ADVANCES IN ENDOSCOPY

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The Role of Endoscopic Impedance Planimetry in Esophageal Disease

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G&H How is endoscopic impedance planimetry performed?

KR In clinical practice, endoscopic impedance planimetry utilizes an endoscopic functional luminal imaging probe known as EndoFLIP (Medtronic). It consists of a catheter with electrodes spaced along its length surrounded by an infinitely compliant balloon. EndoFLIP is typically placed transorally following a sedated upper endoscopy and positioned such that the distal 2 to 3 cm are below the gastroesophageal junction. The balloon is filled in a sequential manner with a proprietary solution with a known electrical conductivity. Utilizing Ohm's law, which states that the impedance to the flow of current is inversely related to electrical conductivity of the medium, the cross-sectional area of the esophagus can be determined at each electrode for assessment of the distal esophageal lumen and gastroesophageal junction. Further, a pressure sensor is located at the distal end, and, consequently, the relationship between the cross-sectional area and pressure allows for measurement of the distensibility index at the lower esophageal sphincter (LES) and the distal esophageal body.

G&H How has this technology changed since its introduction?

KR Initially, EndoFLIP lacked real-time interpretation. Now, it is feasible. The software allows for a color-coded topographic display of the esophageal lumen, with both the diameter and distensibility index displayed along the length of the distal esophagus and gastroesophageal junction. This allows clinicians to assess the diameter and distensibility index at the gastroesophageal junction and within the esophagus in real time.

Further, with distension of the esophagus with balloon inflation, secondary peristalsis is precipitated. Resultant dynamic changes in the esophageal diameter can be seen along the length of the distal esophageal lumen, which allow for recognition of contractile patterns such as repetitive antegrade contractions (representing normal peristaltic activity) and repetitive retrograde contractions (representing abnormal peristaltic activity). Ultimately, this ability for real-time study interpretation potentially allows for treatment decisions to be made at the time of endoscopy.

G&H How does EndoFLIP complement other technologies used for the diagnosis of esophageal disease?

KR It clearly helps in the assessment of patients in whom the diagnosis of achalasia is uncertain. Manometric integrated relaxation pressure may be borderline and not completely consistent with achalasia. EndoFLIP can be quite helpful in clarifying the diagnosis and whether therapy directed at the gastroesophageal junction would be of benefit.

In one study involving 30 patients with achalasia and 15 controls, the EndoFLIP distensibility index correlated quite well with poor esophageal emptying and patient symptoms even when the LES pressure was borderline or low. In another study that included 31 patients with achalasia following therapy, a higher LES distensibility index correlated with a clinically successful therapeutic response. Consequently, EndoFLIP can be used in conjunction with high-resolution esophageal manometry and barium esophagram to help assess treatment efficiency and guide subsequent therapy.

The technology also can be used during both surgical myotomy and peroral endoscopic myotomy to assess myotomy adequacy as reflected by the degree of increase in the distensibility index of the LES. That real-time measurement can help tailor therapy and ensure an adequate myotomy length.

Finally, EndoFLIP allows the clinician to see patterns of contractility within the esophageal lumen of patients with achalasia that may not be readily identified on high-resolution manometry. At least one study has shown that EndoFLIP identified esophageal body contractility in a significant proportion of patients with manometrically defined types 1 and 2 achalasia in whom known contractility is not visualized on high-resolution manometry. The identification of contractile patterns that are not seen on manometry may theoretically guide the choice of therapy and the length of the myotomy.

EndoFLIP's role in the assessment of patients meeting esophageal manometry criteria for esophagogastric junction outflow obstruction (EGJOO) may be even more important than its role in the diagnosis and monitoring of achalasia. EGJOO is defined by the Chicago classification criteria as the presence of impaired lower esophageal relaxation reflected by an elevated integrated relaxation pressure with preserved esophageal peristalsis on high-resolution esophageal manometry. This can present a major diagnostic conundrum. This presentation was first thought to be a major abnormality with important clinical implications. However, subsequent research has increasingly shown that this manometric finding does not necessarily correlate with symptoms or esophageal structure or function, and it may be clinically irrelevant in many patients. Consequently, determining which patients with EGJOO require LES-targeted therapy and which should be managed conservatively has proven challenging.

Different imaging techniques have been tried to help better define exactly what EGJOO is and who needs treatment for it. The techniques have had mixed reliability; however, evidence suggests that EndoFLIP can reliably detect poor esophageal emptying. In fact, the most recent iteration of the Chicago classification states that a clinical diagnosis of EGJOO requires manometric criteria and symptoms plus supportive evidence on either timed barium esophagram or EndoFLIP.

G&H Does EndoFLIP have utility in patient screening prior to manometry?

KR Data suggest that EndoFLIP may be just as reliable as manometry in the primary assessment of esophageal dysmotility. A study of 145 patients with dysphagia found that EndoFLIP was abnormal in all 70 patients with achalasia. The take-home message was that EndoFLIP may be a good screening tool and, when normal, provides reliable reassurance that achalasia is not being missed. A more recent study by the same group found that real-time EndoFLIP assessment correlated well in both patients with achalasia and those with normal and minor abnormalities on high-resolution esophageal manometry.

Ultimately, these findings suggest the possibility that clinical assessment of a patient with dysphagia can be accomplished at the time of a single upper endoscopy whereby the endoscopy can be used to rule out a structural abnormality, esophageal biopsies can be obtained to rule out eosinophilic esophagitis (EoE), and EndoFLIP can be performed to rule out a significant esophageal motility abnormality. Such an approach would improve the efficiency of care for patients and obviate the need for multiple clinical visits for additional testing, such as barium esophagram and high-resolution manometry. However, further clinical trials are needed before such an approach can be recommended.

G&H Can EndoFLIP be a more patient-friendly alternative to manometry or fluoroscopy in select circumstances?

KR Absolutely. EndoFLIP is generally performed after sedated upper endoscopy and is a far more comfortable procedure for patients than a nonsedated esophageal manometry. Based on the evidence discussed previously, achalasia can be ruled out with some confidence in a patient who cannot tolerate and undergo high-resolution esophageal manometry but is able to undergo an upper endoscopy and has a normal EndoFLIP result. However, larger and more robust prospective trials are needed that assess the reliability of EndoFLIP as a primary assessment of esophageal motility, and this technology should be thought of as complementary to high-resolution esophageal manometry in clinical practice at this time.

G&H Which patients are ideal candidates for EndoFLIP?

KR Manometry has remained the standard for diagnosis of dysmotility. EndoFLIP is complementary in patients in whom manometry or esophagography is not definitive.

Ideal candidates for EndoFLIP include patients who have suspected abnormalities at the LES, especially patients with achalasia and EGJOO. As discussed, even if the diagnosis of achalasia is clear based on manometry and esophagram findings, EndoFLIP may provide additional information about contractility to guide therapy choice, may have a role during myotomy to ensure adequacy, and may be used following treatment to predict recurrence and the need for further therapy. EndoFLIP in patients with EGJOO can help identify the patients who would most benefit from therapy and prevent unnecessary therapeutic procedures. EndoFLIP may also be able to guide therapy selection and assess treatment efficacy.

G&H What applications may emerge for this technology in the near future?

KR The first and foremost hope is that EndoFLIP can be incorporated into a comprehensive evaluation for dysphagia at the time of upper endoscopy. The technology is also gaining traction for use in other diseases of the esophagus. EoE is an example. EOE is a condition associated with esophageal fibrosis leading to diffuse esophageal narrowing and dysphasia. Upper endoscopy has demonstrated poor diagnostic assessment of the diffuse esophageal narrowing seen in EoE. EndoFLIP has been shown to reliably identify patients with EoE with significant fibrosis and esophageal narrowing through the assessment of the distensibility plateau. Consequently, this tool could be useful in EoE with persistent symptoms despite histologic response to medical therapy and could identify patients who require dilation. EndoFLIP also may be a useful tool in the treatment of complex esophageal strictures by assessing length and diameter in guided endoscopic therapy.

In concept, EndoFLIP may be helpful in gastroesophageal reflux disease (GERD). In some patients with GERD, the gastroesophageal junction barrier may be lax and result in reflux. Consequently, assessment of the gastroesophageal junction with EndoFLIP has been considered an attractive concept, with the idea that a high distensibility index would predict GERD and potentially guide therapy. However, studies to date have had conflicting results without reliable prediction of pathologic GERD with EndoFLIP. Consequently, this tool does not have a role in current clinical practice.

An exciting area of research is the potential use of EndoFLIP in bariatric surgery. As more people undergo bariatric surgery, more effects are being seen on esophageal function. For example, patients who undergo gastric sleeve surgery are at high risk for GERD after the procedure. Studies are currently assessing whether the measurement of distensibility with EndoFLIP may be useful to predict which patients are at risk before or after sleeve gastrectomy.

Another area of research is the use of EndoFLIP to assess distensibility of sphincters other than the LES. This has perhaps been most studied in the assessment of the pylorus in patients with gastroparesis. Gastric peroral endoscopic myotomy (G-POEM) involves the creation of an endoscopic submucosal tunnel to allow myotomy at the antrum to improve gastric emptying in patients with gastroparesis. There is some evidence to suggest that the measurement of distensibility of the pylorus with EndoFLIP in patients with gastroparesis can predict which patients will have a therapeutic response with G-POEM. However, evidence is early and consists of limited observational studies. Consequently, further investigation with randomized clinical trials is needed to further elucidate the role of EndoFLIP and G-POEM in these patients.

Disclosures

Dr Ravi has no relevant conflicts of interest to disclose.

Suggested Reading

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