



Ambulatory pH and Impedance Monitoring

- Ambulatory pH monitoring quantifies distal esophageal acid exposure and is the “gold standard” test to diagnose GERD.
 - A 24-hour pH monitoring is conducted with a thin catheter that is passed into the esophagus through the patient's nares.
 - The simplest catheter is a dual-probe pH catheter,
 - Contains two solid-state electrodes that are spaced 10 cm apart
 - detect fluctuations in pH between 2 and 7
 - The distal electrode must be placed 5 cm proximal to the LES;
 - location of the LES is identified on esophageal manometry
 - 48-hour ambulatory pH monitoring can be performed using an endoscopically placed wireless pH monitor “Bravo monitor”
 - Ambulatory pH monitoring generates data concerning esophageal acid exposure
 - Objective Data
 - total number of reflux episodes (pH < 4),
 - longest episode of reflux,
 - number of episodes lasting longer than 5 minutes
 - percentage of time spent in reflux in the upright and supine positions
 - Each of these data points a relative weight according to its capacity to cause esophageal injury, and the composite DeMeester score is calculated
 - Abnormal distal esophageal acid exposure is defined by a DeMeester score of 14.7 or higher.
 - Subjective data
 - patient can keep track of reflux-related symptoms using an electronic data recorder
 - During the interpretation of the pH study, symptom index and symptom-associated probability are calculated on the basis of the temporal relationship between the symptom event and episodes of distal esophageal acid exposure
 - Symptoms occurring within 2 minutes of a reflux episode is defined as a close temporal relationship
 - Suggesting the cause and effect relationship between GER and patient's symptoms. ¹
- Esophageal impedance monitoring identifies episodes of nonacid reflux.
 - Similar to 24-hour pH monitoring, esophageal impedance is performed with a thin, flexible catheter placed through the patient's nares into the esophagus.
 - Impedance catheters use electrodes placed at 1-cm intervals to detect changes in the resistance to flow of an electrical current (i.e., impedance).
 - Impedance increases in the presence of air and decreases in the presence of a liquid bolus. This technology can detect both gas and liquid movement in the esophagus



- Some impedance catheters also have one or more pH sensors, allowing the simultaneous detection of acid and nonacid reflux.
- When pH-impedance catheters are used, it is possible to determine the direction of movement of esophageal acid exposures and therefore to differentiate between an antegrade event (as in a swallow) and a retrograde event (as in GER).
- A specialized pH-impedance catheter with a very proximal pH sensor that detects pharyngeal acid reflux.
 - This catheter can be useful in the evaluation of patients with Laryngopharyngeal reflux symptoms cough, throat clearing, hoarseness, and wheezing
- One disadvantage of impedance is that the automated analytic software is sensitive and overestimates the nonacid reflux episodes,
 - these studies must be manually reviewed and edited
- Combined impedance-pH monitoring has been shown to identify reflux episodes with greater sensitivity than pH testing alone. ²
 - Although there is no consensus on whether impedance-pH testing should be performed on or off acid suppression therapy
 - How impedance-pH monitoring should guide the management of GERD is unknown
 - Patel and colleagues ³ attempted to determine the parameters on esophageal impedance-pH monitoring that predict response of GERD symptoms to both medical and surgical treatment.
 - Showed that acid exposure time, and not the number of nonacid reflux events, best predicted symptom improvement with both medical and surgical therapy
 - Normal values off acid suppression therapy have been determined from US and European Studies see table below ^{4,5}

Normal Values for Impedance pH monitoring:

	Distal reflux events (5cm above LES)					Proximal reflux events 15 cm above LES				
	Total	Acid	Weakly Acid	Weakly Alkaline	Super-Imposed Acid	Total	Acid	Weakly Acid	Weakly Alkaline	Super-Imposed Acid
Total	73	55	26	1	4	31	28	12	1	2
Upright	67	52	24	1	4	29	25	11	1	2
Recumbent	7	5	4	0	1	3	2	1	0	0

- Analysis of Impedance pH data
 - Analyze pH data alone
 - The impedance (bolus transit) data alone
 - The temporal relationship between pH change and impedance change



- The temporal relationship between reflux episodes and occurrence of symptoms
- Key clinical measurement for impedance testing is the number of acid and non-acid events as well as relationship to symptoms

References:

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3. Patel A, Sayuk GS, and Gyawali CP: Parameters on esophageal pH-impedance monitoring that predict outcomes of patients with gastroesophageal reflux disease. *Clin Gastroenterol Hepatol* 2015; 13: pp. 884-891
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5. Zentilin P, et al; Normal values of 24-h ambulatory intraluminal impedance combined with pH-metry in subjects eating a Mediterranean Diet *Dig Liver Dis* 2006;38 226-232