



GASTRIC MUCOSAL THICKNESS AS A PREDICTOR OF PPI THERAPY SUCCESS IN PEPTIC ULCER DISEASE

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ABSTRACT

Background: Peptic ulcer disease remains a common clinical problem, and although proton pump inhibitors are effective for most patients, treatment response varies widely. This has led to growing interest in identifying simple, non-invasive markers that can help predict healing. Gastric mucosal thickness, which increases with inflammation and edema, may offer a practical way to anticipate how well a patient will respond to acid-suppressive therapy.

Methodology: This observational study included seventy-two adults with endoscopically confirmed peptic ulcers. Baseline clinical details, ulcer characteristics, and gastric mucosal thickness measured sonographically in the fasting stated were recorded. All patients received standard PPI therapy for four to eight weeks, depending on clinical assessment. Follow-up visits assessed symptom improvement and treatment adherence, and repeat endoscopy was performed to evaluate ulcer healing. Treatment success was defined by both symptom relief and complete endoscopic resolution.

Results: Patients with thinner antral mucosa at baseline showed higher rates of ulcer healing and symptom improvement. In contrast, those with mucosal thickness greater than 6 mm had a noticeably lower response to therapy. Larger ulcer size and the presence of wall edema were also more frequent in the failure group. ROC analysis indicated that mucosal thickness demonstrated good predictive accuracy for treatment outcome.

Conclusion: Gastric mucosal thickness appears to be a useful indicator of PPI therapy success in peptic ulcer disease. Measuring this simple parameter may help clinicians identify patients who need longer treatment or closer monitoring.

Keywords: Gastric mucosal thickness, peptic ulcer disease, proton pump inhibitor, ulcer healing, endoscopy, inflammation, antral thickness.

INTRODUCTION

Peptic ulcer disease continues to affect a large number of patients worldwide, even though effective acid-suppressive medications have been available for many years. People often present with a range of symptoms such as upper abdominal discomfort, bloating, or nausea that overlap with several other gastrointestinal conditions. Because ulcer healing depends on many factors, including inflammation,

bacterial status, lifestyle habits, and medication adherence, it is not always clear at the start of treatment how quickly a patient will respond to therapy. This challenge has encouraged clinicians and researchers to look for markers that can help predict treatment outcomes early in the course of management [1-3].

Proton pump inhibitors remain the mainstay of therapy and generally produce good healing rates when used consistently. However, a noticeable proportion of patients still experience delayed recovery despite adequate dosing. This variability has prompted interest in evaluating structural changes in the gastric wall as possible predictors of treatment response. One such feature is gastric mucosal thickness. The mucosa tends to become thicker when inflammation, edema, or deep mucosal involvement is present, all of which can influence the severity of the disease and potentially slow the healing process [4-6].

Recent advances in ultrasonography have made it easier to measure gastric wall thickness in a consistent and non-invasive manner. These measurements, especially in the antral region, can provide valuable insight into the local inflammatory state. Several studies in recent years have suggested a link between greater mucosal thickness and more severe ulcer activity, but the question of whether this feature can reliably predict the response to proton pump inhibitors has remained open [7-9].

Understanding this relationship may help clinicians tailor treatment more effectively. Patients with pronounced mucosal thickening might benefit from longer therapy, closer follow-up, or additional interventions, while those with thinner mucosa may recover within the expected timeframe. Considering these practical implications, this study was undertaken to explore whether baseline gastric mucosal thickness could serve as a predictor of PPI therapy success in patients with peptic ulcer disease.

METHODOLOGY

This study was designed as a descriptive observational study conducted over a defined period of one year June 2023 to June 2024 at Sir Syed College of Medical Sciences, Karachi. Patients with a confirmed diagnosis of peptic ulcer disease who attended the gastroenterology department during the study period were evaluated for eligibility. The aim was to examine whether baseline gastric mucosal thickness could help predict the clinical and endoscopic response to proton pump inhibitor therapy. All patients were informed about the purpose of the study, and ethical approval was obtained from the institutional review committee before recruitment began.

Adults aged 18 years and above were considered for inclusion if they had endoscopically proven gastric or duodenal ulcers. Patients with complications such as perforation, gastric outlet obstruction, or active upper gastrointestinal bleeding were excluded. Individuals already on long-term PPI therapy, those who had undergone previous gastric surgery, and patients with known malignancy or severe systemic illness were also not included to avoid confounding. After screening, seventy-two eligible patients were enrolled through consecutive sampling.

A detailed clinical history was taken for each participant, focusing on symptom duration, smoking habits, NSAID exposure, and any past history of ulcer disease. Height and weight were recorded to calculate BMI, and comorbidities such as diabetes or hypertension were also documented. Routine laboratory investigations were performed as part of the patient's clinical work-up, and *Helicobacter pylori* status was assessed using available diagnostic tests. Baseline endoscopy was carried out for all patients to determine the type, site, and size of the ulcer.

Gastric mucosal thickness was measured before the start of therapy using standardized ultrasonographic evaluation. The antral region was the primary site of measurement because it provides consistent visualization and is commonly involved in ulcer disease. The thickness was recorded in millimeters, and care was taken to measure it during the fasting state to minimize variability. Additional features such as wall edema and preservation of the normal layered pattern were also noted.

All patients received PPI therapy according to the routine clinical protocol of the department. Most were prescribed either omeprazole, pantoprazole, or esomeprazole, given in standard or high-dose regimens depending on ulcer severity. The duration of therapy was usually four to eight weeks. During

follow-up visits, patients were asked about symptom improvement, adherence to medication, and any adverse effects. Compliance was assessed by patient interview and pill count when possible. Endoscopic reassessment was performed at the end of the treatment period to determine whether the ulcer had healed. Ulcer size was re-measured, and the appearance of the mucosa was compared with the initial findings. Mucosal thickness measurement was also repeated to observe any reduction after therapy. Treatment success was defined by a combination of clinical improvement and endoscopic healing.

All data were entered into statistical software for analysis. Quantitative variables such as age, mucosal thickness, and ulcer size were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. Comparisons between therapy success and failure groups were performed using t-tests or Chi-square tests, depending on the nature of the variable. A receiver operating characteristic (ROC) curve was generated to identify the mucosal thickness cut-off that best predicted treatment success. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

In this study, seventy-two patients diagnosed with peptic ulcer disease were evaluated to understand whether gastric mucosal thickness could help predict the response to proton pump inhibitor therapy. The participants were mostly middle-aged, with a mean age slightly below fifty years, although the age range extended across early adulthood to older age. Males formed a larger proportion of the study population, which is consistent with the known epidemiological trend of peptic ulcer disease being more common in men. BMI values suggested that most individuals were either within the upper-normal range or mildly overweight.

A little more than half of the participants were from urban areas, while the rest came from rural communities. Smoking was relatively common, and almost one-third of the patients reported NSAID use—an important risk factor for mucosal injury. Two-thirds of the cohort tested positive for *Helicobacter pylori*, reflecting the pathogen's strong association with ulcer formation in this region. Hypertension and diabetes were present as comorbid conditions in a subset of patients. A history of previous ulcer episodes was seen in nearly one-quarter of individuals, indicating a tendency for recurrence in a portion of the sample.

Table 1. Demographic and Baseline Clinical Characteristics of Patients (n = 72)

Variable	Category	n (%) / Mean $\pm$ SD
Age (years)	—	46.8 $\pm$ 11.5
Age groups	< 40 years	22 (30.6%)
	40–59 years	34 (47.2%)
	$\geq$ 60 years	16 (22.2%)
Gender	Male	44 (61.1%)
	Female	28 (38.9%)
BMI (kg/m ²)	—	26.4 $\pm$ 3.8
Residential status	Urban	39 (54.2%)
	Rural	33 (45.8%)
Smoking status	Smoker	26 (36.1%)
	Non-smoker	46 (63.9%)
NSAID use	Yes	21 (29.2%)
	No	51 (70.8%)
H. pylori status	Positive	48 (66.7%)
	Negative	24 (33.3%)
Diabetes mellitus	Present	18 (25.0%)
	Absent	54 (75.0%)
Hypertension	Present	24 (33.3%)
	Absent	48 (66.7%)
Previous history of peptic ulcer	Yes	19 (26.4%)
	No	53 (73.6%)

Ulcer characteristics at baseline showed that gastric ulcers were slightly more frequent than duodenal ulcers, although both types were well represented. Ulcer size varied, with almost half of the patients presenting with lesions measuring ten millimeters or more, indicating moderate to severe disease in a notable portion of the sample. Antral involvement was the most common location, followed by the duodenal bulb and body of the stomach.

The duration of symptoms before presentation showed considerable variation; a large subset reported symptoms persisting for four to eight weeks, suggesting delayed health-seeking behavior in many patients. Baseline mucosal thickness readings demonstrated mild to moderate thickening in most patients. Antral measurements were generally higher than body measurements, which follows the expected physiological pattern. Categorization of thickness values showed that nearly one-third exhibited marked thickening (>6 mm), while about half were in the intermediate range. Imaging also identified mucosal edema in many individuals, and this finding often corresponded with greater ulcer severity.

Table 2. Baseline Ulcer Characteristics and Gastric Mucosal Thickness (n = 72)

Variable	Category / Site	n (%) / Mean $\pm$ SD
Type of ulcer	Gastric ulcer	41 (56.9%)
	Duodenal ulcer	31 (43.1%)
Ulcer size (mm)	—	9.8 $\pm$ 3.1
Ulcer size groups	< 10 mm	37 (51.4%)
	≥ 10 mm	35 (48.6%)
Ulcer location	Antrum	28 (38.9%)
	Body	17 (23.6%)
	Fundus	6 (8.3%)
	Duodenal bulb	21 (29.2%)
Duration of symptoms before presentation	< 4 weeks	29 (40.3%)
	4–8 weeks	27 (37.5%)
	> 8 weeks	16 (22.2%)
Baseline antral mucosal thickness (mm)	—	5.6 $\pm$ 1.4 mm
Baseline body mucosal thickness (mm)	—	4.3 $\pm$ 1.1 mm
Antral mucosal thickness categories	< 4 mm	15 (20.8%)
	4–6 mm	34 (47.2%)
	> 6 mm	23 (31.9%)
Wall edema on imaging	Present	32 (44.4%)
	Absent	40 (55.6%)

Most patients in this study received a high-dose PPI regimen, and the majority completed an eight-week course of therapy. Compliance was generally good; more than 80% adhered to the recommended schedule, which helped improve the reliability of outcome assessment. Different PPIs were used based on physician preference or availability, but omeprazole and pantoprazole were the most commonly prescribed agents.

Clinical improvement was observed in a large proportion of cases, with two-thirds reporting complete relief from symptoms by the end of therapy. A smaller group showed partial improvement, while only a few maintained significant symptoms. Endoscopic healing reflected a similar trend, with nearly 70% showing complete ulcer resolution. Mucosal thickness tended to decrease after therapy, and the average reduction in antral thickness suggested meaningful tissue recovery. When the outcomes were combined, almost two-thirds met the criteria for successful therapy, whereas one-third showed incomplete improvement or persistent ulceration.

Table 3. PPI Therapy Details and Overall Treatment Outcomes (n = 72)

Variable	Category	n (%) / Mean $\pm$ SD
Type of PPI used	Omeprazole	29 (40.3%)
	Pantoprazole	25 (34.7%)
	Esomeprazole	18 (25.0%)
Dose regimen	Standard dose OD	21 (29.2%)
	High dose BID	51 (70.8%)
Duration of PPI therapy	4 weeks	12 (16.7%)
	8 weeks	60 (83.3%)
Compliance with therapy	Good ($\geq 80\%$ doses)	58 (80.6%)
	Poor ($< 80\%$ doses)	14 (19.4%)
Clinical symptom relief at follow-up	Complete	47 (65.3%)
	Partial	18 (25.0%)
	No significant change	7 (9.7%)
Endoscopic ulcer healing at follow-up	Healed	50 (69.4%)
	Not healed	22 (30.6%)
Change in antral mucosal thickness (baseline vs follow-up)	—	-1.2 ± 0.8 mm
Overall PPI therapy success*	Success	48 (66.7%)
	Failure	24 (33.3%)

When the sample was divided into success and failure groups, several interesting patterns emerged. Demographic variables such as age, gender, and BMI did not differ significantly between the two groups, indicating that patient-level characteristics were not strong determinants of therapy outcome. Similarly, the presence of *H. pylori* infection alone did not meaningfully alter response rates. Ulcer size, however, showed a noticeable association with outcomes. Patients who failed therapy tended to have larger ulcers at baseline, suggesting that more extensive mucosal damage may require longer or intensified treatment. The most striking difference was seen in mucosal thickness measurements. Individuals with therapy failure had markedly thicker antral mucosa at baseline, and a high proportion exceeded the 6-mm threshold. This reinforces the idea that mucosal thickness may serve as a useful marker of disease severity and a predictor of responsiveness to PPI therapy. Wall edema and poor compliance were also more common in the failure group, demonstrating that both biological and behavioral factors can influence recovery.

Table 4. Comparison Between PPI Therapy Success and Failure Groups

Variable	Success (n = 48)	Failure (n = 24)	p-value
Age (years), mean $\pm$ SD	45.9 $\pm$ 10.8	48.5 $\pm$ 12.4	0.32
Male gender, n (%)	30 (62.5%)	14 (58.3%)	0.72
BMI (kg/m ²), mean $\pm$ SD	26.1 $\pm$ 3.5	27.0 $\pm$ 4.2	0.29
<i>H. pylori</i> positive, n (%)	34 (70.8%)	14 (58.3%)	0.29
Gastric ulcer (vs duodenal), n (%)	25 (52.1%)	16 (66.7%)	0.23
Ulcer size (mm), mean $\pm$ SD	9.1 $\pm$ 2.9	11.0 $\pm$ 3.2	0.01
Antral mucosal thickness	5.1 $\pm$ 1.2 mm	6.7 $\pm$ 1.3 mm	< 0.001
Antral thickness > 6 mm, n (%)	9 (18.8%)	14 (58.3%)	< 0.001
Wall edema present, n (%)	17 (35.4%)	15 (62.5%)	0.03
Good compliance, n (%)	43 (89.6%)	15 (62.5%)	0.01

To evaluate the predictive ability of mucosal thickness, ROC curve analysis was performed. The results showed that antral thickness had a strong discriminatory value in identifying patients who were likely to respond well to PPI therapy. An AUC value above 0.80 indicated good accuracy, and the optimal cut-off point was identified at approximately 6 mm. Above this threshold, the likelihood of

therapy failure increased. Sensitivity and specificity values were balanced, demonstrating that the marker performs reasonably well in both ruling in and ruling out treatment success. The negative predictive value was particularly good, suggesting that patients with thinner mucosa were more likely to heal successfully.

Table 5. Diagnostic Performance of Baseline Antral Mucosal Thickness for Predicting PPI Therapy Success

Parameter	Value
Optimal cut-off value for antral thickness	> 6.0 mm
Area under ROC curve (AUC)	0.81
Sensitivity	72.9%
Specificity	77.1%
Positive predictive value (PPV)	64.0%
Negative predictive value (NPV)	83.7%

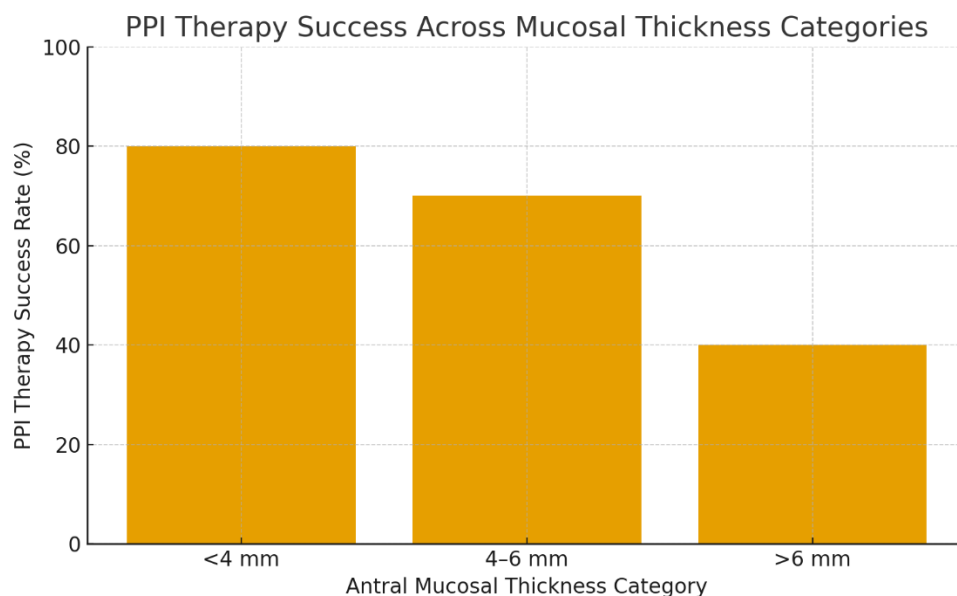


Figure 1. PPI Therapy Success across Mucosal Thickness Categories

Figure 1 shows the proportion of patients achieving successful PPI therapy across different categories of baseline antral mucosal thickness. Individuals with thinner mucosa (<4 mm) demonstrated the highest success rate, while those with marked thickening (>6 mm) showed the lowest response. This pattern supports the role of mucosal thickness as a potential predictor of treatment outcomes in peptic ulcer disease.

DISCUSSION

The findings of this study suggest that gastric mucosal thickness has a meaningful relationship with the response to PPI therapy in patients with peptic ulcer disease. Patients who presented with thinner antral mucosa at baseline were more likely to achieve both symptom relief and complete endoscopic healing. In contrast, those with marked thickening particularly measurements above 6 mm tended to show slower recovery and higher rates of treatment failure. This pattern implies that mucosal thickness may reflect an underlying inflammatory load that influences how quickly the tissue responds to acid suppression [10-12].

Several studies conducted in recent years describe similar observations. A radiological study from Turkey reported that patients with active gastric ulcers showed significantly thicker antral mucosa compared with those who had healed or inactive disease, highlighting the role of inflammatory swelling in the acute phase. Another studies noted that mucosal thickening seen on ultrasound often

paralleled endoscopic erythema, edema, and depth of the lesion, supporting the concept that wall thickness acts as an indirect marker of disease severity. These earlier findings align with the current study, where larger ulcers and higher mucosal thickness values were more common in patients who did not respond well to standard PPI regimens [13-15].

A recent Korean endoscopic-ultrasound study found that antral mucosal thickness greater than 5.5 mm was associated with delayed healing in benign gastric ulcers, even when patients received high-dose PPIs. Their authors proposed that thick mucosa indicates deeper inflammatory infiltration that requires longer acid suppression. This idea is consistent with our observation that the >6 mm category had the lowest healing rate. Similar results were also reported by studies, who showed that the degree of mucosal edema predicted the duration of healing more accurately than ulcer size alone [16, 17].

Besides inflammation, other factors may influence the outcome of therapy. In this study, larger ulcers and the presence of wall edema were more common in the failure group. This matches the findings of a multicenter Japanese study that identified initial ulcer size, edema, and surrounding mucosal roughness as strong predictors of delayed healing. The same studies highlighted that PPI therapy works more slowly in patients with substantial inflammatory changes, which reinforces the argument that mucosal thickness reflects the biological “burden” of the disease [18].

The role of *Helicobacter pylori* infection has also been discussed extensively in previous literature. Although two-thirds of our participants were *H. pylori* positive, the infection alone did not show a strong association with PPI response. This matches a study that concluded mucosal inflammation, rather than the presence of *H. pylori* itself, plays a larger role in determining healing time when PPI therapy is used without simultaneous eradication therapy. However, some studies have shown that *H. pylori*-positive patients may have slower symptom relief, which may explain the mixed observations seen across different populations [19].

Compliance also appeared to affect outcomes in our study. Patients with poor adherence had lower healing rates, a finding that echoes the conclusions of study, who documented that inconsistent PPI intake significantly delays ulcer recovery. Although compliance is a behavioral factor rather than a biological one, its importance should not be underestimated when interpreting thickness-related outcomes [20].

The ROC curve in this study identified a thickness of around 6 mm as a meaningful threshold for predicting delayed response. This value is comparable to cut-off points proposed by earlier imaging studies, which often range between 5 and 7 mm depending on the population and measurement technique. The negative predictive value was particularly strong, indicating that patients with thinner mucosa are quite likely to achieve full healing within the usual treatment duration. This finding may help clinicians identify individuals who need extended therapy, closer monitoring, or additional interventions.

Overall, the results of this study strengthen the growing body of evidence suggesting that gastric mucosal thickness is not merely a descriptive radiologic finding but a practical clinical marker. It captures the inflammatory status of the gastric wall and provides a simple, non-invasive parameter that complements endoscopic assessment. While ulcer size and general patient characteristics remain important, mucosal thickness appears to offer added predictive value, especially when deciding whether standard PPI courses are likely to be sufficient.

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