Evaluation of Esophageal Motor Function With High-resolution Manometry

Jeffrey L Conklin
Division of Digestive Diseases, The David Geffen School of Medicine at UCLA, Los Angeles, CA, USA

For several decades esophageal manometry has been the test of choice to evaluate disorders of esophageal motor function. The recent introduction of high-resolution manometry for the study of esophageal motor function simplified performance of esophageal manometry, and revealed previously unidentified patterns of normal and abnormal esophageal motor function. Presentation of pressure data as color contour plots or esophageal pressure topography led to the development of new tools for analyzing and classifying esophageal motor patterns. The current standard and still developing approach to do this is the Chicago classification. While this methodical approach is improving our diagnosis of esophageal motor disorders, it currently does not address all motor abnormalities. We will explore the Chicago classification and disorders that it does not address. (J Neurogastroenterol Motil 2013;19:281-294)

Key Words
Esophageal motility disorders; Esophagus; Manometry

Where Did High-resolution Manometry Come From and How Does It Work?

The reliable evaluation of esophageal and gastrointestinal motor function with manometric techniques became possible in the 1970s when Wyle Jerry Dodds and Ron Arndorfer developed the first high-fidelity manometry system.1,2 Except for a few technical modifications their approach remained the state-of-the art for 2 decades. In the 1990s, Ray Clouse and his colleagues gave birth to high-resolution manometry (HRM) when they decreased the spacing between pressure sensing sites along the manometry catheter from 3-5 cm to 1 cm, increased the number of pressure sensors and lengthened the sensing segment of the catheter so it spanned from the pharynx to the stomach. At last it was possible to simultaneously see motor function of the upper esophageal sphincter (UES), esophagus and lower esophageal sphincter (LES) with each swallow, giving us a complete spatial and temporal depiction of esophageal motor function for the first time.3,4 The true genius of his method was to convert the pressure data into a topographical plot. The convention at the time was to display manometry recordings in a 2-dimensional (2-D) space with pressure waves stacked sequentially from caudad to cephalad in the y-axis (Fig. 1A). Dr. Clouse and his colleagues added a z-axis, and stacked the pressure waves sequentially in the z-axis with gastric pressures to the front and pharyngeal pressures in the...
Figure 1. Comparing conventional recordings of manometric pressure with the Clouse plot or esophageal pressure topography (EPT). Conventional manometry tracings came from catheters made with pressure sensors spaced at relatively widely intervals, usually at 3- to 5-cm. The recording on the left (A) was made with a high-resolution manometry catheter and recording system, but it is displayed in the line mode so it looks like a conventional esophageal manometry recording. Seven of 36 recording channels were chosen for display to mimic what is seen with conventional manometry systems. Channels were selected to record simultaneously from the pharynx to the stomach. With old conventional manometry systems we could not simultaneously view pressures generated by the entire esophagus, including its sphincters. Notice that pressure is on the y-axis and time is on the x-axis. The numbers on the left indicate sensor location from the nares. EGJ indicates the esophagogastric junction, and WS indicates the timing of a wet swallow. The figure to the right (B) is esophageal motor activity from the same wet swallow displayed in the color contour mode. In this mode, pressure is represented by color (color bar on the right), sensor location is on the y-axis, and time is on the x-axis. Resting upper esophageal sphincter (UES) and lower esophageal sphincter (LES) pressures are seen horizontal bands of color that are several centimeters wide. Their hues indicate pressures that are greater than in the adjacent pharynx, esophagus, or stomach. Opening of the UES and LES relaxation are depicted as changes of color to hues that represent a lower pressure. A diagonal band of color running from the UES to the LES represents the peristaltic pressure wave. Variations in peristaltic pressure are produced by overlapping esophageal contractile segments: S1 is the striated muscle esophagus, S2 and 3 are the proximal and distal smooth muscle esophagus, respectively, and S4 is the LES repositioning itself at its resting position. There is a pressure trough between S1 and S2 that is called the transition zone, because it is the region over which the esophageal musculature transitions from striated to smooth muscle. Pressure in the swallowed bolus (intrabolus pressure) is represented by a small simultaneous rise in intraesophageal pressure seen as a simultaneous change to a lighter blue color (arrowhead). Notice that when the peristaltic wave passes the color becomes a darker blue indicating bolus clearance. TZ, transition zone.

How Is It Done With a High-resolution Manometry Set Up?

The performance of conventional esophageal manometry has been covered in previous reviews, so we will focus on how HRM changed our performance of the study. When positioned appropriately, the HRM catheter’s sensing segment spans from the pharynx to the stomach, so that a pressure profile of the entire esophagus and its sphincters can be viewed simultaneously in real time. This makes it easy to identify and characterize anatomical landmarks like the UES and LES. The procedure is simplified greatly, is more tolerable for patients and shortens the time required for data acquisition. These advantages are primarily be-