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The value of conventional manometry in the identification of normal esophageal manometry

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Abstract

In the last decade, high-resolution esophageal manometry (HREM) is the main device for the management of dysphagia replacing conventional manometry (CM). Conventional manometry still seems to have some space to diagnose major motility disorders and differentiate normal from abnormal esophageal motility. The long term outcomes of patients with normal CM were analyzed in our study.

Participants (patients with dysphagia and normal CM) took a questionnaire via a phone call in February 2021. Impact Dysphagia Questionnaire (IDQ) was used as an assessment tool.

Only 55% (83/151) the individuals with previous normal manometric findings were reached via telephone. The group who have completed the survey was representative of the cohort. 66.2% of the participants were female ($P = .40$). The mean age was 57.21, mean weight was 70.69 kg, mean height was 163.74 cm and mean body mass index was 26.41. More than 40% of patients were completely asymptomatic at follow up, reflected by an IDQ score of 0. Only 28 out of 83 (33.7%) patients reported significant symptoms as reflected by an IDQ score greater than or equal to 7. The rest of responders admitted as having moderate to mild symptoms.

HREM is a valid technique with comparable precision to CM. HREM measurements differ considerably to CM. The identification of normal motor function in CM is not likely a positive prognostic indicator and must be interpreted precautiously.

Abbreviations: CM = conventional manometry, EGJ = esophago-gastric junction, HREM = high-resolution esophageal manometry, IDQ = impact dysphagia questionnaire.

Keywords: conventional manometry, dysphagia questionnaire, high resolution manometry

1. Introduction

In the last decade, high-resolution esophageal manometry (HREM) is the most important device in the management of dysphagia replacing conventional manometry (CM). Distinguishing features between the manometry systems include catheter design and data display. In HREM, the catheter has multiple (up to 36) pressure sensors spaced 1 cm apart along the catheter, whereas CM catheters typically have 5 pressure sensors spaced widely apart. Thus, high resolution manometry generates multiple line tracings. In addition, high resolution manometry data are displayed via esophageal pressure topography, which produces dynamic colorful spatiotemporal topography plots to depict pressure changes along length and time as opposed to conventional line tracings. High resolution manometry is a technologic evolution from conventional line tracing.

The aspect of CM is doubted because HREM has higher specificity and provides more detailed information. Nonetheless, the evidence about the superiority of HREM is limited, and HREM technology is more expensive and available only in referral centers. CM still seems to have a space to diagnose major motility disorders and differentiate normal from abnormal esophageal motility rather than distinguishing the types and subcathegories of motility disorders. The only identifiable advantage of conventional line tracing over high resolution manometry is cost. There are several advantages of HREM over conventional line tracing. HREM provides an illustrative depiction of esophageal motility compared to conventional line tracing and results in increased diagnostic accuracy of motility disorders. HREM also allows identification of anatomic landmarks and assessment of hiatal hernia, and demonstrates pressurization patterns. In addition, impedance combined with high HREM provides valuable information regarding bolus transit, reflux episodes, rumination syndrome, and belching disorders.

Esophageal manometry is most often used to diagnose dysphagia and for diffential diagnosis of gastroesophageal reflux disorder. In addition to allowing physicians to treat patients with

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esophageal symptoms, CM is a cost-effective treatment. According to Peixoto et al, CM can and should be used in a subgroup of patients where significant changes are suspected, despite being less responsive and precise than HREM.[1]

Since the large number of pressure sensors eliminates the need for the pull through technique, data acquisition takes less time with HREM.[2] The use of plots to depict data corresponds to the methods used in imaging, making understanding easier, particularly for practitioners with limited background.[3] To classify esophageal motility disorders in HREM, the Chicago classification was created and revised.[4] This international consensus mechanism has led to HREM's success by providing generally accepted definitions of esophageal motility disorders. Despite these benefits, HREM is not available in all medical centers throughout the world. HREM, in reality, necessitates a larger financial investment than CM.

Inter-rater reliability and/or agreement of esophageal motility disorders were identified in some studies using both CM and HERM. When only evaluating for agreement between achalasia and regular motility, the agreement between all and highly experienced raters improved to strong (= 0.68 for both).[5] Carlson and colleagues conducted a reliability comparison in 2015.[6] When comparing HERM to CM, the authors discovered that overall interrater agreement and diagnostic accuracy were higher for HERM. On the other hand, the distinction between major motility dysfunction and completely normal tracings was more successful.

Clause and Staiano compared the accuracy of esophageal motility diagnoses using topographic representation versus limited, 4-channel line tracings (sensors at the lower esophageal sphincter and 3, 8, and 13 cm above the lower esophageal sphincter) for 212 consecutive patients who were referred for manometry in an early study using 21-channel water-perfused manometry.[7] The most significant differences and difficulties were related with achalasia classification.

Significant motility disorders, minor motility disorders, and normal motility are the 3 types of esophageal motility study results. Achalasia and other major motor disorders have undeniable clinical importance and can be identified by CM. Minor motor abnormalities are common in healthy volunteers, though long-term results for individuals with swallowing symptoms who were initially tested with CM are unknown. We planned to figure out what happened to patients who had regular CM findings at the first visit.

2. Material and method

The study was approved by our instutional ethic committe.

2.1. Subjects

Consecutive patients who applied to the Emergency Department or Gastroenterology Department of Katip Celebi University with dysphagia or food impaction and latter on had esophageal manometric studies between January 2015 and March 2020 were scanned. The individuals with normal manometric results were involved. The patients were referred to the motility center from the outpatient clinics and the emergency department due to their dysphagia symptom. Participants took a questionnaire via a phone call in February 2021. Subjects who were not reached by phone were excluded from the study.

2.2. Manometrical method

Conventional manometry was performed using a water-perfused system. Three side holes were located at the same level at the catheter's distal extremity, and 3 side holes were located 5, 10, and 15 cm away from the aforementioned holes, respectively. A low-compliance hydraulic capillary infusion system was used to infuse it at 0.5 mL/min. Pressure transducers were attached to the infusion device. Signals were recorded on a polygraph digitized, computer-processed, and stored using commercially available software. In the supine position, the three distal side holes of the catheter were first placed on the esophago-gastric junction (EGJ). A total of ten 5-mL water swallows were carried out.

2.3. Impact dysphagia questionnaire

The subjects were reached by phone and asked to answer the Impact Dysphagia Questionnaire (IDQ). Clinical notes were reviewed to assess clinical characteristics, endoscopic findings, and radiographic features. Identified study subjects were contacted for a phone survey utilizing the impact dysphagia questionnaire (IDQ)[8] (Table 1). The IDQ is a tool consisting of 10 questions to assess dysphagia with a total score range of 0 to 50.[9] The IDQ has previously been used to test dysphagia in research. Ravi et al validated the IDQ in over 1000 patients recently, with a score of greater than or equal to 7 serving as a cut-off for irregular motor activity.[9]

2.4. Statistical analysis

The data obtained in the study were analyzed using the SPSS (Statistical Package for Social Sciences) for Windows 25.0 program. Descriptive statistical methods (number, percentage, min-max values, median, mean and standard deviation) were used while evaluating the data.

It was determined that the data used were not suitable for normal distribution. Compliance with normal distribution can be examined with the Q-Q Plot drawing. In addition, the normal distribution of the data used depends on the skewness and kurtosis values between ± 3. Since outliers increase the value of error variance, they are also effective on the power of statistical tests. Therefore, before the statistical tests, it was checked whether the outliers were present in the analyzed data sets.

Nonparametric tests were used in statistical evaluations for data that did not have a normal distribution. In comparison of quantitative data in non-normally distributed data, Mann–Whitney *U* test was used for the difference between 2 independent groups, and Kruskal–Wallis test was used for comparing more than 2 groups.

3. Results

The individuals with normal manometric findings were reached by phone and only 55% (83/151) of them were eligible to reply. The group who completed the survey was representative of the cohort. 66.2% of the participants were female ($P = .40$). The mean age was 57.21, mean weight was 70.69 kg, mean height was 163.74 cm and mean body mass index was 26.41. The distribution of the age was as follows; 13.9% 20 to 39 years interval,40.4% 40 to 59 interval, 45.7% over 60 years. Normal body mass index was in 34.4% of the total, 41.1% was overweight and 21.9% was obese.

Table 1

Impact dysphagia questionnaire.

Questions	Score 0 to 5
Over the past 30 d, on average, how often have you had the following	never (0)
Trouble eating solid food (meat, bread)	less than once a month (1)
Trouble swallowing liquids	1–9 times a month (2)
Pain while swallowing	10–19 times a month (3)
Trouble eating soft foods (yogurt, jello, pudding)	20–29 times a month (4)
Coughing or choking when swallowing foods	daily (5)
Over the past year, how often have you had the following?	never (0)
Food stuck in throat or esophagus for more than 30 minutes	1 time in the past year (1)
An emergency room visit because of food being stuck in the throat or esophagus	2 times in the past year (2)
	3 times in the past year (3)
	4 times in the past year (4)
	more than 4 times in the past year (5)
Over the past 6 mo, on average, how would you rate your discomfort or pain during swallowing?	none (0)
Eating solids (meat, bread)	very mild (1)
Eating soft foods (yogurt, jello, pudding)	mild (2)
Drinking liquid	moderate (3)
	moderately severe (4)
	severe (5)

The distribution of the answers the participant gave to the IDQ is reported in Table 2. 73.5% of the population declared that they never experienced of having difficulty swallowing soft food. Daily difficulty in swallowing solid food was declared by 7.3% of the participants and 3.6% for the liquids. Odinophagia was reported as daily in 6% of the subjects. Around 70% of the cases never experienced of food impaction.

The reliability of the IDQ scaling system was calculated by Cronbach Alpha which was found as 0.929. This result shows a reasonably high reliability of the questionnaire (Cronbach Alpha level greater than 0.60 means high reliability) (Table 3).

The sum of the scores was statistically different between the genders, males having a higher IDQ total score (Mann–Whitney U test) ($P < .05$). There were no differences between the ages in IDQ scores (Kruskall–Wallis test) ($P > .05$). There were no differences in IDQ scores between normal, over-weight and obese subjects (Kruskall–Wallis test) ($P > .05$).

Table 2

The distribution of the impact dysphagia questionnaire scores (30 days interval).

Over the past 30 days, on average, how often have you had the following	Never		Less than 1 day		1–9 times		10–19 times		20–29 times		Daily		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Trouble eating solid food	44	53.0	20	24.1	9	10.8	3	3.6	1	1.2	6	7.3	83	100.0
Trouble swallowing liquids	50	60.3	20	24.1	5	6.0	5	6.0	0	0.0	3	3.6	83	100.0
Pain while swallowing	49	59.0	17	20.6	10	12.0	1	1.2	1	1.2	5	6.0	83	100.0
Trouble eating soft foods	61	73.5	13	15.7	3	3.6	1	1.2	0	0.0	5	6.0	83	100.0
Coughing or choking when swallowing foods	50	60.2	21	25.4	7	8.4	2	2.4	1	1.2	2	2.4	83	100.0

Over the past year, how often have you had the following?	Never		Once		2 times		3 times		4 times		>4 times		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Food stuck in throat or esophagus for more than 30 minutes	60	72.3	15	18.1	5	6.0	0	0.0	2	2.4	1	1.2	83	100.0
An emergency room visit because of food being stuck in the throat or esophagus	54	65.1	26	31.3	1	1.2	1	1.2	0	0.0	1	1.2	83	100.0

Over the past 6 months, on average, how would you rate your discomfort or pain during swallowing?	Never		Very mild		Mild		Moderate		Moderately severe		Severe		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Solid food	43	51.8	18	21.8	10	12.0	5	6.0	5	6.0	2	2.4	83	100.0
Eating soft food	53	63.9	20	24.1	3	3.6	4	4.8	1	1.2	2	2.4	83	100.0
Drinking liquid	53	63.9	18	21.7	4	4.8	6	7.2	0	0.0	2	2.4	83	100.0
Aditional treatment														
No	57	68.7												
Yes	26	31.3												
Total	83	100.0												

Table 3

IDQ reliability statistics reliability statistics.

	Cronbach's Alpha
Symptoms in the last 30 d	0.894
Symptom frequency in the past 12 mo	0.692
Assessment of dysphagia nad odinophagia in the last 6 mo	0.875
Total	0.929

Around 40% of patients were completely asymptomatic at follow up, reflected by an IDQ score of 0. Only 28 out of 83 (33.7%) patients reported significant symptoms as reflected by an IDQ score greater than or equal to 7. The rest of them responded to the survey as having moderate to mild symptoms.

Sixty eight hundred seven percentages of the participants did not seek for another consultation after the primary investigation for difficulty in swallowing. Thirty one hundred three percentages of the participants applied to our or to another gastroenterology department swallowing center and received specific treatments. Two patients sought for advanced investigation and received treatment even they have IDQ scores lower than 7.

The endoscopic diagnosis during the patients' application for dysphagia to the outpatient clinic include esophagitis (grade A–B), gastritis, bulbitis and normal. The IDQ score did not differ between the endoscopic diagnosis groups.

4. Discussion

In this study, we have searched if dysphagia symptom persisted after a normal CM tracing was detected. Eighty three patients participated in a phone survey in which they were asked questions from the impact dysphagia questionnaire (IDQ; total follow-up period: 63 months). Around 40% of patients were completely asymptomatic at follow up, reflected by an IDQ score of 0. Only 28 out of 151 (18.5%) patients reported significant symptoms as reflected by an IDQ score greater than or equal to 7. The rest of them responded to the survey as having moderate to mild symptoms.

Carlson et al found that using HREM, esophageal motility diagnoses had a higher degree of agreement among multiple raters and significantly improved diagnostic accuracy.[6] They believe that, in addition to diagnostic precision, HREM offers knowledge that influences clinical management decisions. HREM Clouse plots are simple to read, resulting in higher diagnostic accuracy and information retention in inexperienced and intermediate esophageal manometry trainees. These findings suggest that pattern recognition is important in HREM perception, regardless of academic level or prior knowledge of oesophageal motor function.[10] When compared to CM, Roman et al found that HREM had a higher diagnostic yield for achalasia.[8] Patients who underwent HREM had more diagnoses reported, meaning that esophageal motility problems could be detected earlier with HREM than with CM. Furthermore, high-resolution manometry forecasts oesophageal bolus transport performance and detects clinically significant anomalies that traditional manometry misses.[11] Nonspecific esophageal motility disorders may be an early stage of a specific disorder, particularly achalasia[12] and these might not be detected by CM especially in moderately trained hands. The diagnostic test's other significant function, aside from diagnostic precision, is that it provides knowledge that influences clinical management decisions.

Additionally HREM is evolving; Chicago Classification version 4.0 (CCv4.0) has been published recently.[4] There were major changes in CCv4.0 compared to the previous version, which can be summarized as follows: CCv4.0 no longer distinguishes between major and minor motility disorders, instead separating disorders of EGJ outflow from disorders of peristalsis.[13]

There are some limitations of the study. IDQ questions might have been misunderstood by some participants hence face-to-face survey would have been a better technique to evaluate the symptoms. The other limitation is the lack of the results and type of treatment they received when they have applied to a clinician after the first investigation. However even if there is a scenerio in which second manometric test comes out to be normal, it still is an unsuccessful first visit (CM) since the patient was not persuaded well enough about ruling out any kind of organic esophageal motility disorder to prevent the patient from duplicate applications to the swallowing centers.

Our study displays that CM as an old friend and finished its role and does not have too much space in the HREM era. Nonetheless CM might be applied in a recurring manner, even if the results are normal, as a tool to preclude disorders of EGJ outflow and peristalsis in patients with swallowing problems in areas where HREM is out of reach.

In conclusion, findings from this study suggest that some patients with normal CM do not progress over time. The identification of normal motor function in CM is not likely a positive prognostic indicator and must be interpreted precautiously. In the HREM era, the usage of CM must be avoided as it would delay proper diagnosis.

Author contributions

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