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Article

The Effect of Simethicone Administration Timing and Pre-Examination Modified Position Changes on Defoaming Efficacy During Gastroscopy

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Abstract

Background: Gastroscopy remains a cornerstone in diagnosing upper gastrointestinal tract diseases. However, intragastric foam impairs mucosal visualization, potentially reducing early lesion detection rate. Simethicone is widely used as a defoaming agent in clinical practice, yet its efficacy may be influenced by administration methods and timing. **Aims:** To investigate the effects of body position changes and waiting time after simethicone administration on defoaming efficacy during gastroscopy. **Methods:** A prospective study was conducted at the Endoscopy center, Hospital, Macau, Jul–Aug 2024. Patients scheduled for gastroscopy were divided into a control group (supine position) and an experimental group (body position changes). The experimental group was further subdivided into Group A (traditional sequence: right lateral, supine, left lateral positions, each maintained for 5 min) and Group B (modified sequence: right lateral position for 5 min, followed by alternating head-down/head-up positions for 1 min each, then left lateral position for 3–5 min). The control group was additionally stratified by waiting time post-simethicone administration (≤ 15 min, 16–30 min, ≥ 31 min). The primary outcome was mucosal clarity score assessed with the KUO score; secondary outcomes included examination time and polyp detection rate. **Results:** Group B demonstrated significantly better mucosal clarity compared with both the control group and Group A ($P < 0.001$). Among control patients, those examined within 15 minutes post-medication showed superior defoaming efficacy compared with those examined after 31 minutes ($P < 0.05$). Examination times were comparable across groups. No significant association was observed between mucosal clarity and polyp detection rates. **Conclusions:** Combining optimized body position changes with appropriate timing post-simethicone administration significantly improves mucosal visualization during gastroscopy. This strategy provides a simple, cost-effective approach to enhance diagnostic performance and is recommended for broader clinical application.

Keywords: simethicone; gastroscopy; body position changes; waiting time; mucosal clarity; defoaming efficacy

1. Introduction

Gastroscopy remains the gold standard for direct visualization and diagnosis of upper gastrointestinal tract diseases. By enabling detailed assessment of the gastric mucosa and structural abnormalities, gastroscopy plays a critical role in the early detection and management of gastrointestinal pathology ¹. According to the latest estimates by the International Agency for Research on Cancer (IARC), approximately 358,000 new cases of gastric cancer were reported in China in 2022, accounting for 37.0% of the global burden. Gastric cancer remains the third leading cause of cancer-related mortality in China, with 260,000 deaths, representing 39.5% of global gastric cancer mortality². These figures underscore the urgent need for improving early detection methods and optimizing gastroscopic procedures.

Previous studies have demonstrated that gastroscopy significantly enhances the detection rate of early gastric cancer, with more than 50% of lesions identified among asymptomatic patients³. However, the presence of foam and mucus on the gastric mucosal surface can obstruct the endoscopic visual field, leading to missed diagnoses of small lesions and delays in treatment⁴⁻⁶. The generation of foam and mucus is primarily influenced by the physicochemical properties of gastric secretions, intestinal gases, and residual food material. Excessive intragastric foam significantly impairs endoscopic visualization quality, thereby compromising diagnostic yield⁷.

To address this, various defoaming agents, including dimethicone powder, simethicone, streptokinase, and chymotrypsin, have been utilized to improve mucosal clarity⁸⁻¹⁰. Among these, simethicone is widely adopted due to its established safety and efficacy profile. By reducing surface tension and promoting the collapse of gas bubbles, simethicone facilitates clearer mucosal visualization. Nevertheless, clinical experience indicates that the effectiveness of simethicone may vary depending on dosage, concentration, and the method and timing of administration. In certain cases, even standard doses fail to prevent the need for repeated water flushing during gastroscopy to clear residual foam¹¹.

Background

Despite the widespread use of defoaming agents, achieving complete elimination of intragastric foam remains challenging. Increasing the dosage may impose additional financial burden and does not guarantee uniform efficacy, particularly in the presence of variable gastric conditions such as acid secretion, mucosal injury, or *Helicobacter pylori* (Hp) infection¹². Moreover, excessive intraprocedural flushing and suctioning not only prolong examination time but also increase patient discomfort, further emphasizing the need for improved defoaming strategies.

In addition to pharmacological interventions, mechanical strategies such as patient body position changes have been proposed to enhance the intragastric distribution of defoaming agents. A study by Zhong Xiaoqin et al.¹³ demonstrated that alternating among left lateral, right lateral, and supine positions significantly enhanced the defoaming effect of dimethicone powder. These findings suggest that combining pharmacologic defoaming agents with dynamic body positioning may be an effective strategy to optimize mucosal clarity.

Clinical practice guidelines, such as the group standard "Gastrointestinal Preparation Before Digestive Endoscopy" issued by the Shanghai Nursing Association, recommend limiting the total volume of mucolytic and defoaming agents to 50 mL to prevent excessive gastric fluid accumulation and advise frequent position changes after administration¹⁴. Furthermore, a network meta-analysis by Wu Bingbing et al.¹⁵ encompassing 13 randomized controlled trials and 11,978 patients found that specific positional interventions—particularly sequential right lateral, supine, and left lateral positioning—could significantly improve mucosal cleanliness and reduce examination time.

Despite these advances, the European Society of Gastrointestinal Endoscopy (ESGE) and American guidelines for upper gastrointestinal endoscopy have not yet provided standardized recommendations regarding patient preparation with simethicone or positional changes¹⁶⁻¹⁷. A study by Cao et al. further highlighted the lack of globally standardized premedication protocols for upper gastrointestinal endoscopy¹⁸.

Timing of simethicone administration may also critically impact its efficacy. Some studies have indicated that defoaming agents achieve peak effectiveness within approximately 20 minutes of ingestion^{4, 6}. Wu Yunlin reported that administering simethicone combined with lidocaine gel orally 20 minutes before gastroscopy enhanced visualization particularly in the gastric body and fundus, facilitating improved morphological assessment and biopsy accuracy. Similarly, Liu Xiaoling et al. proposed that administration of dimethicone powder 15–30 minutes prior to gastroscopy optimizes its defoaming effect, although coordinating such timing in busy clinical settings may pose practical challenges¹⁹.

At the Endoscopy Center of Macao, patients are currently instructed to ingest 45 mL of simethicone solution before gastroscopy without strict timing requirements and remain in the supine

position during the waiting period. However, endoscopists have frequently reported suboptimal defoaming outcomes, often necessitating additional flushing maneuvers during the procedure to maintain an adequate visual field.

2. Materials and Methods

2.1. Aims and Objective

The primary objectives of this study are to investigate the effects of postural changes on gastric mucosa cleanliness and the impact of improved gastric mucosa cleanliness on examination time. The secondary objective is to understand the influence of gastric mucosa cleanliness on the detection rate of gastric polyps.

2.2. Methods

Study Design and Population

Patients were assigned to groups based on their examination order and preparation protocol: Control Group: Patients remained in a conventional supine position following simethicone ingestion; Experimental Group: Patients underwent a sequence of body position changes after simethicone administration. The experimental group was further subdivided into Group A (Traditional Position Changes) and Group B (Modified Position Changes). The Group A Patients adopted the right lateral position for five minutes, then the supine position for five minutes, followed by the left lateral position for another five minutes. The Group B Patients maintained a right lateral position for five minutes, then shifted to a supine position with a head-down tilt for one minute, followed by a head-up tilt for one minute, and finally moved to a left lateral position for 3–5 minutes. The speed and angle of the patient's position change remain consistent.

Additionally, based on findings from a recent multicenter, single-blind, randomized controlled trial by Beaufort IN et al.²⁰, which recommended simethicone administration 10–20 minutes prior to gastroscopy, patients in the control group were stratified according to the waiting time after medication into Group a: Examination performed within 15 minutes after simethicone ingestion; Group b: Examination performed between 16–30 minutes after ingestion; Group c: Examination performed more than 31 minutes after ingestion.

2.3. Instrument with Validity and Reliability

2.3.1. Mucosal Clarity Assessment

Mucosal clarity was independently assessed by two experienced endoscopists using the KUO scoring scale²¹, evaluating four anatomical sites: the gastric body, fundus, antrum, and duodenum. The KUO scoring criteria were defined as: **Score 1**: Clear view; no mucus or foam adhering to mucosa; **Score 2**: Relatively clear view; minimal mucus or foam present, not interfering with observation; **Score 3**: Blurred view; substantial mucus or foam requiring flushing (flushing volume ≤ 30 mL); **Score 4**: Very blurred view; extensive mucus or foam requiring significant flushing (flushing volume > 30 mL). Lower scores indicated better mucosal clarity. Scores of 1–2 were classified as “qualified” (clean mucosa), whereas scores of 3–4 were considered “unqualified” (unclean mucosa). The medication process was completed and recorded by the dispensing nurse. Gastroscopy was performed by two experienced endoscopists, who jointly scored the cleanliness of the gastric mucosal surface of the patients after learning and training on the KUO scoring scale.

2.3.2. Examination Time

Examination time was recorded for each patient, defined as the duration from endoscope insertion to procedure completion, measured in minutes.

2.3.3. Polyp Detection Rate

The polyp detection rate was also documented to explore any potential association between mucosal clarity and lesion detection.

2.4. Criteria

This prospective observational study was conducted at the Endoscopy Center of Hospital, Macau, from July to August 2024. Patients scheduled for diagnostic gastroscopy were consecutively recruited based on the following inclusion criteria: full consciousness and cooperation during the procedure; no contraindications to gastroscopy; no known coagulation disorders; no history of allergy to the administered medications. The sample size was based on all eligible patients undergoing gastroscopy during the study period.

2.5. Sampling

This study adopted a population-based screening approach, investigating all examinees during a two-month study period.

2.6. Ethics

The study protocol was reviewed and approved by the Scientific Research Ethics Committee of "REDACTED", Macau (Ethics Approval Number: KWH 2025-017). The personnel have access to the random allocation sequence. The authors is responsible for the storage and integrity of the data. The data of the participants in this study will be well preserved. Personal data will be marked with numbers. If the examiner feels uncomfortable, he/she can withdraw at any time without interfering with the original examination.

2.7. Statistical Analysis

Data analysis was performed using SPSS version 27.0. Continuous variables were expressed as mean $\pm$ standard deviation (SD) and compared using analysis of variance (ANOVA). Categorical variables were analyzed using the Chi-square (χ^2) test. A two-tailed P-value of <0.05 was considered statistically significant.

2.8. Reagents and Equipment

All enrolled patients were instructed to orally ingest 40 mg of simethicone (dissolved in 45 mL distilled water; simethicone concentration: 20 mg/mL; product specification: 300 mL/bottle) prior to the gastroscopy. Gastrosopies were performed using Olympus 290/1500 series endoscopes.

3. Results

3.1. Patient Demographics

A total of 651 eligible patients were enrolled, with 308 patients assigned to the control group and 343 patients to the experimental group (154 in Experimental Group A and 189 in Experimental Group B). The patients' ages ranged from 9 to 91 years, with a mean age of 53.8 ± 13.92 years. Baseline characteristics were comparable between groups: 53.92 ± 13.71 years in the control group versus 53.69 ± 14.13 years in the experimental group ($P = 0.835$). 114 males and 194 females in the control group; 129 males and 214 females in the experimental group ($P = 0.875$). (Table 1)

Table 1. Demographic Characteristics (N = 651).

	Control Group (n = 308)	Experimental Group (n = 343)	P-value
Age (years)	53.92 ± 13.71	53.69 ± 14.13	0.835
Gender			0.875
- Male	#####	129	
- Female	#####	214	

3.2. Mucosal Clarity and Examination Time

3.2.1. KUO Score Analysis

Significant differences in mucosal clarity were observed among groups ($\chi^2 = 40.032$, $P < 0.001$). Pairwise comparisons revealed: Experimental Group A vs. Control: significant improvement ($\chi^2 = 18.312$, $P < 0.001$); Experimental Group B vs. Control: significant improvement ($\chi^2 = 33.312$, $P < 0.001$); No significant difference between Experimental Groups A and B ($\chi^2 = 2.427$, $P = 0.489$). Patients achieving qualified mucosal clarity (KUO scores 1–2) were: Control Group 39.6%; Experimental Group A 58.4%; Experimental Group B 65.6%.

Thus, body position changes, especially the modified sequence in Group B, markedly improved mucosal clarity (Table 2).

Table 2. Statistical Analysis of KUO Scores and Examination Time.

Variable	Control Group (n = 308)	Experimental Group (n = 343)		χ^2/F	P-value
		Experimental Group A (n = 154)	Experimental Group B (n = 189)		
KUO Score				40.032#	<0.001#*
Score 1	21 (6.8%)	20 (13.0%)	27 (14.3%)	18.312+	<0.001+*
Score 2	101 (32.8%)	70 (45.5%)	97 (51.3%)	33.312++	<0.001+++
Score 3	147 (47.7%)	57 (37.0%)	55 (29.1%)	2.427+++	0.489+++
Score 4	39 (12.7%)	7 (4.5%)	10 (5.3%)		
Examination Time (min)	13.37 ± 6.30	13.45 ± 6.85	14.21 ± 7.65	0.942	0.390

= Chi-square test comparing control vs combined experimental groups. + = Chi-square test comparing control vs Experimental Group A. ++ = Chi-square test comparing control vs Experimental Group B. +++ = Chi-square test comparing Experimental Group A vs B. * = $P < 0.05$, statistically significant.

3.2.2. Examination Time Analysis

The mean examination times were similar across groups: Control Group 13.37 ± 6.30 minutes; Group A 13.45 ± 6.85 minutes; Group B 14.21 ± 7.65 minutes.

No statistically significant differences were found ($F = 0.942$, $P = 0.390$), suggesting that body position changes did not prolong the procedure duration. (Table 2)

3.2.3. Cleanliness Achievement Rates

The cleanliness qualification rate (KUO scores 1–2) was significantly higher in the experimental group (62.4%) compared with the control group (39.9%) ($\chi^2 = 33.721$, $P < 0.001$). Subgroup analysis

showed: Group A 58.4% clean; Group B 65.6% clean. Both significantly superior to the control group ($\chi^2 = 35.466$, $P < 0.001$).

Although Group B achieved a slightly higher qualification rate than Group A, the difference between the two experimental groups was not statistically significant (Table 3).

Table 3. Cleanliness Achievement Rate Analysis Across Groups.

Variable	Control Group (n = 308)	Experimental Group (n = 343)		χ^2	P-value
		Experimental Group A (n = 154)	Experimental Group B (n = 189)		
Cleanliness				33.721#	<0.001*
Clean	122 (39.9%)	90 (58.4%)	124 (65.6%)	35.466+	<0.001**
Unclean	186 (60.4%)	64 (41.6%)	65 (34.4%)		

Chi-square test comparing control group vs combined experimental groups (A + B). + Chi-square test comparing control group, Experimental Group A, and Experimental Group B. * Statistically significant ($P < 0.05$)

3.2.4. Impact of Simethicone Intake Timing

Within the control group, the timing of gastroscopy after simethicone administration significantly affected mucosal cleanliness ($\chi^2 = 10.088$, $P = 0.006$).0–15 minutes group: 59.0% clean (23/39); 16–30 minutes group: 44.3% clean (39/88); 30 minutes group: 33.1% clean (60/181).Pairwise comparisons indicated that gastroscopies performed within 15 minutes achieved significantly better mucosal clarity compared to examinations performed after 30 minutes ($\chi^2 = 9.109$, $P = 0.003$). No significant difference was observed between the 0–15 minutes and 16–30 minutes groups (Table 4).

Table 4. Analysis of the Relationship Between Simethicone Intake Timing and Gastric Mucosal Cleanliness in the Control Group.

Variable	0–15 minutes (n = 39)	16–30 minutes (n = 88)	>30 minutes (n = 181)	χ^2	P-value
Cleanliness				10.088	0.006*
Clean	23 (59.0%)	39 (44.3%)	60 (33.1%)	9.109+	0.003**
Unclean	16 (41.0%)	49 (55.7%)	121 (66.9%)		

+ = Chi-square test comparing 0–15 minutes vs >30 minutes. * = $P < 0.05$, indicating statistical significance.

3.2.5. Relationship Between Mucosal Cleanliness and Polyp Detection

There was no statistically significant relationship between mucosal cleanliness and polyp detection rate ($\chi^2 = 0.286$, $P = 0.592$). Polyp detection rates were similar between patients with qualified mucosal cleanliness (52.8%) and those with unqualified cleanliness (47.2%) (Table 5).

Table 5. Relationship Between Gastric Mucosal Cleanliness Scores and Polyp Detection Rates.

Variable	Qualified Cleanliness	Unqualified Cleanliness	χ^2	P
Polyp Detection	151 (52.8%)	135 (47.2%)	0.286	0.592

No Polyp Detected	185 (50.7%)	180 (49.3%)
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4. Discussion

This study systematically evaluated the impact of simethicone administration timing and post-medication body positioning on mucosal clarity during gastroscopy. The findings demonstrated that combining optimized body positioning with appropriate medication timing significantly enhances mucosal visualization without prolonging examination duration, offering a practical, cost-effective strategy to improve the quality of gastroscopic examinations.

The enhancement of mucosal clarity observed with body position changes highlights the importance of gravitational redistribution in facilitating the uniform spread of defoaming agents within the gastric lumen. Patients who underwent sequential positional adjustments achieved significantly higher rates of qualified mucosal clarity compared with those who remained in a supine position, consistent with prior studies showing that dynamic positioning aids foam dispersion across gastric regions^{13,15}. Particularly, the modified positioning protocol—incorporating a right lateral position, head-down and head-up tilts, followed by a left lateral position—demonstrated superior outcomes. This suggests that relatively simple refinements to conventional positioning strategies can yield meaningful clinical improvements.

Beyond physical positioning, the timing of simethicone administration also emerged as a critical factor. Patients who underwent gastroscopy within 15 minutes of simethicone ingestion achieved significantly better mucosal clarity than those examined after 30 minutes. These results likely reflect the pharmacodynamic properties of simethicone, which acts promptly to reduce surface tension and promote gas bubble collapse²². Delays beyond 30 minutes may allow enzymatic degradation or dilution of simethicone by gastric secretions, diminishing its effectiveness²³. Operationally, maintaining a tight window between medication administration and gastroscopy enhances consistency in defoaming efficacy, streamlines clinical workflow, and reduces patient discomfort caused by prolonged waiting.

Importantly, neither body position changes nor optimized timing negatively impacted overall examination time. This finding alleviates concerns that pre-procedure interventions might compromise procedural efficiency, a crucial consideration in high-volume endoscopy centers. In alignment with previous reports by Chen Xinbo et al.²⁴, reduced reliance on intra-procedural water flushing was associated with improved operator focus, potentially enhancing the detection of subtle or early gastric lesions.

From a clinical implementation perspective, the integration of modified positioning and early examination post-simethicone ingestion requires minimal additional resources and staff training²⁵. These interventions can be easily standardized across diverse healthcare settings, representing low-cost yet impactful optimizations of pre-endoscopic preparation.

Nonetheless, this study has certain limitations. The single-center design and relatively homogeneous patient cohort may limit the generalizability of the findings. Future multicenter trials, encompassing a broader demographic and geographic diversity, are warranted to confirm the robustness of these observations. Expansion of the sample size would enhance statistical power, and longitudinal follow-up studies could elucidate whether improved mucosal clarity translates into better diagnostic yield, earlier detection of neoplastic lesions, and improved clinical outcomes.

Moreover, further research should explore the reproducibility of these findings across various endoscopic systems and operator experience levels. Given the growing role of artificial intelligence in endoscopic imaging, incorporating AI-assisted mucosal cleanliness scoring may enhance the objectivity and reproducibility of future analyses, further strengthening the evidence base for optimized pre-gastroscopy protocols.

5. Conclusions

This study represents the first investigation in the Macau region to specifically evaluate strategies for optimizing gastric mucosal clarity during gastroscopy. The findings demonstrate that implementing modified body positioning combined with timely simethicone administration significantly improves defoaming efficacy without extending examination time.

Based on these results, it is recommended that patients undergo gastroscopy within 15–20 minutes after simethicone ingestion, accompanied by a modified body positioning sequence: right lateral position, followed by alternating head-down and head-up tilts, and concluding with a left lateral position. This approach substantially improves mucosal visibility, facilitating more accurate and efficient endoscopic examinations.

From a broader clinical perspective, the adoption of these interventions could enhance diagnostic performance, reduce missed lesions, particularly in early gastric cancer detection, and improve patient comfort by minimizing the need for excessive irrigation. Moreover, optimizing pre-procedure preparation may contribute to more efficient resource utilization and workflow management in busy endoscopy centers.

Future research should focus on multicenter validation of these findings and assess their applicability across various clinical environments and patient populations to support the development of standardized global protocols for gastroscopy preparation.

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Informed consent statement: Informed consent was obtained from all subjects involved in the study.

Data availability statement: Data supporting these findings are available within the article or upon request.

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