J. MD. Anesthesia & Analgesia [103(4):p 941-947, October 2006.](https://journals.lww.com/anesthesia-analgesia/toc/2006/10000)

6. Mark A. Warner, Karen L. Meyerhoff, Mary E. Warner, Karen L. Posner, Linda Stephens, Karen B. Domino; Pulmonary Aspiration of Gastric Contents: A Closed Claims Analysis. __Anesthesiology__2021;135:284-291. https://doi.org/10.1097/ALN.0000000000003831

7. Paranjothy S, Griffiths JD, Broughton HK, Gyte GM, Brown HC, Thomas J. Interventions at caesarean section for reducing the risk of aspiration pneumonitis. Cochrane Database Syst Rev. 2010Jan20;(1):CD004943. https://doi.org/10.1002/14651858.CD004943.pub3

8. Babaei A, Bhargava V, Aalam S, Scadeng M, Mittal RK. Effect of proton pump inhibition on the gastric volume: assessed by magnetic resonance imaging. Aliment Pharmacol Ther. 2009 Apr 15;29(8):863-70. https://doi.org/10.1111/j.1365-2036.2009.03947.x

9. Jellish WS, Kartha V, Fluder E, Slogoff S. Effect of metoclopramide on gastric fluid volumes in diabetic patients who have fasted before elective surgery. Anesthesiology. 2005 May;102(5):904-909. https://doi.org/10.1097/00000542-200505000-00007

10. Ohashi Y, Walker JC, Zhang F, Prindiville FE, Hanrahan JP, Mendelson R, Corcoran T. Preoperative gastric residual volumes in fasted patients measured by bedside ultrasound: a prospective observational study. Anaesth Intensive Care. 2018 Nov;46(6):608-613. https://doi.org/10.1177/0310057X1804600612

11. Raghavendran K, Nemzek J, Napolitano LM, Knight PR. Aspiration-induced lung injury. Crit Care Med. 2011 Apr;39(4):818-26. https://doi.org/10.1097/CCM.0b013e31820a856b

12. Avery, P., Morton, S., Raitt, J. _et al._ Rapid sequence induction: where did the consensus go?. _Scand J Trauma Resusc Emerg Med_ **29**, 64 (2021). https://doi.org/10.1186/s13049-021-00883-5

13. Klucka J, Kosinova M, Zacharowski K, De Hert S, Kratochvil M, Toukalkova M, Stoudek R, Zelinkova H, Stourac P. Rapid sequence induction: An international survey. Eur J Anaesthesiol. 2020Jun;37(6):435-442. https://doi.org/10.1097/EJA.0000000000001194

14. Yilmaz N, Cekmen N, Bilgin F, Erten E, Ozhan MÖ, Coşar A. Preoperative carbohydrate nutrition reduces postoperative nausea and vomiting compared to preoperative fasting. J Res Med Sci. 2013 Oct;18(10):827-32.
15. Sharma V, Gudivada D, Gueret R, Bailitz J. Ultrasound-Assessed Gastric Antral Area Correlates With Aspirated Tube Feed Volume in Enterally Fed Critically Ill Patients. Nutr Clin Pract. 2017 Apr;32(2):206-211. https://doi.org/10.1177/0884533616681530
16. Fruehauf H, Menne D, Kwiatek MA, Forras-Kaufman Z, Kaufman E, Goetze O, Fried M, Schwizer W, Fox M. Inter-observer reproducibility and analysis of gastric volume measurements and gastric emptying assessed with magnetic resonance imaging. Neurogastroenterol Motil. 2011 Sep;23(9):854-61.
17. Bouvet L, Desgranges FP, Aubergy C, Boselli E, Dupont G, Allaouchiche B, Chassard D. Prevalence and factors predictive of full stomach in elective and emergency surgical patients: a prospective cohort study. Br J Anaesth. 2017 Mar 1;118(3):372-379. https://doi.org/10.1093/bja/aew462
18. Bisinotto FM, Pansani PL, Silveira LA, Naves AA, Peixoto AC, Lima HM, Martins LB. Qualitative and quantitative ultrasound assessment of gastric content. Rev Assoc Med Bras (1992). 2017 Feb;63(2):134-141. https://doi.org/10.1590/1806-9282.63.02.134
19. Kruisselbrink R, Gharapetian A, Chaparro LE, Ami N, Richler D, Chan VWS, Perlas A. Diagnostic Accuracy of Point-of-Care Gastric Ultrasound. Anesth Analg. 2019 Jan;128(1):89-95. https://doi.org/10.1213/ANE.0000000000003372
20. Perlas A, Mitsakakis N, Liu L, Cino M, Haldipur N, Davis L, Cubillos J, Chan V. Validation of a mathematical model for ultrasound assessment of gastric volume by gastroscopic examination. Anesth Analg. 2013 Feb;116(2):357-63. https://doi.org/10.1213/ANE.0b013e318274fc19
21. Cubillos J, Tse C, Chan VW, Perlas A. Bedside ultrasound assessment of gastric content: an observational study. Can J Anaesth. 2012 Apr;59(4):416-23. https://doi.org/10.1007/s12630-011-9661-9
22. Chen X, Chen F, Zhao Q, Zhang L, Liu Z. Ultrasonographic measurement of antral area for estimating gastric fluid volume in pregnant women. J Clin Anesth. 2019 Mar;53:70-73. https://doi.org/10.1016/j.jclinane.2018.06.040
23. T. Asai, Editorial II: Who is at increased risk of pulmonary aspiration?, _BJA: British Journal of Anaesthesia_, Volume 93, Issue 4, October 2004, Pages 497-500 https://doi.org/10.1093/bja/aeh234
24. Perlas A, Davis L, Khan M, Mitsakakis N, Chan VW. Gastric sonography in the fasted surgical patient: a prospective descriptive study. Anesth Analg. 2011 Jul;113(1):93-7. https://doi.org/10.1213/ANE.0b013e31821b98c0
25. Perlas A, Mitsakakis N, Liu L, Cino M, Haldipur N, Davis L, Cubillos J, Chan V. Validation of a mathematical model for ultrasound assessment of gastric volume by gastroscopic examination. Anesth Analg. 2013 Feb;116(2):357-63. https://doi.org/10.1213/ANE.0b013e318274fc19
26. Schmitz A, Schmidt AR, Buehler PK, Schraner T, Frühauf M, Weiss M, Klaghofer R, Kellenberger CJ. Gastric ultrasound as a preoperative bedside test for residual gastric contents volume in children. Paediatr Anaesth. 2016 Dec;26(12):1157-1164. https://doi.org/10.1111/pan.12993
27. I-AIM framework for point-of-care gastric ultrasound. A. Perlas; P. Van de Putte; P. Van Houwe.
28. Perlas A, Davis L, Khan M, Mitsakakis N, Chan VW. Gastric sonography in the fasted surgical patient: a prospective descriptive study. Anesth Analg. 2011 Jul;113(1):93-7. https://doi.org/10.1213/ANE.0b013e31821b98c0
29. Perlas A, Mitsakakis N, Liu L, Cino M, Haldipur N, Davis L, Cubillos J, Chan V. Validation of a mathematical model for ultrasound assessment of gastric volume by gastroscopic examination. Anesth Analg. 2013 Feb;116(2):357-63. https://doi.org/10.1213/ANE.0b013e318274fc19

Document Type : Original Article, Doi: https://doi.org/10.33762/bsurg.2024.144977.1066

30. Bouvet L, Mazoit JX, Chassard D, Allaouchiche B, Boselli E, Benhamou D. Clinical assessment of the ultrasonographic measurement of antral area for estimating preoperative gastric content and volume. Anesthesiology. 2011 May;114(5):1086-92. https://doi.org/10.1097/ALN.0b013e31820dee48
31. Perlas A, Mitsakakis N, Liu L, Cino M, Haldipur N, Davis L, Cubillos J, Chan V. Validation of a mathematical model for ultrasound assessment of gastric volume by gastroscopic examination. Anesth Analg. 2013 Feb;116(2):357-63. https://doi.org/10.1213/ANE.0b013e318274fc19
32. Arzola C, Carvalho JC, Cubillos J, Ye XY, Perlas A. Anesthesiologists' learning curves for bedside qualitative ultrasound assessment of gastric content: a cohort study. Can J Anaesth. 2013 Aug;60(8):771-9. https://doi.org/10.1007/s12630-013-9974-y
33. Bouvet L, Desgranges FP, Aubergy C, Boselli E, Dupont G, Allaouchiche B, Chassard D. Prevalence and factors predictive of full stomach in elective and emergency surgical patients: a prospective cohort study. Br J Anaesth. 2017 Mar 1;118(3):372-379. https://doi.org/10.1093/bja/aew462
34. Segura-Grau E, Segura-Grau A, Ara Jo R, Payeras G, Cabral J, Afreixo V. Reinforcing the valuable role of gastric ultrasound for volume and content assessment: an observational study. Braz J Anesthesiol. 2022 Nov-Dec;72(6):749-756. https://doi.org/10.1016/j.bjane.2021.07.008
35. Mohammad Khalil A, Gaber Ragab S, Makram Botros J, Ali Abd-Aal H, Labib Boules M. Gastric Residual Volume Assessment by Gastric Ultrasound in Fasting Obese Patients: A Comparative Study. Anesth Pain Med. 2021 Feb 3;11(1):e109732. https://doi.org/10.5812/aapm.109732

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Data collection and analysis 3
Responsibility for statistical analysis 1
Writing the article 1,2,3
Critical review, 1, 2,4
Final approval of the article 1,2,3,4
Each author believes that the manuscript represents honest work and certifies that the article is original, is not under consideration by any other journal, and has not been previously published.
Availability of Data and Material: The corresponding author is prompt to supply datasets generated during and/or analyzed during the current study on wise request.

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