Oesophageal motility testing and 24-hour reflux studies

Andres Vales
Anthony Hobson

Abstract

High-resolution manometry (HRM) and 24-hour pH/impedance studies of the oesophagus have become more widely available and are a useful tool for investigating symptoms, leading to better decision-making and ultimately improved outcomes. Advances in technology have made analysis more intuitive, and efforts have been made to better classify motility disorders and reflux exposure. However, pitfalls remain for the novice, and care is needed that the correct diagnosis is made before being applied to clinical management. Current areas of focus include improved incorporation of challenge swallows in HRM and the best way to treat borderline measurements in 24-hour reflux studies.

Keywords Gastro-oesophageal reflux disease; laryngopharyngeal reflux; manometry; MRCP; oesophageal motility disorder; oesophageal pH monitoring

Key points

- Manometry and 24-hour pH monitoring are now more widely available and are an integral part of the diagnostic pathway for oesophageal disorders
- Once mucosal and extrinsic pathologies have been ruled out, high-resolution manometry is the gold standard for assessing the major motility disorders, and 24-hour pH/impedance studies are the gold standard for assessing reflux
- Having a trained gastrointestinal physiologist perform the tests ensures high-quality acquisition and proper application of the relevant criteria to the diagnosis

Introduction

Symptoms that arise from the oesophagus are common and include dysphagia, odynophagia and heartburn. For instance, gastro-oesophageal reflux disease (GORD) affects up to a third of the global population. A comprehensive clinical history is key for formulating an initial diagnosis, and oesophageal symptoms should be initially investigated with endoscopy and/or contrast radiology. However, when further investigation is needed, high-resolution manometry (HRM) and 24-hour pH/impedance studies are the gold standard tests for assessing reflux and diagnosing the major motility disorders. Having a dedicated gastrointestinal physiologist perform these tests ensures high-quality studies are undertaken; this facilitates tailoring of the procedure to the patient's history and avoids repeated referrals and testing.[1]

Manometry

The high-resolution set-up has been a major advantage for manometry analysis. Use of topographical colour plots allows for a continuous display of pressure data across the entire length of the oesophagus (Figure 1). This makes manometry useful and also relatively intuitive to learn.

Indications

The most sensitive symptoms indicating oesophageal disorders are dysphagia and bolus regurgitation. HRM is the most precise investigation for diagnosing the major motility disorders when mucosal and extra-oesophageal pathologies have been excluded. It is useful to note that inflammation, i.e. erosive oesophagitis, is the most common cause of non-specific dysmotility. Testing is also recommended to ensure accurate pH probe placement, and to assess patients before and after significant oesophageal intervention such as surgery or pneumatic dilatation.

Procedure

HRM catheters typically have >30 sensors with 1 cm spacing, which usually allows measurement from the pharynx to the stomach. Patients should fast for 4 hours before the test, and it should be noted that some medications, especially opioids, can affect motility.

Initial assessment is by means of 10 × 5 ml water swallows administered via a syringe. Swallows should be 20–30 seconds apart, avoiding saliva swallows in between. Challenge swallows are increasingly more relevant to the diagnosis, with a 200 ml rapid volume challenge being used to further assess lower oesophageal sphincter (LOS) relaxation, and solid boluses of bread or rice used to assess increases in peristaltic vigour. The multiple rapid swallow test, in which 5 × 2 ml swallows are administered in rapid succession, is the most well-studied adjunctive test and is predictive of good surgical outcome. In the case of hypomotility, the 5 x 2 ml swallow is also predictive of a potentially good response to prokinetics.

Analysis

The Chicago classification delineates normal values and criteria for manometric analysis; in this, a hierarchy of oesophageal dysmotility has been created to prioritize oesophageal outflow (Figure 2). For this reason, measurement of LOS relaxation, known as the integrated relaxation pressure (IRP), is the single

Andres Vales *BSc(Hons) is a Clinical Scientist in Gastrointestinal Physiology at the Functional Gut Clinic, London, UK. Competing interests: none declared.*

Anthony Hobson *BSc PhD is a Consultant Clinical Scientist and Clinical Director at the Functional Gut Clinic, London, UK. Competing interests: none declared.*

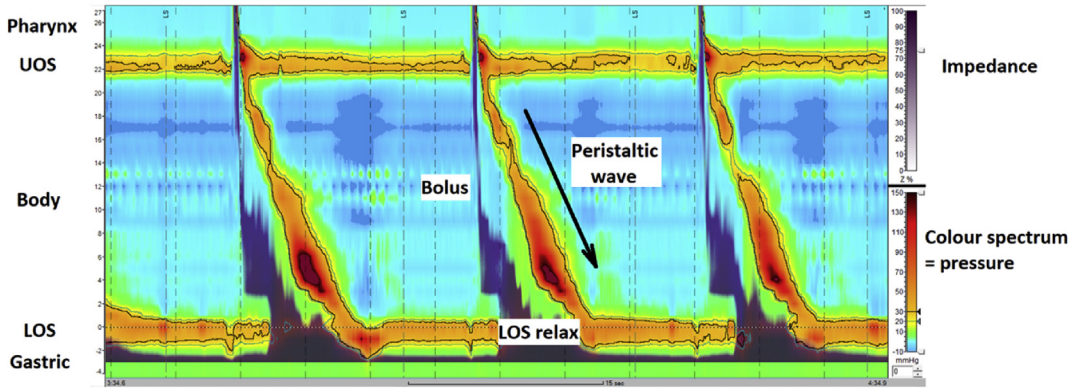

Figure 1 HRM display using a topographical colour plot. The colour spectrum allows the range of pressure to be visualized, and the purple impedance tracking shows the movement of the bolus ahead of the peristaltic wave. LOS, lower oesophageal sphincter; UOS, upper oesophageal sphincter.

most important parameter in oesophageal manometry. Peristalsis is measured by the distal contractile integral (DCI), which combines the pressure, length and duration of the swallow. Normal values are based on measurements made in the supine position, so careful interpretation is needed if the patient is upright, and it is noteworthy that manometric profiles classed as 'minor disorders' may have questionable clinical significance.[2] A description of these parameters, which have been interrogated by a trained operator, should make up the basis of a good report, with a summary that considers the challenge swallows and the patient's history.

24-Hour pH monitoring

The seminal paper on ambulatory oesophageal pH monitoring was published by Johnson and DeMeester in 1974.[3] A 24-hour test was devised to measure all acid events with a pH <4 with the sensor placed 5 cm above the upper border of the LOS. The test involves placement of a nasogastric catheter with an integrated pH probe whilst allowing swallowing and reflux to continue as normal. Acid levels <pH4 had been found to correlate with pepsin activation so were shown to be the most efficient way to monitor erosive reflux.

The major change of the last decade has been the measurement of impedance, in which an array of sensors is used to detect the flow of electrical current up or down the length of the catheter. When a liquid bolus passes over the probe, a decrease in impedance is detected, and conversely an increase is detected for a gas bolus (Figure 3). In this way, reflux can be distinguished from normal swallows, thereby avoiding erroneous pH measurements caused by the patient consuming acidic foods. It also allows for additional measurements of non-acid reflux and belching/aerophagia.[4]

Indications

As with manometry, an accurate history is essential. The symptoms most sensitive for GORD are heartburn and regurgitation, with atypical symptoms including chest pain and throat/respiratory symptoms. The treatment of GORD with proton pump inhibitors (PPIs) based on symptoms alone is pragmatic and cost-effective but has probably led to overuse of PPIs. Therefore, pH testing is best used to confirm GORD in individuals with normal endoscopy but continuing symptoms, in those with atypical symptoms or when considering antireflux surgery. For patients with previously established evidence of GORD (endoscopically or from pH readings), it is recommended that the test should be performed with the patient on PPI therapy to assess efficacy and the correlation of refractory symptoms to reflux.

Single-channel pH monitoring is the most cost-effective and widely available test, with relatively simple analysis. However, the increased yield of pH/impedance techniques makes it more suited to monitoring atypical symptoms, and it is the only test that can be performed if deciding to keep the patient on PPI therapy.

Procedure

The patient should fast for 4 hours before the test, and acid suppression therapy should be stopped up to 1 week before. The patient should be asked to carry on their day as normally as possible. With single pH studies, patients may have to avoid acidic foods. Correct use of the machine is essential to ensure that meals, supine periods and symptoms are properly recorded.

Analysis

The main parameter for measurement is acid exposure time (AET), which provides a percentage value for the amount of time the oesophagus has been exposed to a pH <4. The number of reflux events can be used as an additional parameter to aid diagnosis when AET is inconclusive. Other parameters are also measured and can be combined to make the Johnson–DeMeester score, but AET and number of reflux episodes remain the most clinically relevant.

Symptom analysis is also important. The symptom index is the percentage of reflux-associated symptoms and therefore

Breakdown of the Chicago classification

DISORDERS WITH EGJ OUTFLOW OBSTRUCTION	CRITERIA	
Type I achalasia (classic achalasia)	Elevated median IRP (>15 mmHg†), 100% failed peristalsis (DCI <100 mmHg) *Premature contractions with DCI values less than* 450 mmHg/second/cm *satisfy criteria for failed peristalsis*	**Impaired LOS relaxation** **No normal peristalsis**
Type II achalasia (with oesophageal compression)	Elevated median IRP (>15 mmHg†), 100% failed peristalsis, panoesophageal pressurization with ≥20% of swallows *Contractions may be masked by oesophageal pressurization and DCI should not be calculated*	
Type III achalasia (spastic achalasia)	Elevated median IRP (>15 mmHg†), no normal peristalsis, premature (spastic) contractions with DCI >450 mmHg/second/cm with ≥20% of swallows *May be mixed with panoesophageal pressurization*	
EGJ outflow obstruction	Elevated median IRP (>15 mmHg†), sufficient evidence of peristalsis such that criteria for types I–III achalasia are not met*	**Impaired LOS relaxation but intact peristalsis**
MAJOR DISORDERS OF PERISTALSIS	*(Not encountered in normal subjects)*	**Normal LOS relaxation** **Impaired motility**
Absent contractility	Normal median IRP, 100% failed peristalsis *Achalasia should be considered when IRP values are borderline and when there is evidence of oesophageal pressurization* *Premature contractions with DCI values less than* 450 mmHg/second/cm *meet criteria for failed peristalsis*	
Distal oesophageal spasm	Normal median IRP, ≥20% *premature contractions with DCI values less than* 450 mmHg/second/cm†. Some normal peristalsis may be present	
Hypercontractile esophagus (jackhammer)	At least two swallows with DCI >8000 mmHg/second/cm†§ Hypercontractility may involve, or even be localized to the LOS	
MINOR DISORDERS OF PERISTALSIS	*(Characterized by contractile vigour and contraction pattern)*	**Minor disorders**
Ineffective esophageal motility (IEM)	>50% ineffective swallows *Ineffective swallows can be failed or weak* *Multiple repetitive swallow assessment may be helpful in determining peristaltic reserve*	
Fragmented peristalsis	>50% fragmented contractions not meeting (IEM) criteria	
NORMAL OESOPHAGEAL MOTILITY	Not fulfilling any of the above classifications	

Not seen in normal controls

Questionable clinical significance

† Cut-off value dependent on the manometric hardware; this is the cut-off for the Sierra device
* Potential aetiologies: early achalasia, mechanical obstruction, oesophageal wall stiffness, or manifestation of hiatal hernia
§ Hypercontractile oesophagus can be a manifestation of outflow obstruction as evident by instances in which it occurs in association with an IRP greater than the upper limit of normal

Achalasia is the most well-known oesophageal motility disorder, but distinction should be made between it and OGJ outflow obstructiojn in terms of both diagnosis and treatment. DCI, distal contractile integral; IRP, integrated relaxation pressure; LOS, lower oesophageal sphincter; OGJ, oesophago-gastric junction.
Source: Modified from Kahrilas et al.[2]

Figure 2

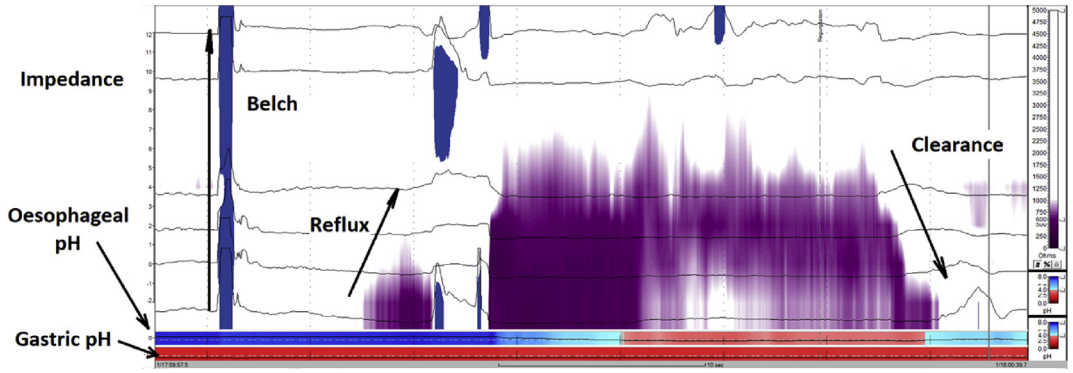

Figure 3 pH/impedance trace. High impedance (blue) denotes air; low impedance (purple) denotes liquid. Here a belch can be seen causing a reflux event that is then cleared. The oesophageal pH channel has identified this as an acid reflux event.

denotes effect size. The symptom association probability, however, uses Fisher's exact test to find the probability that symptoms and reflux events are associated. The best prediction of benefit from medical or surgical therapy is achieved when both parameters show a positive association.[5] ◆

KEY REFERENCES

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TEST YOURSELF

To test your knowledge based on the article you have just read, please complete the questions below. The answers can be found at the end of the issue or online here.

Question 1

A 45-year-old woman presented with symptoms of heartburn, regurgitation and chest pain that responded well to proton pump inhibitors. A gastroscopy showed only mild oesophagitis but a 3 cm hiatus hernia. She was being considered for antireflux surgery.

Investigations

A single-channel 24-hour pH study showed:

- Total acid exposure time 7.4% (<4.2%)
- Total acid events 82 (<50)
- DeMeester score 23.1 (<14.72)

What is the diagnosis?

A. Pathological acid exposure
B. Normal acid exposure
C. Excessive non-acid reflux
D. Laryngopharyngeal reflux
E. Bile reflux

Question 2

A 60-year-old man presented with a 3-month history of low dysphagia occurring at least every day. There was no regurgitation, and his weight was stable. He had heartburn but this was controlled with a proton pump inhibitor.

Investigations

- Gastroscopy showed oesophagitis
- Barium swallow showed poor outflow and non-specific dysmotility
- A manometry study showed reduced lower oesophageal sphincter relaxation (raised integrated relaxation pressure) and mostly absent contractility with the 5 ml swallows; however; there were at least two normal swallows during the bread challenge

What is the most likely diagnosis?

A. Hypercontractile oesophagus
B. Achalasia
C. Absent contractility
D. Oesophago-gastric junction obstruction
E. Distal oesophageal spasm

Question 3

A 20-year-old woman presented with symptoms of regurgitation and epigastric discomfort that had not responded to a proton pump inhibitor.

Investigations

- Gastroscopy was normal
- A 24-hour pH/impedance study showed:
  - Total acid exposure time 0.3% (<4.2%)
  - Total acid events 11 (<50)
  - Total acid and non-acid events 115 (<73)
  - Total acid and non-acid events (postprandial period) 80

What is the most likely diagnosis?

A. Pathological acid exposure
B. Normal acid exposure
C. Excessive non-acid reflux
D. Laryngopharyngeal reflux
E. Rumination