

# A Comprehensive Review of 24-hour pH Monitoring in the Assessment of Pre- and Post-laparoscopic Fundoplication

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## ABSTRACT

This review addresses gastroesophageal reflux disease (GERD), a prevalent and challenging condition worldwide, focusing on the role of 24-hour pH monitoring in assessing pre- and post-laparoscopic fundoplication. Laparoscopic fundoplication reinforces the lower esophageal sphincter (LES) in GERD. The review analyzes 35 relevant studies, exploring pH monitoring's significance in patient selection, tailored surgical intervention, and postoperative evaluation. Pre-fundoplication pH monitoring establishes baseline acid exposure, aiding surgical decision-making. Post-fundoplication monitoring evaluates procedure effectiveness, revealing reduced acid exposure time (AET) and improved De Meester Score (DMS), indicating symptom relief. The review draws from diverse databases, emphasizing pH monitoring's clinical importance in GERD management. Despite various diagnostic tools, 24-hour pH monitoring remains the gold standard, enhancing personalized patient care. The review identifies gaps, emphasizing the need for further research in wireless pH monitoring and laparoscopic or robotic antireflux surgery. Overall, integrating 24-hour pH monitoring with laparoscopic fundoplication shows promise for improving outcomes, warranting future research for methodological refinements and technological advancements in GERD management.

**Keywords:** 24-hour pH monitoring, Future research, Laparoscopic fundoplication, Pre- and postoperative outcome.

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## INTRODUCTION

Gastroesophageal reflux disease (GERD) poses a global health challenge, affecting millions worldwide with an incidence of about 14%. Laparoscopic fundoplication has come out as the best surgical remedy to relieve the symptoms of GERD and prevent further complications. Accurate evaluation, particularly through 24-hour pH monitoring, plays a pivotal role in the success of this procedure. This diagnostic modality quantifies esophageal acid exposure, serving as the gold standard for GERD evaluation. The review aims to comprehensively evaluate the role of 24-hour pH monitoring before and after laparoscopic fundoplication, offering nuanced insights into patient selection, treatment decisions, and outcomes. The focus is on bridging knowledge gaps, analyzing the multifaceted aspects of pH monitoring, and addressing the evolving techniques in GERD management. This review emphasizes the vital role of 24-hour pH monitoring to improve patient care, various surgical interventions, and the diagnostic capabilities of laparoscopic fundoplication.

## MATERIALS

This review obtained data from 35 studies from diverse surgical and gastroenterology journals over the past 32 years. The article was predominantly conducted in hospital settings, with the main emphasis on the role of 24-hour pH monitoring in GERD patients pre- and post-fundoplication. The inclusion criteria ensured clinical applicability and relevance to GERD management. The selected studies varied in publication year, study design, sample sizes, and patient demographics, representing a wide range of geographical regions. Follow-ups up to 20 years after laparoscopic fundoplication, with preoperative and postoperative assessments using 24-hour pH monitoring and De Meester Score (DMS). Three types of pH monitoring devices were utilized, including ambulatory pH monitoring, a double intraluminal pH monitor (Mill-pH), and

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wireless pH monitoring. The systematic data extraction process focused on essential information, providing a comprehensive understanding of laparoscopic fundoplication's role in GERD management. The review offers clinicians and surgeons an overall view in this field.

## METHODS

Thorough literature searches were carried out methodically in surgical and gastroenterology journals, Google Scholar, Medline, and PubMed regarding 24-hour pH monitoring, laparoscopic fundoplication, and GERD.

The search used targeted keywords of pH monitoring, laparoscopic fundoplication, and GERD without data restriction. In line with the review objective, specific inclusion criteria focused on articles concerning 24-hour pH monitoring pre- and post-laparoscopic fundoplication, studies lacking relevant data, or studies not published in English.

The initial search yielded numerous articles, and after removing duplicates, titles and abstracts were reviewed for analysis. A total of 35 articles from gastroenterology and surgical journals were selected for detailed analysis. The extraction of data was thorough,

as were publication details, study characteristics, and specifics related to the methods and findings of 24-hour pH monitoring. The extracted data were structured for subsequent analysis.

The review covered three types of pH monitoring tools, i.e., 24-hour pH monitoring, multichannel intraluminal impedance pH monitor (MII-pH), and wireless capsule technology (Bravo). Ambulatory and MII-pH are invasive procedures involving catheter insertion, while wireless capsule technology is non-invasive, adhering to the esophageal mucosal wall. Fasting before pH monitoring is recommended, with 24-hour pH monitoring extensively used worldwide and being relatively cheaper and more effective.

Post-laparoscopic fundoplication, fasting is advised for 24-hour pH monitoring to assess surgical effectiveness. Patient adherence to specific fasting instructions is crucial. Proton pump inhibitors (PPI), H<sub>2</sub> antagonists, and antacids should be withdrawn a week prior to the pH monitoring procedure.

Laparoscopic fundoplication, including Nissen fundoplication (360-degree wrap), Toupet fundoplication (270-degree wrap), and partial fundoplication are commonly performed for GERD. The primary goal is to strengthen the lower esophageal sphincter (LES), which gets weaker in GERD.

While the reviewed literature offers valuable insights into 24-hour pH monitoring in GERD management, examination in depth reveals variations in protocols and criteria. This proves there should be uniformity for standardization and patient-oriented care, future research is needed in this field. The introduction of modern technology, for example, wireless pH monitoring, may be a game changer in the future.

## RESULTS

Extensive detailed analysis of 35 studies from gastroenterology and surgical journals demonstrates diverse 24-hour pH monitoring findings before laparoscopic fundoplication operation in GERD patients. Heterogeneity existed; some showed a severe type of acid reflux (pH <4) and prolonged acidic periods, while others showed weak acidic or non-acidic reflux. This highlights the individualized nature of GERD profiles.

Most reviewed literature emphasized the vital role of 24-hour pH monitoring prior to laparoscopic fundoplication to ascertain the diagnosis of GERD and evaluate the extent and severity of acid reflux. Across the 35 articles, centers consistently performed pre- and postoperative pH monitoring. Multichannel intraluminal impedance pH monitor monitoring was predominant, with consistent pre-operative pH findings confirming the GERD diagnosis. Postoperative monitoring consistently demonstrated reduced acid exposure time (AET) and reflux episodes, validating laparoscopic fundoplication's efficacy in controlling acid reflux.

Clinicians generally agree that GERD patients with esophagitis proven by gastroscopy and a good response to PPIs may not need preoperative pH monitoring. Abnormal acid exposure (>5 minutes) predicts positive outcomes after anti-reflux surgery. Recommendations include preoperative pH monitoring for patients without esophagitis and a good PPI response or those with symptoms unresponsive to high-dose PPI.

A detailed comparative analysis of pre- and postoperative pH monitoring consistently showed substantial postoperative improvements in acid reflux parameters following laparoscopic fundoplication. Studies demonstrated better outcomes with laparoscopic fundoplication compared to PPI for GERD patients.<sup>1</sup>

Studies on 24-hour pH monitoring device efficacy concluded that ambulatory monitoring is a sensitive and specific diagnostic tool. Wireless pH monitoring, although promising, requires standardization. Long-term follow-ups affirmed laparoscopic fundoplication's effectiveness, emphasizing its role in managing GERD by reducing acid reflux and improving esophageal motility.<sup>2</sup>

Comparisons between laparoscopic Nissen fundoplication and other types consistently favored Nissen for symptom control and acid reflux reduction. Predictors of positive outcomes included male gender, BMI <30, typical reflux symptoms, abnormal acidic reflux (pH <4), and positive GERD symptoms.<sup>3</sup>

The compiled results highlight laparoscopic fundoplication's effectiveness in managing GERD by reducing acid reflux, with variability in preoperative pH monitoring emphasizing the need for personalized approaches. While short-term success is reported, long-term outcomes and potential complications require further investigation. Standardization of pH monitoring protocols is crucial for reliable and comparable results in future research and clinical practice. The review underscores laparoscopic fundoplication's efficacy but emphasizes the individualized nature of GERD and the importance of consistent pH monitoring techniques.

## DISCUSSION

Gastroesophageal reflux disease, characterized by acid reflux into the lower esophagus, poses significant health risks. Laparoscopic fundoplication is a common surgical intervention, but its impact on 24-hour pH monitoring outcomes varies. Preoperative monitoring helps identify suitable candidates by assessing acid reflux severity. Postoperatively, it gauges surgical success, though it may miss non-acidic reflux events.

Though 24-hour pH monitoring is the real benchmark, the gold standard, impedance (MII-pH), and wireless devices offer extended monitoring, but with limitations. Laparoscopic Nissen fundoplication is favored for controlling acid reflux, outperforming Toupet and partial fundoplication in pH monitoring. Long-term studies confirm its sustained benefits.<sup>4</sup>

Ambulatory pH monitoring aids GERD management, especially in assessing laparoscopic fundoplication efficacy. Persistent postoperative acid reflux prompts adjustments, potentially involving medication changes or revision surgery. Monitoring also detects complications like gas bloating early.<sup>5</sup>

Comparative studies highlight the Laparoscopic Nissen Fundoplication superior control over acid reflux, correlating with symptom relief. Toupet and partial fundoplication are viable alternatives, but they may not match Nissen's outcomes. The improvement in motility favors partial fundoplication. Laparoscopic anti-reflux surgery also excels at laryngopharyngeal reflux.<sup>6</sup>

Individual factors influence outcomes; patients with typical GERD symptoms benefit more. Gas-related symptoms may vary, with Nissen causing a transient problem. pH monitoring, though sensitive, may yield false positives or false negatives. Combining it with impedance improves accuracy.<sup>7</sup>

Multivariate analyses suggest pH monitoring strongly predicts Nissen fundoplication outcomes. Despite negative endoscopies, pH monitoring detects pathological reflux. Specialists should interpret results, guiding individualized treatment decisions and realistic postoperative expectations.<sup>8</sup>

Future research should explore advanced surgical techniques, individualized patient criteria, and ancillary testing. For children, newer pH monitoring approaches are crucial. Wireless devices

and smart implants may enhance monitoring accuracy. Research should focus on the early detection and prevention of long-term complications.<sup>9</sup>

Alternative techniques like Transoral Incisionless Endoscopic Fundoplication and the LINX device show promise but need validation. Robotic-assisted fundoplication, though precise, is expensive and in its early phases. Personalized care, involving shared decision-making, is essential for optimal outcomes.<sup>10</sup>

In conclusion, 24-hour pH monitoring remains an integral part of GERD management, guiding pre- and post-laparoscopic fundoplication decisions. The evolving field emphasizes informed decision-making for improved patient care.<sup>11–16</sup>

## CONCLUSION

This review highlights the vital role of 24-hour pH monitoring in managing GERD and evaluating laparoscopic fundoplication. Pre-operative pH monitoring is essential for GERD diagnosis and selecting suitable surgical candidates. Postoperative monitoring consistently demonstrates laparoscopic fundoplication's efficacy in reducing acid reflux and improving symptoms, with laparoscopic Nissen fundoplication often favored. While traditional 24-hour pH monitoring is the gold standard, impedance MII-pH monitoring excels in comprehensive diagnostics, detecting non-acidic and weakly acidic reflux events. Standardized guidelines for patient selection and postoperative monitoring are crucial to reducing literature variations, and future research should focus on long-term outcomes and quality of life assessment. Despite study limitations, laparoscopic fundoplication remains a significant intervention for GERD, emphasizing the importance of personalized care and comprehensive guidelines for optimal outcomes.

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