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Twenty-Four-Hour Ambulatory versus Stationary Esophageal Manometry in the Evaluation of Esophageal Motility in Patients with Gastroesophageal Reflux Disease

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Key Words
Esophageal motility · Esophageal stationary manometry · Esophageal ambulatory manometry · Gastroesophageal reflux disease · Esophageal emptying · Esophageal clearance

Abstract
Background: Although stationary manometry commonly reveals esophageal body motility disorders in patients with gastroesophageal reflux disease (GERD), esophageal function cannot be fully and precisely assessed during normal daily activities by this investigatory modality. ***Aim:*** To compare the results of 24-hour ambulatory manometry with those of stationary manometry and to determine the specificity and accuracy of the former to detect motility disorders in patients with GERD. ***Patients and Methods:*** 15 patients with documented GERD were included in the study. Clinical assessment, upper alimentary endoscopy and stationary manometry as well as 24-hour ambulatory manometry with concomitant 24-hour monitoring of the esophageal pH were performed in each patient. ***Results:*** 24-hour ambulatory manometry revealed a significant number of dropped or interrupted esophageal contractions in patients who were found to have only complete peristalsis on stationary manometry. Furthermore, in certain patients, ambulatory manometry detected an increased incidence of dropped or interrupted contractions as compared to those recorded during stationary manometry. Ineffective contractions, suggestive of poor esophageal motility, although absent on stationary manometry, were detected in a large number of patients during a 24-hour period of recording. Also, the amplitude of esophageal contractions was clearly overestimated when evaluated by stationary manometry. ***Conclusions:*** 24-hour ambulatory esophageal manometry reveals esophageal motor abnormalities to a greater extent than those demonstrated at stationary manometry, in patients with GERD. This might be of significance in designing the treatment and predicting possible outcome.

Introduction

Effective esophageal peristalsis is the most important factor of adequate esophageal clearance of refluxing gastric contents. A low amplitude peristalsis, i.e. <30 mm Hg at the distal esophagus, simultaneous non-peristaltic contractions, interrupted contractions or dropped contractions signify inadequate clearance of the esophagus [1].

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The parameters that characterize esophageal peristalsis have been found to be impaired in a substantial percentage of patients with gastroesophageal reflux disease (GERD) [2–4]. According to some authors [5], esophageal motility status in GERD should be considered when planning an antireflux procedure, and a partial rather than a total wrap should be offered to those refluxers with impaired motility of the esophageal body.

Ambulatory esophageal manometry has been used to study esophageal body motor function in an accurate fashion during a 24-hour period, especially in patients with primary esophageal motility disorders [6–8]. Unlike time-limited and procedure-biased stationary manometry, ambulatory esophageal manometry allows evaluation of esophageal motility for a longer period and under normal daily activities, thus permitting more subjective results to be withdrawn [9]. Therefore, it is conceivable that the commonly impaired esophageal motility in patients with GERD may not be precisely evaluated by stationary manometry, thus resulting in a relatively unreliable preoperative assessment. In the present study we attempted to compare the findings obtained by the 24-hour ambulatory esophageal manometry with those obtained by the standard stationary one, and determine the specificity and accuracy of the former modality to detect motility disorders in patients with GERD.

Patients and Methods

Data derived from clinical assessment and laboratory investigation of 15 consecutive patients (9 male, 6 female) with proven GERD were retrospectively analyzed. They were referred to our unit for antireflux surgery, during 2000. Their mean age was 50 years (range 24–66). Patients with Barrett's esophagus, esophageal peptic stenosis, esophageal shortening, connective tissue disease and previous surgery to the esophagogastric junction or stomach were excluded from the study. Laboratory investigations included upper alimentary endoscopy and assessment of esophagitis according to the Los Angeles Classification [10], standard stationary manometry and simultaneous 24-hour ambulatory esophageal manometry and pH monitoring. Any medication that might affect gastric secretion and/or motility of the upper gastrointestinal tract was discontinued at least 3 days prior to any test. In addition, 20 healthy subjects (13 male, 7 female; mean age 43 years) had the aforementioned battery of tests, and served as controls. The protocol of the study was approved by the Ethical Committee of the Medical School of the University of Crete.

Stationary Manometry

Stationary manometry was performed with an eight-lumen polyvinyl catheter. The lumen of each tube was constantly perfused with distilled water at a rate of 0.6 ml/min by a perfusion system with low compliance (Arndorfer Medical Specialties, Greendale, Wisc., USA). The four distal lateral openings of the catheter were circumferentially located at the same level, 3 cm above its distal tip, and served for the recordings of the lower esophageal sphincter (LES). The remaining four lateral openings were placed at 8, 13, 18 and 23 cm from the tip of the catheter and circumferentially orientated at 90° to each other. They served for the recordings of esophageal peristalsis. A pressure transducer was incorporated into each perfusion line and connected to a polygraph device (Synectics Medical, Stockholm, Sweden). The manometric recordings were displaced on the screen of an on-line computer and were stored for later analysis with the use of dedicated software.

With the patient in the supine position and the head elevated at 30°, the catheter was transnasally introduced. With the catheter in situ, the more proximal lateral openings recorded pressure changes at 5, 10, 15 and 20 cm from the LES. A 15-min period of basal recording was allowed for the patient to relax, which was discarded from further evaluation. Thereafter, all patients were instructed to perform a series of ten wet swallows of 5 ml of water each at 22°C and a 30-s interval between swallows. The parameters of esophageal peristalsis that were taken into account were: (a) the amplitude of peristalsis at 5, 10 and 15 cm proximal to the LES, and (b) the duration of peristalsis at 5, 10 and 15 cm proximal to the LES. Recordings obtained from the site at 20 cm proximal to the LES were not taken into account. The final numerical value of each parameter of esophageal peristalsis represents the mean of the ten values obtained from equal wet swallows. A more detailed definition of calculations is offered elsewhere [4].

To interpret the results, esophageal contractions were characterized as: (i) *complete peristaltic* if they were sequentially detected in all recording channels; (ii) *dropped* if there was no contraction detected at 5 cm above the LES; (iii) *interrupted* if there was no contraction detected at either 10 or 15 cm above the LES, and (iv) *mixed* if two or more contractions were simultaneously detected at the recording channels. Contractions with amplitude <15 mm Hg were not considered as contractions at all, consisting in part of a dropped or interrupted peristaltic sequence. Additionally, contractions were characterized as *effective* if they were peristaltic and had adequate amplitude (>30 mm Hg at 5 cm above the LES, >25 mm Hg at 10 cm above the LES and >20 mm Hg at 15 cm above the LES); *possibly effective* if, although peristaltic, they had inadequate amplitude (<30 mm Hg at 5 cm above the LES, <25 mm Hg at 10 cm above the LES and <20 mm Hg at 15 cm above the LES), and *ineffective* if they were mixed and of inadequate amplitude. For comparison reasons, the aforementioned definitions were those also applied for the interpretation of data acquired from the ambulatory esophageal manometry, as described by others [6].

24-Hour Ambulatory Esophageal Manometry and pH Monitoring

The 24-hour ambulatory monitoring of esophageal motility was performed with the use of a 7-Fr catheter, bearing three miniaturized electronic pressure transducers (Synectics Médical/Sentron, Amsterdam, the Netherlands). The pressure transducers were able to accurately measure pressure changes ranging from –50 to 350 mm Hg, with a resolution of ± 1 mm Hg. When transnasally introduced and positioned in place, the transducers were located at 5, 10 and 15 cm proximally to the manometrically defined LES. Prior to introduction, the catheter was calibrated in a water-filled calibrating tube at pressures 0 mm Hg (representing 1 atm) and +50 mm Hg. The catheter was connected to a portable digital recording device with 4 Mb

Table 1. Data obtained from the standard esophageal manometry and 24-hour pH esophageal monitoring in patients and normal controls

Manometric parameters	Controls	Patients	p
Amplitude of peristalsis, mm Hg			
Level 1	128 ± 32	74 ± 51	0.03
Level 2	94 ± 22	49 ± 27	0.002
Level 3	46 ± 11	30 ± 18	0.04
Duration of peristalsis, s			
Level 1	3 ± 0.4	2.5 ± 0.6	0.01
Level 2	2.8 ± 0.3	2.3 ± 0.6	0.007
Level 3	2.6 ± 0.5	2.1 ± 0.6	0.02
Complete peristaltic sequences	187/200 (93.5%)	123/150 (82%)	0.04
Dropped peristaltic sequences	2/200 (1%)	5/150 (3.3%)	n.s.
Interrupted peristaltic sequences	11/200 (5.5%)	22/150 (14.7%)	0.005
Effective peristaltic sequences	177/200 (88.5%)	92/150 (61.3%)	0.002
Possibly effective peristaltic sequences	23/200 (11.5%)	58/150 (38.7%)	<0.001
pH monitoring parameters			
Percentage of time with pH <4	1.9 + 1	28 + 26	<0.001

Level 1: 5 cm proximal to the LES; level 2: 10 cm proximal to the LES; level 3: 15 cm proximal to the LES.

memory (MicroDigitrapper; Synectics Medical), which was able to sample esophageal motor activity at a frequency of 4 Hz over 24 h. After the introduction of the motility catheter, the patients were sent home and instructed to note sleep and meal times as well as symptom events by pressing the relative buttons on the portable device. All subjects were given a standard diet and were encouraged to perform their usual daily activities. After the end of the 24-hour period, the data were loaded to a personal computer for analysis with a use of dedicated software (Gastrosoft version 3.0; Synectics Medical). According to the settings of the program, each contraction was classified as peristaltic, if velocity of propagation was <20 cm/s. If velocity of propagation of a contraction was >20 cm/s, the pressure waves detected at two or three channels were classified as simultaneous or non-peristaltic. Contractions were also classified as complete, dropped, interrupted, or mixed and as effective, possibly effective or ineffective, according to the same definitions as at stationary esophageal manometry. Analysis of the data also included mean amplitude and duration of peristalsis at all three levels. Esophageal motility was calculated for the total 24-hour period and separately for the upright, the supine and the meal periods.

The ambulatory 24-hour esophageal pH monitoring was performed with the use of a catheter bearing an antimony electrode, which when in place was located at 5 cm proximal to the LES. Prior to transnasal introduction, the electrode was calibrated at pH values of 1 and 7, and was able to measure pH changes ranging from 0 to 11, with a resolution pH value of 0.05. Ambulatory pH monitoring was performed simultaneously to the esophageal motility monitoring, and pH data were stored in the same portable digital device (MicroDigitrapper). pH data were sampled at 6-s intervals. After the 24-hour period, the data were loaded to a personal computer for analysis. Esophageal exposure to acid (pH <4) was quantitated with the use of dedicated software (Gastrosoft version 3.0), and expressed as a composite scoring system [11].

Statistical Analysis

Unless otherwise stated, values are expressed as mean ± SD. Comparisons of data between stationary and ambulatory manometry were made by applying non-parametric tests such as the Mann-Whitney U test and the Wilcoxon test for paired values. The prevalence of different types of contraction was compared between the two methods of manometric assessment, by applying Fisher's exact test. Regression analysis was applied to correlate the various manometric data to severity of esophagitis and extent of esophageal exposure to acid. Values of $p < 0.05$ were considered statistically significant.

Results

All patients had typical reflux symptoms including heartburn and regurgitation. Three of them had difficulty in swallowing solid food and another 4 experienced chest pain of non-cardiac etiology (negative tests for myocardial ischemia). At esophagoscopy, grade A esophagitis was present in 3 patients, grade B in 8 and grade C in the remaining 4. Patients with dysphagia had grade C esophagitis. All patients had been on antisecretory treatment with proton pump inhibitors for 6–67 months. At 24-hour ambulatory esophageal pH monitoring the percentage of time with pH <4 was 28 ± 26, significantly higher than in controls (1.9 ± 1; $p < 0.001$).

The findings of standard esophageal manometry, endoscopy and ambulatory esophageal pH monitoring are shown in table 1. The parameters that characterize peri-

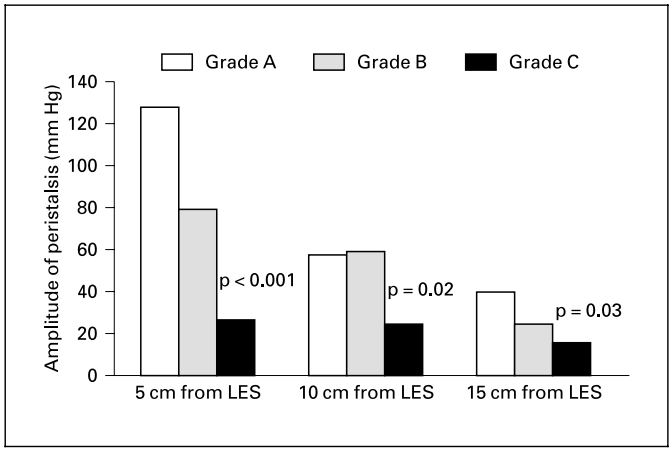

Fig. 1. At stationary manometry, amplitude of peristalsis at all levels of the esophageal body was significantly lower in patients with grade C esophagitis as compared to those with grade A and B esophagitis.

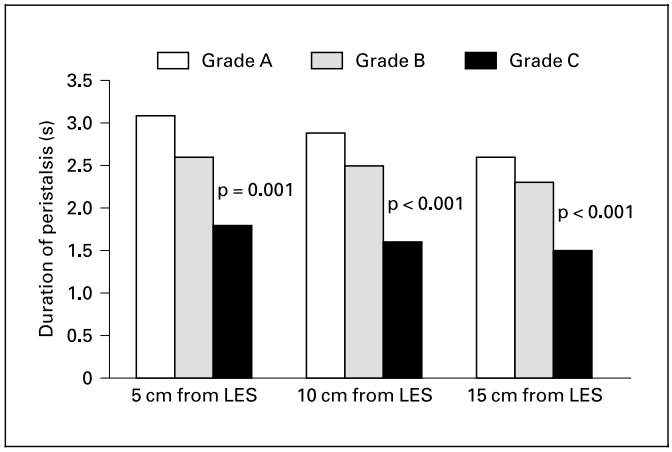

Fig. 2. At stationary manometry, duration of peristalsis at all levels of the esophageal body was significantly lower in patients with grade C esophagitis as compared to those with grade A and B esophagitis.

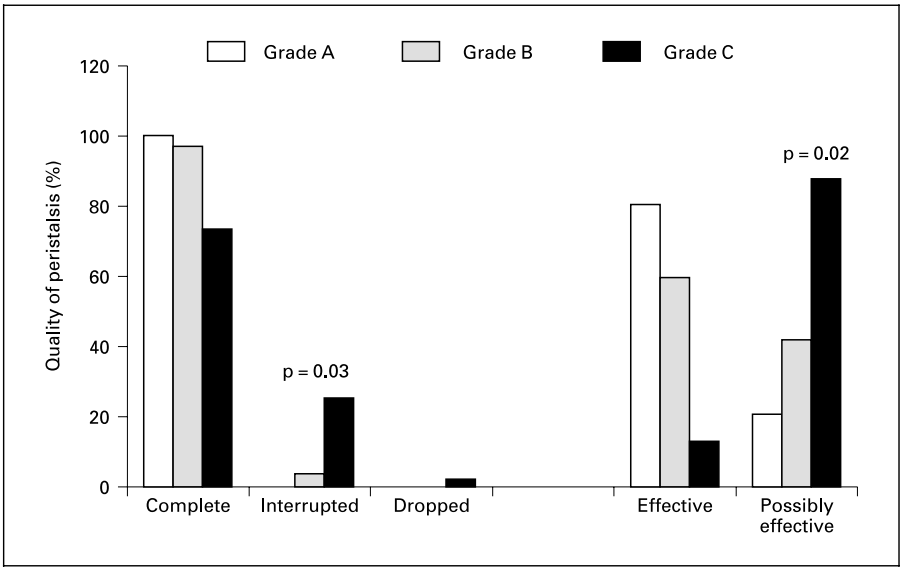

Fig. 3. At stationary manometry, the incidence of interrupted and possibly effective esophageal contractions was significantly lower in patients with grade C esophagitis as compared to those with grade A and B esophagitis.

stalsis and the percentage of interrupted and possibly ineffective peristaltic sequences were significantly impaired compared to normals, and were related to the grade of esophagitis, but not the extent of reflux. In detail, the amplitude and the duration of peristalsis at all levels of measurement were significantly lower in patients with grade C esophagitis, and a significantly greater percentage of dropped and possibly ineffective peristaltic waves were seen in that subset of patients, as compared to patients with grade A and B esophagitis (fig. 1–3). Complete peristaltic contractions at all swallows were detected in 8 out of the 15 patients, while the rest of them had either dropped or interrupted, but not mixed contractions in some of their swallows. Of the 8 cases with complete contractions, peristalsis was effective in 6, while some of the peristaltic sequences in the remaining 2 were possibly effective. On the contrary, a varying number of possibly effective contractions were seen in all but 1 patient with non-peristaltic contractions during some of their swallows. In particular, 2 patients had only possibly effective contractions during all swallows. Conceivably, as mixed contractions were absent, no ineffective contractions were detected.

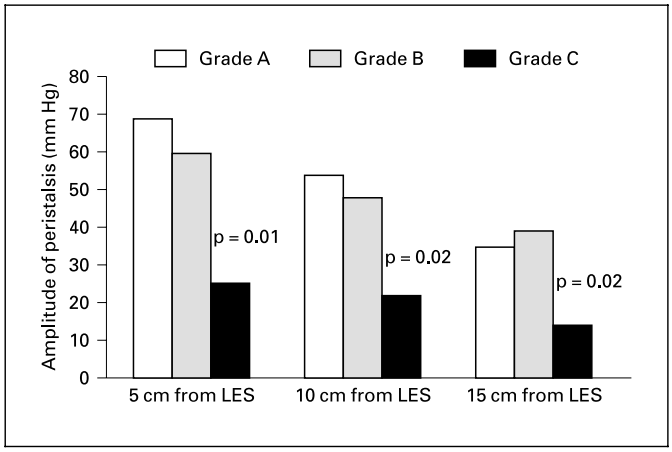

Fig. 4. Similarly to stationary manometry, at ambulatory manometry, amplitude of peristalsis at all levels of the esophageal body was significantly lower in patients with grade C esophagitis as compared to those with grade A and B esophagitis.

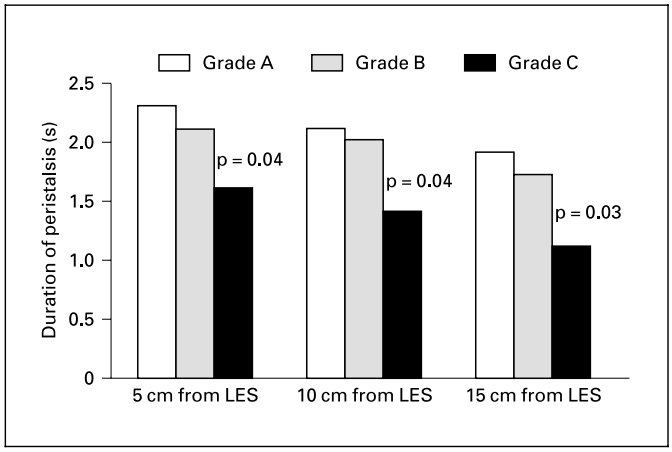

Fig. 5. Similarly to stationary manometry, at ambulatory manometry, duration of peristalsis at all levels of the esophageal body was significantly lower in patients with grade C esophagitis as compared to those with grade A and B esophagitis.

Table 2. Characteristics of esophageal contractions obtained from ambulatory esophageal manometry in controls and patients

Parameter	Total			Upright			Supine			Meals		
	normals	patients	p	normals	patients	p	normals	patients	p	normals	patients	p
Amplitude, mm Hg												
Level 1	50±15	38±14	0.03	47±8	36±11	0.03	57±11	43±12	0.02	71±14	59±13	0.01
Level 2	44±14	31±13	0.01	41±10	27±9	0.05	50±11	34±10	0.02	58±12	48±13	0.03
Level 3	34±10	23±8	0.02	33±4	22±8	0.04	35±6	26±7	0.04	45±8	40±7	0.05
Duration, s												
Level 1	2.2±0.5	2.1±0.4	n.s.	2.1±0.3	2.0±0.3	n.s.	2.5±0.6	2.2±0.5	0.05	2.3±0.4	1.9±0.3	0.04
Level 2	2.0±0.5	2.0±0.5	n.s.	2.0±0.4	2.0±0.4	n.s.	2.2±0.5	2.1±0.3	n.s.	2.3±0.5	1.7±0.3	0.01
Level 3	1.8±0.4	1.7±0.5	n.s.	1.7±0.3	1.7±0.3	n.s.	2.0±0.5	1.9±0.3	n.s.	2.0±0.5	1.7±0.4	0.04
Peristaltic, %	83±11	69±8	0.02	85±15	68±9	0.007	69±17	67±14	n.s.	90±10	74±13	0.005
Complete	80±16	50±19	<0.001	82±17	51±23	0.01	65±14	45±22	0.01	91±12	55±18	<0.001
Dropped	4±4	13±9	<0.001	4±4	12±8	0.02	14±6	13±12	n.s.	2±2	15±15	<0.001
Interrupted	16±7	37±16	<0.001	14±6	37±20	0.009	21±10	42±19	0.007	7±5	30±15	<0.001
Non-peristaltic, %	17±3	31±8	<0.001	15±5	32±9	<0.001	31±6	33±14	n.s.	10±4	26±13	<0.001
Effectiveness, %												
Effective	39±17	21±14	0.008	41±20	21±14	0.003	35±14	19±16	0.02	62±19	30±17	<0.001
Possibly effective	30±14	14±8	0.005	32±18	15±9	0.002	21±10	13±9	0.04	16±9	12±7	n.s.
Ineffective	31±6	65±15	<0.001	27±19	64±17	<0.001	44±14	68±19	0.02	22±11	57±18	<0.001

Level 1: 5 cm proximal to the LES; level 2: 10 cm proximal to the LES; level 3: 15 cm proximal to the LES.

Ambulatory Manometry

At ambulatory esophageal manometry, the amplitude of peristalsis at all levels of measurement and at all time periods, and the duration of peristalsis also at all levels of measurement and during the meal period, were significantly lower in patients than in controls. Furthermore, a significantly higher percentage of contractions were dropped, interrupted, non-peristaltic, possibly effective or ineffective in patients than in controls. That was true for all time periods of monitoring, but differences were even more pronounced during meals (table 2). As in the case of stationary manometry, at ambulatory esophageal motor monitoring, the amplitude and duration of peristalsis were significantly more impaired in patients with grade C

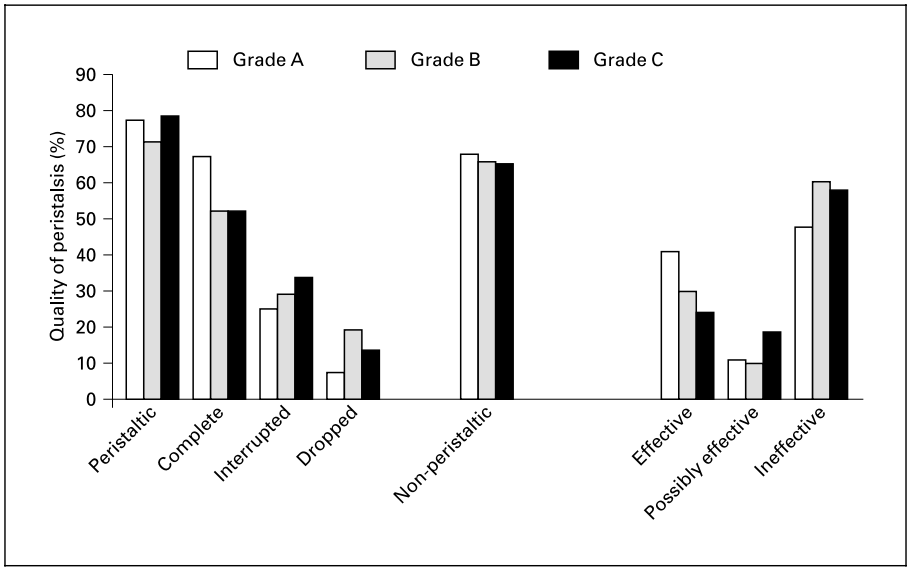

Fig. 6. Unlike stationary manometry, at ambulatory motor esophageal monitoring, no differences in the incidence of the various types of esophageal contractions were found between patients with severe and those with mild esophageal mucosal injury.

than those with grade A or B esophagitis (fig. 4, 5). On the contrary, the incidence of dropped, interrupted, non-peristaltic, possibly effective or ineffective contractions did not differ significantly between the different grades of esophagitis (fig. 6). Also, impairment of peristalsis was not related to the extent of reflux.

Ambulatory vs. Stationary Manometry

At ambulatory manometry during meals only half of the peristaltic sequences were complete and only 30% of them were effective. These findings are dissimilar to those obtained by stationary manometry, where peristaltic sequences were complete in 82% and effective in 61% of the total number of sequences ($p < 0.001$) (table 2).

Amplitude and duration of peristalsis in each individual were lower at ambulatory than stationary manometry during meals ($p < 0.001$). Although not exhibited during stationary esophageal manometry, at ambulatory manometry non-peristaltic and ineffective contractions were present at all times and in all patients in percentages significantly higher than in controls. During the 24-hour monitoring, almost one third of the esophageal contractions were non-peristaltic and up to two thirds were ineffective. Similarly to controls, the incidence of non-peristaltic and ineffective contractions in patients decreased during meals, although not significantly as compared to all periods of motor monitoring (table 2).

Considering patients with or without complete peristaltic sequences on stationary manometry as separate groups, and comparing their results to those obtained on ambulatory motor monitoring during meals, several observations can be made (fig. 1). First, ineffective contractions, not shown at standard manometry, were evident in both groups of patients, at ambulatory manometry; in half of the patients of either group, almost 60% of the contractions were ineffective. Second, as a result of the increased incidence of ineffective contractions at ambulatory manometry, the incidence of effective and possibly effective contractions was significantly different at ambulatory than at stationary manometry. In those with complete peristaltic sequences at stationary manometry, the incidence of effective and possibly effective contractions was 96 and 4% respectively at ambulatory manometry, as opposed to 27 and 13% respectively at ambulatory manometry ($p < 0.001$ and $p = 0.05$, respectively). Similarly, in patients with incomplete peristaltic sequences at stationary manometry, the incidence of effective and possibly effective contractions was 35 and 65% respectively at stationry manometry, as opposed to 16 and 14% respectively at ambulatory manometry ($p = 0.04$ and $p < 0.001$, respectively). Third, the incidence of dropped and interrupted contractions differed significantly between the two methods of assessment. In particular, in patients with complete peristaltic sequences at stationary manometry, dropped-interrupted, mixed and ineffective contractions were absent at stationary manometry, as opposed to an incidence of 45, 28 and 60% respectively at ambulatory manometry during meals ($p < 0.001$).

Discussion

Stationary manometry in combination with ambulatory 24-hour monitoring of esophageal pH have been extensively used in assessing motor function of the esophagus, and in particular ability of the organ to adequately empty its contents into the stomach, in patients with GERD [9]. Considering that surgical correction of reflux is mandatory when esophageal motility deteriorates because of the reflux [12] and that the antireflux procedure should be designed according to the motility status of the organ [5], it is important to assess esophageal motility accurately and identify any possible motor disorders prior to surgery. Findings derived from stationary manometry in the present study confirmed observations of others, according to which esophageal body motor function is impaired in GERD [4]. In particular, amplitude and duration of peristalsis is reduced, and the extent of reduction is related to the severity of esophagitis. Furthermore, the incidence of dropped and possibly effective peristaltic sequences was significantly increased in patients with severe esophagitis, depicting an impaired esophageal clearance and emptying. It has been also suggested that impairment of esophageal peristaltic activity parallels the extent of gastroesophageal reflux [4, 13]. The results of the present study failed to show such a relationship, possibly because all the patients of the present series had been on long-term antisecretory treatment, and this might have altered somehow the profile of esophageal exposure to acid.

However, findings of stationary manometry might be far from reflecting the real motor status of the esophageal body, because of limitations inherent to the method. The examination is performed for a very limited period of time, with the patient in the supine position and in a predetermined fashion of ten swallows of 5 ml of water, with a preset interval of 30 s between swallows. Therefore, the examination disregards the role of body position and bolus consistency in esophageal motor behavior. Esophageal body produces contractions of lower amplitude and duration while in the upright as compared to the supine position, thus compromising esophageal clearance [14]. On the other hand, swallowing in the upright position requires much less effort to be exerted by the esophageal peristaltic activity for a bolus to be propelled to the stomach, while a solid bolus requires esophageal contractions of higher amplitude and duration, but of lower velocity of propagation than liquid boluses, to be advanced through an open LES into the stomach [13, 15, 16]. More specifically, liquids enter the stomach before the esophageal peristaltic wave reaches LES, while solids are propelled as far as the proximal esophagus and then traverse the rest of the esophageal body slowly under the action of the peristaltic wave [15, 17]. As a result of low propagation velocity, the duration of relaxation of the LES increases in response to a solid bolus swallow [6]. This fact may be of great importance in GERD patients where a long-lasting LES relaxation can aggravate reflux during meal. Furthermore, it is known that as bolus consistency increases, incidence of non-peristaltic and ineffective contractions of the esophageal body increases as well [16, 18]. Therefore, in GERD patients, swallowed solids might further influence an already impaired esophageal emptying by allowing an increased amount of gastric contents, refluxing through a relaxed LES for longer periods, not to be promptly rejected back into the stomach. Finally, it has been reported that esophageal motility becomes discoordinated during sleep [8], and this may further aggravate an already impaired esophageal clearance in GERD patients. Apparently, all the aforementioned circadian alterations in esophageal motor function cannot be detected by the standard stationary manometry.

As opposed to the stationary technique, ambulatory 24-hour esophageal manometry allows continuous recording of esophageal body contractions during normal daily activities, thus providing accurate information about effectiveness of esophageal peristalsis and detecting the precise incidence of complete, dropped, interrupted or mixed contractions [8, 9]. The method assessed esophageal motor activity at all positions and circadian situations, including normal meals. Stein et al. [6] compared the findings of stationary to continuous ambulatory esophageal manometry in patients with primary esophageal motor disorders, and found that, unlike the former, the latter method allows a more precise classification of esophageal motor disorders and identifies abnormal esophageal motor activities associated with non-cardiac chest pain. Furthermore, the result of surgical intervention can be reliably assessed by ambulatory esophageal manometry. The same study group assessed the findings of ambulatory esophageal manometry in patients with GERD [13]. They found that the time of esophageal exposure to acid and the frequency of non-peristaltic contractions during upright, supine and meal periods were proportionally related with the degree of mucosal injury. They also showed that patients with mechanically defective LES, as well as those with esophageal strictures of Barrett's esophagus, had esophageal body contractions of lower amplitude than those of patients with less mucosal damage. The authors conclude that esophageal clearance function is greatly compromised in patients with severe GERD.

The findings of the present study based on ambulatory esophageal manometry are similar to those reported by the aforementioned authors. Patients with GERD had a substantially increased incidence of dropped, interrupted, non-peristaltic and ineffective esophageal contractions, and lower amplitude and duration of esophageal peristalsis as compared to controls. The differences were more pronounced during meals during which period motility impairment has a functional sense. Furthermore, impairment of esophageal contractility was even greater in patients with severe mucosal damage.

Comparing the findings of stationary to ambulatory esophageal manometry in GERD patients of the present series, it is evident that the former method clearly underestimates the severity of esophageal motor dysfunction. In general, amplitude and duration of peristalsis in each patient tends to be higher at stationary than the ambulatory manometry. Furthermore, the subset of patients with completely normal motor function of the esophageal body at stationary manometry exhibits peristaltic abnormalities of similar incidence and severity to those with positive stationary manometric findings, at ambulatory esophageal motor monitoring; that is, patients with normal esophageal stationary manometry show an increased frequency of dropped, interrupted or even mixed and ineffective contractions at ambulatory esophageal motor monitoring. In addition, in GERD patients with impaired esophageal peristaltic activity at stationary manometry, esophageal motor dysfunction seems to be even more pronounced at ambulatory esophageal manometry; that is, an increased incidence of dropped, interrupted or possibly effective peristaltic sequences are detected with the latter method. Considering these observations, it can be speculated that esophageal emptying and peristaltic ability to clear the esophageal body from any refluxate can be much more impaired than possibly estimated by the findings of esophageal stationary manometry. Hence, this method of esophageal motor assessment could be misleading when designing an antireflux procedure, particularly in patients with severe long-standing reflux and extended esophageal mucosa injury [13]. Therefore, we propose that preoperative assessment of patients with severe GERD requiring antireflux surgery should also include ambulatory esophageal motor monitoring.

In conclusion, stationary manometry might be of limited diagnostic value when assessing esophageal motor activity in patients with GERD prior to antireflux surgery. The method usually underestimates the severity of esophageal peristaltic abnormalities, and may lead to incorrect choice of the antireflux procedure. Ambulatory 24-hour esophageal body manometry provides accurate information about the esophageal motor behavior through the circadian cycle, and this might be of great importance for the surgical management of GERD.

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