International Journal of Biomedicine 15(3) (2025) 535-539
http://dx.doi.org/10.21103/Article15(3)_OA13

INTERNATIONAL JOURNAL OF BIOMEDICINE

ORIGINAL ARTICLE

Radiology

Sonographic Evaluation of Gallbladder Distension Based on Interval Fasting Hours: A Prospective Study

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Abstract

The primary objective of this study was to systematically investigate the relationship between gallbladder (GB) distension and fasting duration (FD) by measuring the length and width of the gallbladder.

Methods and Results: A total of 30 healthy adult male volunteers (mean age: 23 ± 0.20 years; mean BMI: 23.16 ± 1.89 kg/m²) were recruited through convenience sampling. Participants were stratified into three groups based on their FD: Group A (n=10) with FD of 8 hours, Group B (n=10) with FD of 6 hours, and Group C (n=10) with FD of 4 hours. Each participant underwent a standardized GB ultrasound scan, during which the size and characteristics of the GB were measured in both transverse and longitudinal planes.

Longitudinal GB size increased significantly with FD (P=0.016): 46.84±8.83 mm (4 hours), 54.82±11.93 mm (6 hours), and 59.63±6.37 mm (8 hours). The transverse size showed no significant difference (P=0.193): 19.42±4.60 mm (4 hours), 3.48±5.35 mm (6 hours), and 22.56±5.27 mm (8 hours). GB wall thickness did not differ significantly across the three time points (P=0.766): 0.14±0.97 mm (4 hours), 0.22±0.57 mm (6 hours), and 0.42±1.03 mm (8 hours). The GB neck was visualized in 40% of cases at 4 hours and 100% at 6 and 8 hours. Cystic duct visualization showed no significant difference (P=0.585), with rates of 40%, 60%, and 60% at 4, 6, and 8 hours, respectively.

Conclusion: Fasting for four hours can provide adequate GB visualization in most healthy individuals, with no significant issues evaluating the wall, cystic duct, or lumen. Prolonged fasting durations may improve the visualization of the GB neck, although they are not always necessary. Standardizing the fasting duration to four hours may optimize workflow while preserving diagnostic quality in routine practice.(**International Journal of Biomedicine. 2025;15(3):535-539.**)

Keywords: gallbladder distension • fasting duration • ultrasound visualization

For citation: Alsaadi M. Sonographic Evaluation of Gallbladder Distension Based on Interval Fasting Hours: A Prospective Study. International Journal of Biomedicine. 2025;15(3):535-539. doi:10.21103/Article15(3)_OA13

Introduction

Ultrasound is deemed the first-line investigation for the initial assessment of the gallbladder (GB) due to its ability to provide substantial information about anatomy and the appearance of pathology with high sensitivity.[1] An essential prerequisite for optimal sonographic visualization of the GB is adequate distension, typically achieved through a fasting period that allows bile to accumulate within the GB lumen.[2] A well-distended GB offers enhanced acoustic contrast, more precise visualization of the GB wall, and improved detection of intraluminal abnormalities such as sludge, gallstones, polyps, and wall thickening.[3]

Although current clinical practice generally recommends fasting 6 to 8 hours before GB sonography, there is significant variability in the literature regarding the minimum effective fasting duration (FD) necessary for optimal GB distension.[4] Excessively prolonged fasting may lead to dehydration-related changes or paradoxical contraction due to the influence of hormones such as cholecystokinin. In contrast, inadequate fasting may result in suboptimal imaging and the potential for missed pathology.[5,6] Furthermore, prolonged fasting may present clinical challenges for specific populations. Diabetic patients are at risk of hypoglycemia due to delayed meals or

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insulin administration, which can lead to serious complications during extended fasting.[7]

Similarly, individuals with chronic illnesses often require timely morning medications, such as antihypertensives, antiepileptics, or cardiac drugs, which are usually taken with food. Delaying these medications to accommodate long fasting periods for imaging may compromise treatment adherence and metabolic control.[8] Therefore, standardizing a minimum FD that ensures adequate GB distension without compromising diagnostic accuracy is essential for enhancing the reliability and efficiency of ultrasound evaluations while also minimizing potential health risks in vulnerable patient groups.[9]

The primary objective of this study was to systematically investigate the relationship between GB distension and FD by measuring the length and width of the GB. By evaluating GB dimensions at various fasting intervals, this study aims to determine the minimum fasting period necessary for adequate visualization and diagnostic assessment of the GB. Addressing this knowledge gap may enhance sonographic protocols, reduce unnecessary imaging delays, and optimize the diagnostic efficacy of abdominal ultrasound in clinical practice.

Materials and Methods

Study Design

This study utilized a prospective observational design to assess the effect of varying fasting intervals on GB distension using ultrasound. It was a quantitative investigation conducted at the ultrasound diagnostic unit. The aim was to observe and compare sonographic GB distension patterns among healthy fasting participants for different durations. To reduce bias, all participants underwent their first ultrasound scan as part of this study, thereby minimizing the influence of prior imaging or known clinical conditions. Furthermore, the principal investigator was blinded to the duration of fasting.

A total of 30 healthy adult volunteers were recruited through convenience sampling. Participants were stratified into three groups based on their FD: Group A (n=10) with FD of 8 hours, Group B (n=10) with FD of 6 hours, and Group C (n=10) with FD of 4 hours. Each participant underwent a standardized GB ultrasound scan, during which the size and characteristics of the GB were measured in both transverse and longitudinal planes. The inclusion criteria were healthy adult university faculty members or students, the ability and willingness to fast as instructed, and the provision of written informed consent. The exclusion criteria were age under 18, inability to provide informed consent, history of GB disease or abdominal surgery. The sample size was determined based on prior studies detecting a 10% difference in GB size with 80% power (α=0.05).

Ultrasound Technique and Data Collection

Ultrasound examinations were conducted using a Hitachi EUB-405 ultrasound system (Hitachi Medical, Tokyo, Japan), equipped with a 1–5 MHz curvilinear transducer. Scans were performed in the supine, left lateral decubitus, and sitting positions to evaluate the GB under various postural conditions. Each scan was performed by the principal investigator, who has more than 15 years of experience in ultrasound. Measurements were taken at the largest visualized dimensions in both planes.

The following parameters were assessed: GB size in transverse and longitudinal dimensions, GB wall thickness in both planes, appearance of the cystic duct, and the morphology of the GB neck. All scans were conducted in the morning to minimize circadian variability. Participants were instructed not to consume food or caloric beverages during the fasting period. Data collection was completed within one week to ensure consistency in environmental and procedural conditions.

Statistical Analysis

Data were analysed using IBM SPSS Statistics (Version 28). Descriptive statistics (mean ± SD) summarised continuous variables. One-way ANOVA with Tukey's post-hoc test compared GB sizes and wall thickness across fasting groups. Paired t-tests assessed differences in GB dimensions between body positions. Chi-square or Fisher's exact tests evaluated categorical outcomes (neck/cystic duct visualisation). Effect sizes (eta-squared for ANOVA, Cohen's d for t-tests) were calculated. A *P*-value of <0.05 indicated statistical significance.

Results

The study included 30 male participants (mean age: 23 ± 0.20 years; mean BMI: 23.16 ± 1.89 kg/m²). Longitudinal GB size increased significantly with FD (F (2,27) = 5.12, P = 0.016, η^2 =0.27). Post-hoc tests revealed significant differences between 4 and 8 hours (P = 0.012, Cohen's d = 1.36) but not between 4 and 6 hours (P = 0.184) or 6 and 8 hours (P = 0.573). The mean longitudinal sizes were 46.84±8.83 mm (4 hours), 54.82±11.93 mm (6 hours), and 59.63±6.37 mm (8 hours). The transverse size showed no significant difference (F (2,27) = 1.78, P = 0.193, η^2 = 0.12), with means of 19.42±4.60 mm, 23.48±5.35 mm, and 22.56±5.27 mm, respectively (Table 1, Figure 1).

Table 1.

GB size (mm) at different fasting durations (longitudinal and transverse views).

Measurement	FD	n	Mean	SD	95% CI	*P*-value
Longitudinal Size	4 hours	10	46.84	8.83	(40.53, 53.15)	0.016
	6 hours	10	54.82	11.93	(46.29, 63.35)	
	8 hours	10	59.63	6.37	(55.07, 64.19)	
Transverse Size	4 hours	10	19.42	4.60	(16.13, 22.71)	0.193
	6 hours	10	23.48	5.35	(19.65, 27.31)	
	8 hours	10	22.56	5.27	(18.79, 26.33)	

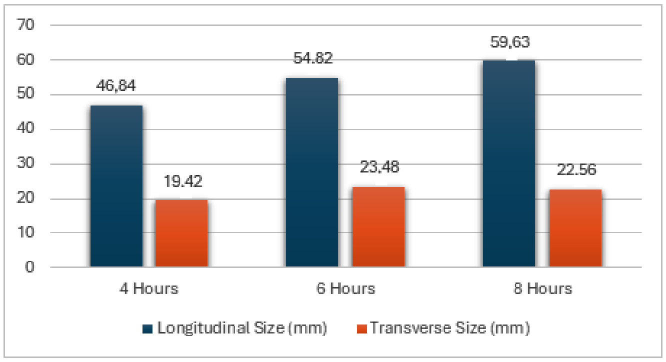

Figure 1. *Longitudinal and transverse GB sizes, annotating the significant difference between 4 and 8 hours for longitudinal size.*

GB wall thickness did not differ significantly across the three time points (F (2,27) = 0.27, $P = 0.766$, $\eta^2 = 0.02$): 0.14±0.97 mm (4 hours), 0.22±0.57 mm (6 hours), and 0.42±1.03 mm (8 hours) (Table 2).

Table 2.
GB wall thickness (mm) at different fasting durations.

FD	n	Mean	SD	95% CI	*P*-value
4 hours	10	0.14	0.97	(-0.55, 0.83)	0.766
6 hours	10	0.22	0.57	(-0.19, 0.63)	
8 hours	10	0.42	1.03	(-0.31, 1.15)	

GB neck visualization improved significantly with extended fasting ($P = 0.001$). The GB neck was visualized in 40% of cases at 4 hours and 100% at 6 and 8 hours. Cystic duct visualization showed no significant difference ($P = 0.585$), with rates of 40%, 60%, and 60% at 4, 6, and 8 hours, respectively (Table 3, Figure 2).

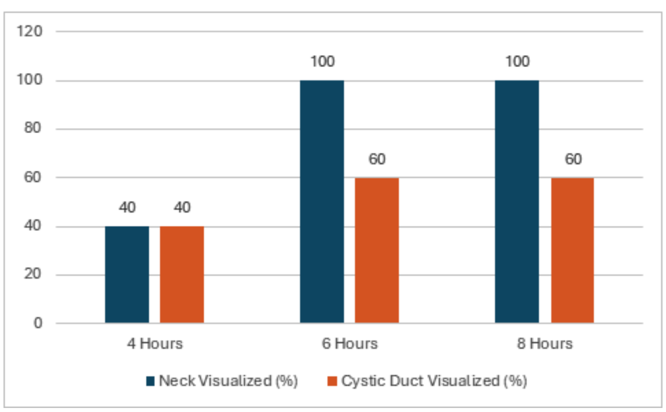

Figure 2. *Visualization rates for the neck and cystic duct, with an annotation highlighting the significant difference in neck visualisation and corrected data.*

Table 3.
The visualization of GB structures (neck and cystic duct) at different FD.

Structure	Visualization	4 Hours	6 Hours	8 Hours	*P*-value
Neck	Yes	4 (40%)	10 (100%)	10 (100%)	0.001
	No	6 (60%)	0 (0%)	0 (0%)	
Cystic Duct	Yes	4 (40%)	6 (60%)	6 (60%)	0.585
	No	6 (60%)	4 (40%)	4 (40%)	

Discussion

In clinical practice, ultrasound remains one of the primary imaging modalities for evaluating gallbladder anatomy and pathology due to its safety profile, non-invasiveness, cost-effectiveness, and high diagnostic sensitivity for detecting gallstones, cholecystitis, polyps, and neoplasms.[10,11] However, the accuracy of sonographic assessment is highly dependent on appropriate gallbladder distension, which is best achieved through adequate fasting.[12]A fully distended gallbladder enables better delineation of the gallbladder wall, more precise visualization of the cystic duct and neck, and improved acoustic contrast for identifying intraluminal or mural abnormalities. This underlines the importance of fasting status as a key pre-analytical variable in the quality of gallbladder ultrasound examinations. Many ultrasound departments instruct their patients to come fasting for such examinations, sometimes for as long as 12 hours, assuming that the gallbladder would otherwise be contracted and difficult to assess, and that fasting patients will have less gas in the duodenum & colon.[13]

The gallbladder functions as a bile reservoir during fasting, regulated by the reduced secretion of cholecystokinin.[5,14,15] This peptide hormone prompts gallbladder contractions and the release of bile after meals. The Society and College of Radiographers and the British Medical Ultrasound Society state patients should fast for 6 hours before their scan to optimise their ultrasound scan.[16] The conventionally recommended fasting times (a minimum of two hours after consumption of clear fluid, six hours after consumption of a light meal, and eight hours after consumption of fried or fatty food.[17] Nonetheless, new research challenges the need for this fasting procedure in healthy individuals without diagnosed biliary issues, indicating that practical imaging might be possible without extended fasting.

Furthermore, certain patient groups may not tolerate prolonged fasting. For instance, diabetic patients might be at risk of low blood sugar if they fast for too long, and others may need to take medications with food in the morning [7,8]. Therefore, it is essential to determine the shortest fasting period necessary to obtain clear, diagnostic images of the gallbladder, especially for these patients. [18]

Our prospective observational study addressed this knowledge gap by comparing the gallbladder sonographic appearance after 4, 6, and 8 hours of fasting in healthy volunteers. The findings indicate that even a 4-hour fasting period was generally sufficient for adequate gallbladder distension, facilitating the visualization of the lumen, wall, and most surrounding anatomical structures. Although gallbladder distension was predictably more pronounced in the 6- and 8-hour groups, the clinical and sonographic significance of this difference was limited, as most examinations in the 4-hour group still met diagnostic standards.

A key observation in our study was that the gallbladder neck was less frequently and less distinctly visualized in the four-hour fasting group, and this difference was statistically significant compared to longer fasting durations. The gallbladder neck can be a site of clinical importance, particularly for detecting impacted stones or subtle anatomical anomalies. Inadequate visualization of this region may result in missed pathology in symptomatic patients, although this risk is likely lower in a healthy screening population like ours.

Conversely, there was no statistically significant difference among the three fasting groups in terms of gallbladder wall thickness or cystic duct appearance, suggesting that these features are less influenced by the degree of distension. Wall thickness remained within normal ranges for all participants, confirming that moderate fasting allows for an accurate assessment of this parameter, which is essential for diagnosing cholecystitis or gallbladder wall edema.

Our study contributes to the expanding body of literature advocating a more flexible approach to fasting protocols before ultrasound. In clinical settings where patient safety, comfort, or logistics may necessitate shorter fasting durations—such as pediatric, geriatric, diabetic, or emergency cases—our findings support the practicality of scanning after a 4-hour fast with acceptable diagnostic quality, provided that clinical suspicion is low and image quality is deemed adequate by the sonographer.

However, the results of this study should be viewed with consideration of its limitations. Our sample included only healthy subjects without any recorded hepatobiliary diseases, and all scans were performed under controlled conditions using standardized equipment and skilled sonographers. Caution is necessary when applying these results to patients with altered gallbladder function, including those with diabetes, biliary dyskinesia, or a history of cholecystitis. Future research involving a more diverse patient population and objective quality assessments of the images would strengthen these findings.

Future Recommendations

Larger-scale studies involving various age groups are highly recommended to validate and apply these findings. Future research should evaluate the diagnostic impact of abbreviated fasting periods in symptomatic patients. Standardized fasting protocols should be developed based on patient risk profiles and imaging requirements.

Conclusion

This study demonstrates that fasting for four hours can provide adequate gallbladder visualization in most healthy individuals, with no significant issues evaluating the wall, cystic duct, or lumen. However, the visibility of the neck is slightly diminished. These results suggest revising fasting guidelines for specific patient groups and enhancing ultrasound scheduling flexibility while preserving diagnostic effectiveness.

Competing Interests

The authors declare that they have no competing interests.

Sources of Funding

The authors extend their appreciation to Prince Sattam bin Abdulaziz University for funding this research work through the project number (PSAU/2024/03/31973).

Ethical Considerations

The study protocol was reviewed and approved by the Prince Sattam bin Abdulaziz University Ethics Committee.All participants provided written informed consent.

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