

# Routine esophageal manometry is not useful in patients with normal videoesophagram

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Received: 16 April 2018 / Accepted: 18 September 2018 / Published online: 24 September 2018  
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## Abstract

**Background** Videoesophagram (VEG) and esophageal manometry (EM) are components of the preoperative evaluation for foregut surgery. EM is able to identify motility disorders and diminished contractility that may alter surgical planning. However, there are no clearly defined criteria to guide this. Reliable manometry is not always easily obtained, and therefore its necessity in routine preoperative evaluation is unclear. We hypothesized that if a patient has normal videoesophagram, manometry does not reveal clinically significant esophageal dysfunction.

**Methods** We reviewed patients who underwent protocolized videoesophagram and manometry at our institution. Measures of esophageal motility including the mean distal contractile integral (DCI), mean wave amplitude (MWA), and percent of peristaltic swallows (PPS) were analyzed. The Chicago Classification was used for diagnostic criteria of motility disorders. Normal VEG was defined as stasis of liquid barium on less than three of five swallows.

**Results** There were 418 patients included. 231 patients (55%) had a normal VEG, and 187 patients (45%) had an abnormal VEG. In the normal VEG group, only 2/231 (0.9%) patients had both abnormal DCI and PPS, 1/231 (0.4%) patients had both abnormal DCI and MWA and no patients had both abnormal MWA and PPS. There were no patients with achalasia or absent contractility and 1 patient with ineffective esophageal motility (IEM) in the normal VEG group. This was significantly different from the abnormal VEG group which included 4 patients with achalasia, 1 with absent contractility and 22 with IEM ( $p < 0.0001$ ). The negative predictive value of VEG was 99.6% and the sensitivity was 96.4%.

**Conclusions** A normal videoesophagram reliably excluded the presence of clinically significant esophageal dysmotility that would alter surgical planning. Routine manometry is not warranted in patients with normal videoesophagram, and should be reserved for patients with abnormal VEG.

**Keywords** Esophageal motility · Videoesophagram · High-resolution manometry

Videoesophagram (VEG) and esophageal manometry (EM) are commonly utilized during evaluation of patients with upper gastrointestinal symptoms [1–3]. Both studies provide information on esophageal motility with manometry being the gold standard to diagnose major and minor disorders.

Additionally, determining the degree of esophageal motility present plays a critical role in operative planning for anti-reflux procedures. However, there are no clear criteria to guide this selection.

Esophageal manometry measures intraluminal pressure via a catheter that passes from the nose through the lower esophageal sphincter [4]. Completion of the procedure and proper interpretation require specific equipment and training. Depending on the practice setting of the patient being evaluated, this specialized test may not be easily available. Therefore, its necessity in routine preoperative evaluation is unclear and some have suggested not requiring it for all patients [5].

Our aim was to examine the relationship between findings of a standardized, protocolized videoesophagram, and

**Electronic supplementary material** The online version of this article (<https://doi.org/10.1007/s00464-018-6456-x>) contains supplementary material, which is available to authorized users.

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**Table 1** Comparison of abnormal motility findings between normal and abnormal videoesophagram groups

	Normal VEG N=231 (%)	Abnormal VEG N=187 (%)	<i>p</i> value
Distal contractile integral <450	19 (8.2)	33 (17.7)	0.004
Mean wave amplitude <30	3 (1.3)	13 (7.0)	0.003
Percent peristaltic swallows <50	12 (5.2)	46 (24.6)	<0.0001

esophageal manometry. We hypothesized that if a patient had a normal videoesophagram, the manometry did not reveal severe esophageal dysfunction or major disorders of peristalsis that would change the operative plan of a surgeon.

## Materials and methods

All patients who underwent high resolution manometry and videoesophagram at our institution between 2012 and 2014 were reviewed. These studies were performed routinely as part of workup of reflux disease prior to planned foregut procedure.

Videoesophagram was performed according to protocol (Full details in Supplementary—USC Videoesophagram Protocol). Importantly, in the prone position, patients are given five separate 10 milliliter (mL) swallows of contrast with 15 s in between swallows. They are instructed to ingest the entire 10 mL in one swallow rather than multiple parts to allow for the most thorough evaluation of esophageal motility. Stasis within the esophagus was defined as residual bolus remaining after passage of a peristaltic wave. This can be further characterized in grades of severity based on the amount of contrast remaining and presence of esophageal dilation. Patients also complete two solid swallows in the upright position of either barium-coated hamburger or marshmallow. A normal videoesophagram was defined as stasis in the distal third of the esophagus on less than three of five liquid swallows. Patients were divided into normal and abnormal groups and manometry findings were compared.

High-resolution esophageal manometry was also performed per institutional protocol. Accepted measures of esophageal motility including the mean distal contractile integral (DCI), mean wave amplitude (MWA), and percent of peristaltic swallows (PPS) were analyzed. The Chicago Classification was used for diagnostic criteria of motility disorders [6]. While all diagnoses were included in the analysis, it was determined via consensus that achalasia, absent contractility, and ineffective esophageal motility were the only clinically significant disorders that could potentially alter surgical decision making. DCI less than 450 mm Hg s cm, MWA less than 30 mm Hg, and PPS less than or equal to 50 were considered abnormal. Composite measures of each separate diagnostic criteria were evaluated to more closely represent information factored into clinical decision making.

**Table 2** Comparison of percent peristaltic swallows and distal contractile integral in patients with normal VEG

	Percent peristaltic swallows	
	≤50%	>50%
Distal contractile integral		
<450	2 (0.9%)	17
≥450	11	201

**Table 3** Comparison of mean wave amplitude and distal contractile integral in patients with normal VEG

	Mean wave amplitude	
	<30	≥30
Distal contractile integral		
<450	1 (0.4%)	18
≥450	2	210

This study was approved by the University of Southern California Institutional Review Board. All statistical analyses were performed with SAS version 9.4 (SAS Institute Inc.). Non-continuous variables were compared with Fisher exact or Chi-square tests. A *p* value less than 0.05 was considered significant. Findings on videoesophagram were compared to clinically significant disorders identified on manometry, considered to be the diagnosis gold standard, to calculate sensitivity, specificity, positive predictive value, and negative predictive value.

## Results

There were 418 patients included in the study, 182 males and 236 females with median age 62 years. 231 patients (55%) were classified as having a normal VEG versus 187 patients (45%) with abnormal VEG.

Motility findings between the two groups were compared (Table 1). There were significantly fewer patients with abnormal DCI, MWA, and PPS in the normal VEG group. When comparing composite measures in the normal VEG group, there were only 2 patients (0.9%) with both abnormal DCI and PPS (Table 2), only 1 patient (0.9%) with both abnormal DCI and MWA (Table 3) and no patients had both abnormal PPS and MWA (Table 4).

**Table 4** Comparison of mean wave amplitude and percent peristaltic swallows in patients with normal VEG

	Mean wave amplitude	
	<30	≥30
Percent peristaltic swallows		
≤50%	0	3
>50%	13	215

Manometric diagnoses were compared between groups (Table 5). In the normal VEG group, there were no patients that were found to meet criteria for achalasia or absent contractility. There were significantly fewer patients with manometrically diagnosed disorders in the normal VEG group compared to the abnormal VEG group (4.8% vs. 26.2%,  $p < 0.0001$ ).

The ability of the normal videoesophagram to reliably exclude clinically significant motility disorders was explored. Rates of these disorders were compared between normal and abnormal VEG groups and were found to be significantly different (1/231 vs 27/187,  $p < 0.0001$ ). If a videoesophagram was normal, 230/231 patients did not have a motility disorder corresponding to a negative predictive value of 99.6% (Table 6). If a motility disorder was present, the VEG was abnormal in 27/28 patients corresponding to a sensitivity of 96.4%. The positive predictive value was 14.4% (27/187) and the specificity was 59.0% (230/390).

## Discussion

Routine preoperative esophageal manometry serves two major roles in foregut surgery [1]. First, identification of major motility disorders, such as achalasia and absent contractility, which assures proper diagnosis and guides the selection of the appropriate operation. In this study, no major disorders of peristalsis were identified in patients with normal videoesophagram. Second, manometry is believed to help surgeons tailor the surgical approach in treating reflux disease by identifying significant

**Table 5** Manometric diagnoses between groups

	Normal VEG N=231	Abnormal VEG N=187
Achalasia	0	4
Absent contractility	0	1
Ineffective esophageal motility	1	22
EGJ outflow obstruction	2	5
Hypercontractile esophagus	8	16
Diffuse esophageal spasm	0	1

**Table 6** Comparison of videoesophagram findings with clinically significant manometric diagnoses

	Motility disorder present	Motility disorder absent
Abnormal VEG	27	160
Normal VEG	1	230

esophageal dysmotility. In our study, when patients had a normal videoesophagram, not only was it rare to have an abnormal motility finding on manometry, but it was extremely rare to have more than one abnormal motility finding. These findings confirm our hypothesis that a protocolized videoesophagram can be used to reliably exclude motility findings that would be significant enough to alter surgical planning. By adopting a structured VEG protocol, unnecessary testing can be avoided. In fact, given a global fee of \$178.04 [7], the cost savings for the normal VEG group of patients from this study would have been \$41,127.24.

Determination of esophageal motility remains a critical aspect of preoperative evaluation for anti-reflux surgery as patients deemed to have poor function should most likely not undergo circumferential wraps (Nissen fundoplication or LINX device). Some may argue that routine esophageal manometry is necessary to identify patients whose level of function may predispose to developing dysphagia. However, multiple studies comparing patients with and without dysphagia after fundoplication found no significant differences in preoperative manometric characteristics [8–11]. The only factor that seems to be consistently associated with post-operative dysphagia is the presence of preoperative dysphagia [9–11]. Interestingly, as part of a multi-variate analysis to predict post-operative dysphagia, Tsuboi et al. found that while no manometric findings reliably correlated, delayed esophageal transit identified on barium swallow was an independent risk factor [10].

The relationship between esophageal manometry and VEG has not been extensively characterized with most studies examining only groups of patients with known motility disorders and utilizing older manometric technology [12–14]. In a study published in 1999, Fuller et al. compared findings from 202 patients who underwent structured videoesophagram and esophageal manometry [14]. Using abnormal manometric findings as the gold standard for diagnosing esophageal dysmotility, videoesophagram had a sensitivity of 0.55 and negative predictive value of 0.80. While an interesting finding, it is important to note that in our study, we calculated sensitivity and negative predictive value for detecting the presence of clinically significant motility disorders and not general esophageal dysmotility. Interestingly, Fuller's study did note that abnormalities were

detected on videoesophagram in 94% with achalasia and 100% of patients with scleroderma.

In the only large study comparing global findings of VEG with high-resolution manometry, the sensitivity for detecting esophageal dysmotility identified on manometry was 0.69 and the negative predictive value was 0.58 [15]. While seemingly low it is notable that a protocolized evaluation and reporting system for dysmotility was not performed and therefore the inherent heterogeneity in these interpretations may have underestimated the true rate of dysmotility. In our study, strict definitions of esophageal stasis and dysmotility were used and a protocolized dictation template ensured that each study included this level of detail.

High-resolution manometry provides a comprehensive evaluation of esophageal motility [4]. However, the cost of the specialized equipment and need for specially trained staff can make the test difficult to reliably obtain. Additionally, patients experience discomfort from having to be awake while having a nasal catheter in place. For these reasons, we believe that manometry should be performed only when indicated and when expected to provide significant information.

## Conclusion

In this study, we have demonstrated that routine esophageal manometry did not identify significant esophageal dysfunction or major motility disorders in patients with normal videoesophagram. Therefore, routine manometry is not indicated in patients with normal videoesophagram and should be reserved for patients with abnormal studies.

**Funding** None.

## Compliance with ethical standards

**Disclosures** Evan T. Alicuben, Kamran Samakar, Namir Katkhouda, Adrian Dobrowolsky, Kulmeet Sandhu have no conflicts of interest or financial ties to disclose. Nikolai Bildzukewicz and John C. Lipham are consultant for Torax Medical, Inc.

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