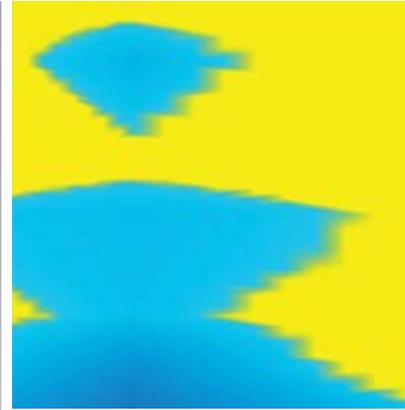


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# Mucosal Integrity Studies

Annotated Bibliography



# Mucosal Integrity (MI) Studies: Annotated Bibliography

## **Development and Validation of a Mucosal Impedance Contour Analysis System to Distinguish Esophageal Disorders.**

Patel DA, Higginbotham T, Slaughter JC, Aslam M, Yuksel E, Katzka D, Gyawali CP, Mashi M, Pandolfino J, Vaezi MF. *Gastroenterology* (2019), doi: <https://doi.org/10.1053/j.gastro.2019.01.253>.

### **Discussion**

We have developed a novel balloon mucosal impedance device for detecting esophageal mucosal changes due to chronic GERD or EoE instantly during routine endoscopy potentially obviating the need for 24 to 48 hour ambulatory wireless pH monitoring or esophageal biopsies for histopathology. This can help reduce diagnostic and treatment latency and might allow for monitoring disease activity over time.

## **Mucosal Impedance Measurements Differentiate Pediatric Patients With Active Versus Inactive Eosinophilic Esophagitis.**

Lowry MA, Vaezi MF, Correa H, Higginbotham T, Slaughter JC, Acra S.

*J Pediatr Gastroenterol Nutr.* 2018 Aug;67(2):198-203. doi: 10.1097/MPG.0000000000001943.

### **Discussion**

This preliminary study suggests MI measurements may provide the ability to immediately detect inflammation in patients with active EoE during an esophagogastroduodenoscopy, guiding immediate therapeutic decisions. This needs to be confirmed by further, prospective studies. The natural progression of this concept is to create a minimally invasive device that does not require endoscopic placement and addresses potential confounders such as intraluminal fluid/air, an effort currently ongoing. If successful, it has the potential to significantly reduce risks and costs of repeated endoscopic and histological evaluation.

## **Comparison of Mucosal Impedance Measurements Throughout the Esophagus and Mucosaleosinophil Counts in Endoscopic Biopsy Specimens in Eosinophilic Esophagitis.**

Alexander JA, Ravi K, Geno DM, Tholen CJ, Higginbotham TC, Wildhorn S, Camilleri M, Vaezi MF, Katzka DA. *Gastrointest Endosc.* 2018 Aug 24. pii: S0016-5107(18)32989-4. doi: 10.1016/j.gie.2018.08.031. [Epub ahead of print]

### **Discussion**

This study demonstrates that determination of a maximum number of eos/HPF on routine endoscopic biopsy samples as a determinant of EoE activity is inaccurate in reflecting the degree of abnormal esophageal impedance. Furthermore, this pattern of altered esophageal epithelial permeability can be seen as a uniform field defect or can be heterogeneously distributed with patchy areas of altered abnormality. This data further emphasizes the likely need for additional criteria that rely on a more comprehensive measurement of whole organ dysfunction to more accurately assess mucosal activity in EoE. Whether this method of measuring esophageal impedance becomes a therapeutic endpoint in EoE needs to be determined.

## **Mucosal Impedance: A New Approach to Diagnosing Gastroesophageal Reflux Disease and Eosinophilic Esophagitis.**

Barrett C, Choksi Y, Vaezi MF.

*Curr Gastroenterol Rep.* 2018 Jun 9;20(7):33. doi: 10.1007/s11894-018-0639-4. Review.

### **Discussion**

Mucosal impedance testing represents a major advancement in the diagnosis of gastroesophageal reflux disease and eosinophilic esophagitis. MI values correlate with the degree of spongiosis in both disease processes, affording the ability to both diagnose and distinguish between the two diseases during endoscopy. MI has also demonstrated utility in monitoring response to treatment in both diseases. Advantages of MI are that testing can be performed quickly in 2 minutes, allowing for the measurement of esophageal epithelial integrity in real time during endoscopy. It provides a measurement of disease chronicity rather than the 1- or 2-day reflection of reflux activity as provided by current ambulatory pH monitoring. The sensitivity and specificity in diagnosis is similar to that of pre-existing modalities but eliminates the need for hours of prolonged, uncomfortable ambulatory monitoring in GERD diagnosis and the need for multiple invasive biopsies to monitor response to treatment in EoE, saving both time and money. Future studies evaluating surgical outcomes are planned to assess whether mucosal impedance measurements can be used to predict patients' potential responses to fundoplication. Future studies will also investigate whether MI can be used to distinguish EoE and GERD from other pan-esophageal disorders, such as lichen planus and lymphocytic esophagitis.

## **Esophageal Mucosal Impedance Patterns Discriminate Patients With Eosinophilic Esophagitis From Patients With GERD.**

Choksi Y, Lal P, Slaughter JC, Sharda R, Parnell J, Higginbotham T, Vaezi MF.

*Clin Gastroenterol Hepatol.* 2018 May;16(5):664-671.e1. doi: 10.1016/j.cgh.2017.12.020. Epub 2017 Dec 14.

### **Discussion**

This study is the first of its kind to show that physician interpretation of the MI pattern can diagnose EoE accurately. More importantly, patients with EoE have increasing cost burden, and repeated endoscopy with biopsies are a significant part of that cost. With that in mind, the potential to assess disease activity over time without biopsies could prove useful clinically especially since symptoms have low accuracy in predicting endoscopic or histologic remission. Our current studies are focusing on whether mucosal impedance can assess disease activity over time, and whether MI can be used as a therapeutic endpoint to guide duration of therapy. Our group is hopeful that the continued study of mucosal impedance will significantly aid in the long-term management of difficult EoE patients.

## **Utility of Esophageal Mucosal Impedance as a Diagnostic Test for Esophageal Disease.**

Patel DA, Vaezi MF.

*Curr Opin Gastroenterol.* 2017 Jul;33(4):277-284. doi: 10.1097/MOG.0000000000000367. Review.

### **Conclusions**

MI-pH was an important advancement in diagnostic testing for PPI-refractory GERD with its ability to detect both acidic and nonacidic reflux, but the clinical relevance of isolated nonacidic reflux is still unclear. The recent conceptual change in the fundamental purpose of impedance testing from being an indirect, intraluminal measurement of reflux events to being a direct marker of mucosal integrity has been a major advance in esophageal disease testing. MI correlates with the degree of DIS, can distinguish among esophageal disorders instantly during endoscopy, and can monitor treatment response in GERD and EoE. Further studies evaluating the role of MI in predicting fundoplication outcomes and utility in other gastrointestinal diseases are under way.

### **Recent Advances in Diagnostic Testing for Gastroesophageal Reflux Disease.**

Naik RD, Vaezi MF.

Expert Rev Gastroenterol Hepatol.

2017 Jun;11(6):531-537. doi:

10.1080/17474124.2017.1309286. Epub 2017

Mar 27. Review.

#### **Expert Commentary**

Important advances in novel parameters in intraluminal impedance monitoring such as baseline impedance monitoring has created some insight into alternative diagnostic strategies in GERD. Recent advances in endoscopic assessment of esophageal epithelial integrity via mucosal impedance measurement is questioning the paradigm of prolonged ambulatory testing for GERD. The future of reflux diagnosis may very well be without the need for currently employed technologies and could be as simple as assessing changes in epithelia integrity as a surrogate marker for GERD. However, future studies must validate such an approach.

### **Esophageal Mucosal Impedance Pattern is Distinct in Patients With Extraesophageal Reflux Symptoms and Pathologic Acid Reflux.**

Kavitt RT, Lal P, Yuksel ES, Ates F, Slaughter JC, Garrett CG, Higginbotham T, Vaezi MF.

J Voice. 2017 May;31(3):347-351. doi: 10.1016/j.jvoice.2016.06.023. Epub 2016 Aug 3.

#### **Discussion**

In this novel prospective cohort study, we showed the clinical performance of an innovative MI measurement device in patients presenting with extraesophageal symptoms presumed reflux related. Important observations from our study include the findings that patients with EER and evidence of acid reflux have a lower MI than those without at 2 cm above the SCJ, with a trend at 5 cm and 10 cm as well. This finding was true despite endoscopic presence of erosive esophagitis. In those with nonerosive disease who had abnormal reflux by pH monitoring, MI values were similar to those with erosive esophagitis. This has important clinical relevance in that despite lack of obvious mucosal changes at endoscopy, MI can differentiate those with abnormal reflux pattern from those with normal reflux parameters. Thus, MI potentially can be a tool to assess presence of GERD in patients presenting with EER symptoms.

### **Mucosal Impedance: A New Way To Diagnose Reflux Disease and How It Could Change Your Practice.**

Michael F. Vaezi, MD, PhD, MSc, FACP1 and Yash Choksi, MD1.

Am J Gastroenterol 2017; 112:4–7; doi:10.1038/ajg.2016.513; published online 13 December 2016.

#### **Conclusions**

MI measures conductivity across the esophageal epithelium, correlates with level of DIS, can distinguish esophageal disorders, and can monitor treatment response in GERD and EoE. The ability of this new test to assess barrier function in real time in a way that adds little time to endoscopy and without discomfort to the patient is novel. At this time we have much to learn about its role in the management of the aforementioned esophageal disorders and are just beginning to assess its potential in other intestinal disorders. We have hopes that future designs will allow outpatient MI measurements similar to currently performed manometry. This will allow a more efficient and less costly means of monitoring treatment response in various esophageal and possibly non-esophageal diseases.

### **Diagnosing Gastroesophageal Reflux Disease With Endoscopic-guided Mucosal Impedance.**

Vaezi MF.

Gastroenterol Hepatol (N Y). 2016 Apr;12(4):266-8. No abstract available.

### **Endoscopic Mucosal Impedance Measurements Correlate With Eosinophilia and Dilatation of Intercellular Spaces in Patients With Eosinophilic Esophagitis.**

Katzka DA, Ravi K, Geno DM, Smyrk TC, Iyer PG, Alexander JA, Mabary JE, Camilleri M, Vaezi MF.

Clin Gastroenterol Hepatol. 2015 Jul;13(7):1242-1248.e1. doi: 10.1016/j.cgh.2014.12.032. Epub 2015 Jan 13.

#### **Discussion**

This study allows for identification of the association between site-specific esophageal eosinophilia, dilatation of intercellular spaces, and measurement of esophageal mucosal impedance in patients with active and inactive eosinophilic esophagitis when compared with controls. It reaffirms the patchy nature of eosinophilic esophagitis not only from a histologic perspective, but also a functional point of view. Our findings support the possibility that in vivo measurement of esophageal mucosal impedance may be an accurate means of assessing activity in a patient with EoE without the need for obtaining esophageal biopsy specimens.

### **Mucosal Impedance Discriminates GERD From Non-GERD Conditions.**

Ates F, Yuksel ES, Higginbotham T, Slaughter JC, Mabary J, Kavitt RT, Garrett CG, Francis D, Vaezi MF.

Gastroenterology. 2015 Feb;148(2):334-43. doi: 10.1053/j.gastro.2014.10.010. Epub 2014 Oct 16.

#### **Discussion**

We have developed a novel, minimally invasive, short-duration MI technique for detecting esophageal mucosal changes due to chronic GERD without the need for 24- to 48-hour ambulatory impedance pH catheter placement. Our data show (1) an innovative method for differentiating the mucosal pattern in GERD compared with non-GERD, (2) recovery of GERD-related MI changes with PPI therapy, (3) distinction of the MI pattern from EoE, and (4) favorable detection of GERD compared with pH monitoring. Taken together, our findings are encouraging steps forward in improving our ability to diagnose GERD. Future improvements in device design will likely reduce measurement variability, thus improving device sensitivity for GERD and paving the way for a new means of reflux-related diagnoses.

### **Use of Direct, Endoscopic-guided Measurements of Mucosal Impedance in Diagnosis of Gastroesophageal Reflux Disease.**

Saritas Yuksel E, Higginbotham T, Slaughter JC, Mabary J, Kavitt RT, Garrett CG, Vaezi MF.

Clin Gastroenterol Hepatol. 2012 Oct;10(10):1110-6. doi: 10.1016/j.cgh.2012.05.018. Epub 2012 May 27.

#### **Discussion**

We have developed a novel, minimally invasive, short-duration MI technique for detecting esophageal mucosal changes caused by chronic GERD without the need for 24- to 48-hour ambulatory impedance-pH catheter placement. Our encouraging data shows feasibility of the MI concept in providing an innovative method for differentiating the mucosal pattern in GERD compared with non-GERD.

# Innovations in Clinical Education

## Diversatek University Online

Our online training platform contains free content on esophageal and anorectal manometric studies, as well as impedance/pH reflux monitoring studies. Included are tutorials providing step-by-step guidance to develop skills in data acquisition, study review and report generation. Simply go to **DiversatekHealthcare.com** to request log-in information.

## Denver Training Center

Our Technical Research & Training Center offers a number of product training courses to provide clinical users with the knowledge and skills necessary to effectively acquire and analyze High Resolution Impedance manometry studies, impedance/pH reflux monitoring studies and High Resolution Anorectal manometry studies. Email us at **clinicaleducation@diversatekhc.com** or visit us online to learn more about our Denver course offerings.

## Webinars

Diversatek Healthcare is proud to present a series of live, interactive discussions on topics related to esophageal function testing, impedance/pH reflux monitoring studies and anorectal manometry. Each webinar includes a didactic session followed by an open discussion. All webinars are recorded and posted to the Diversatek U online portal for easy reference. Access **DiversatekHealthcare.com** for upcoming webinar announcements.

## The Diversatek Healthcare Review

The Diversatek Healthcare Review e-newsletter features what's new at Diversatek University along with up-to-date product information. Every issue also includes our Clinical Insights, providing educational tips for Z/pH and HRiM analysis as well as answers to the most frequently asked questions.

# Personalized Clinical Support

## Onsite Training

Diversatek Healthcare Clinical Specialists deliver product support to suit your specific needs—on your schedule. Specialists are onsite at your facility to train and support you on your Diversatek Healthcare manometry or reflux monitoring equipment as you work through patient cases, acquire and analyze patient data, and create patient reports.

## Virtual Coaching

Online and in real-time, Diversatek Healthcare Clinical Specialists work with you via screen sharing to provide study-specific data review and report generation coaching for your more difficult studies. Email us at **clinicalsupport@diversatekhc.com** to schedule a one-on-one session.



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