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Gender effects on esophageal motility

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Abstract

It has been suggested that there are no gender effects on esophageal motility. However, in previous studies the subjects did not perform multiple swallows and the quantitative features of esophageal contractions were not evaluated. In order to investigate the gender effects on esophageal motility we studied 40 healthy normal volunteers, 20 men aged 37 ± 15 years (mean ± SD), and 20 women aged 38 ± 14 years. We used the manometric method with an eight-lumen polyvinyl catheter and continuous perfusion. The upper and lower esophageal sphincter pressures were measured by the rapid pull-through method. With the catheter positioned with one lumen opening in the lower esophageal sphincter, and the others at 5, 10 and 15 cm above the sphincter, ten swallows of a 5-ml water bolus alternated with ten dry swallows were performed. Statistical analysis was done by the Student *t*-test and Mann-Whitney test. Gender differences ($P<0.05$) were observed for wet swallows in the duration of contractions 5 cm above the lower esophageal sphincter (men: 3.7 ± 0.2 s, women: 4.5 ± 0.3 s, mean ± SEM), and in the velocity of contractions from 15 to 10 cm above the lower esophageal sphincter (men: 4.7 ± 0.3 cm/s, women: 3.5 ± 0.2 cm/s). There was no difference ($P>0.05$) in sphincter pressure, duration and percentage of complete lower esophageal sphincter relaxation, amplitude of contractions, or in the number of failed, multipeaked and synchronous contractions. We conclude that gender may cause some differences in esophageal motility which, though of no clinical significance, should be taken into consideration when interpreting esophageal motility tests.

Key words
- Esophageal motility
- Gender
- Esophageal physiology

Introduction

Human esophageal motility is affected by various factors such as volume (1,2), viscosity (3,4), temperature of the bolus swallowed (5,6), body position during deglutition (7,8), and age (4,9).

It has been suggested that gender has no effect on esophageal motility (10,11). However, no systematic study comparing the quantitative parameters of multiple swallows in males and females is available. In the present investigation we studied esophageal motility in men and women matched by age using wet and dry swallows.

Material and Methods

Subjects

We studied 40 healthy normal volunteers, 20 males and 20 females. The men ranged in age from 23 to 70 years (mean ± SD: 37 ± 15 years; median, 29 years), and the women from 21 to 68 years (mean 38 ± 14 years; median: 32 years).

Informed consent was obtained from each volunteer. The study was approved by the Human Research Committee of Hospital das Clínicas of FMRP-USP.

Esophageal manometry

For esophageal manometry we used a round eight-lumen polyvinyl catheter with an external diameter of 4.5 mm and an internal diameter of 0.8 mm (Arndorfer Specialties Inc., Greendale, WI). The four distal openings were at the same level, at 90° angles. The four proximal openings were 5 cm apart from each other, also at 90° angles. The lumens of the catheter were connected to external pressure transducers (Model RP1500, Narco Bio Systems, Narco Scientific, Houston, TX), which in turn were connected to a four-channel physiograph (Model MK IV, Narco Bio Systems, Narco Scientific). The lumens were perfused with distilled water at a rate of 0.5 ml/min through a system of low-compliance continuous perfusion.

The study method was previously described (4). Briefly, all volunteers were studied in the supine position. The catheter was inserted through the nose into the stomach after an overnight fast. After a 10-min period of stabilization, the pressures of the lower esophageal sphincter (LES) and the upper esophageal sphincter (UES) were recorded using the four distal openings and the rapid pull-through (RPT) technique. For the LES pressure measurement the volunteers were instructed to stop breathing at the end of expiration when the catheter was pulled by hand at the velocity of 1 cm/s. For the UES the volunteers were instructed to stop breathing during the movement of the catheter, which was pulled at the same velocity as for the LES. The sphincter pressures were recorded in triplicate.

The intragastric pressure and intraesophageal pressure were used as reference for the LES and UES pressures, respectively. The results were the mean of the three pressures measured at the site where they were highest, and the mean of the twelve values was recorded.

For the study of the esophageal body the catheter was positioned with the more distal of the four proximal openings situated at the level of the LES, and the other proximal openings located at 5, 10 and 15 cm above the LES. In this position the volunteers performed 10 swallows of a 5-ml bolus of distilled water at room temperature, alternated with 10 dry swallows. The interval between successive swallows was at least 30 s.

The variables considered were contractile wave amplitude, duration and velocity, as previously described (11). The duration of LES relaxation, in seconds, was measured from the beginning of the descending curve to the beginning of the ascending curve. LES relaxation was complete when its pressure fell to values of less than 4 mmHg above the intragastric pressure. The complete absence of motor activity after a swallow at a given site was considered to be a failure of contraction. Contractions of simultaneous onset at recording sites 5 cm apart, or with a velocity of more than 10 cm/s, were considered synchronous. Multipeaked waves occurred when there was more than one peak in the esophageal contraction.

For each volunteer we calculated the parameters as the mean of 10 dry and 10 wet swallows. For the proportions we show the number of events related to the total number of 200 deglutitions in each group. We also calculated the index of variance for each subject, which represents the variance of the ten swallows divided by the mean.

Statistical analysis

The results are reported as mean ± SEM and as number of events.

The Student *t*-test was used for data analysis, and the Mann-Whitney test for analysis of the number of events. Differences were considered significant when $P<0.05$.

Results

There was no difference (P>0.05) in esophageal contraction amplitude between men and women (Table 1). The duration of contractions was higher in women than in men at 5 cm above the LES after wet swallows (P = 0.05). From 15 to 10 cm above the LES, also with wet swallows, the velocity of contractions was higher in men than in women (P<0.01, Table 1).

Although there was a difference in LES and UES pressures between men and women it was not statistically significant (P>0.05, Table 2).

There was no difference in the duration of LES relaxation (P>0.46), the percentage of deglutitions followed by complete LES

Table 1 - Gender effects on amplitude, duration and velocity of esophageal contractions in men (N = 20) and women (N = 20) after deglutition of a 5-ml bolus of water and dry swallows.

Results are reported as mean ± SEM. *P = 0.05 and **P<0.01 compared with women (*t*-test).

	Water			Dry swallows		
	Amplitude (mmHg)					
	15 cm	10 cm	5 cm	15 cm	10 cm	5 cm
Men	75.6 ± 6.1	85.1 ± 9.4	102.4 ± 11.3	56.1 ± 7.0	56.5 ± 8.4	71.9 ± 9.1
Women	60.9 ± 5.0	98.2 ± 10.1	115.9 ± 8.5	49.2 ± 5.7	61.5 ± 8.2	85.2 ± 7.7
	Duration (s)					
	15 cm	10 cm	5 cm	15 cm	10 cm	5 cm
Men	3.2 ± 0.1	3.9 ± 0.2	3.7 ± 0.2*	2.9 ± 0.2	3.6 ± 0.2	4.0 ± 0.2
Women	3.3 ± 0.2	4.2 ± 0.2	4.5 ± 0.3	3.0 ± 0.1	3.7 ± 0.2	4.2 ± 0.3
	Velocity (cm/s)					
	15 → 10 cm		10 → 5 cm	15 → 10 cm		10 → 5 cm
Men	4.7 ± 0.3**		3.3 ± 0.3	5.2 ± 0.4		4.3 ± 0.4
Women	3.5 ± 0.2		3.0 ± 0.3	4.7 ± 0.3		3.4 ± 0.3

Table 2 - Lower (LES) and upper (UES) esophageal sphincter pressures in men (N = 20) and women (N = 20) measured by the rapid pull-through method in the direction where it is highest, and by the mean of the four directions.

Results are reported as mean ± SEM in mmHg.

	LES		UES	
	Highest	Mean	Highest	Mean
Men	46.3 ± 4.3	28.4 ± 2.5	125.6 ± 9.5	75.7 ± 6.0
Women	54.0 ± 4.2	34.1 ± 2.7	100.4 ± 10.5	61.8 ± 6.1

relaxation (P>0.44, Table 3), or the number of failed (P>0.56), multipeaked (P>0.10) and synchronous contractions (P>0.25, Table 4).

We did not observe significant differences in the index of variance (P>0.10, Table 5).

Discussion

Esophageal manometry is the most useful method for studies of the physiology of esophageal motility and for the detection of functional esophageal motility disorders (12).

Using this method we found that men have an increase in the velocity of esophageal peristalsis in the middle part of the esophageal body and a decreased duration of contractions 5 cm above the LES when compared with women. The differences, although statistically significant, are probably of no clinical significance. However, we have taken them into consideration when interpreting esophageal motility tests.

There are no gender differences in esophageal functional anatomy or innervation that could explain these small changes in esophageal motility (13,14). Gastric emptying of solid food in young women is slower than in men as a consequence of altered distal gastric motor function (15).

These differences in upper gastrointestinal motility between men and women may be attributed to reduced gastrointestinal smooth muscle contractility caused by female reproductive hormones (16,17). However, we did not find differences in esophageal amplitude contractions or sphincter pressures.

Table 3 - Duration of lower esophageal sphincter (LES) relaxation (mean ± SEM) and the percentage of swallows with complete LES relaxation in men (N = 20) and women (N = 20) after deglutition of a 5-ml bolus of water and dry swallows.

	LES relaxation duration (s)		Complete LES relaxation (%)	
	Water	Dry	Water	Dry
Men	8.6 ± 0.3	7.4 ± 0.3	99	92
Women	9.0 ± 0.4	7.6 ± 0.3	97	83

Table 4 - Number of failed, multipeaked and synchronous contractions in men (N = 20) and women (N = 20) after 200 deglutitions of water and 200 dry swallows in each group.

	Water			Dry swallows		
	Failed contractions					
	15 cm	10 cm	5 cm	15 cm	10 cm	5 cm
Men	5	3	3	23	23	15
Women	5	9	5	14	19	9
	Multipeaked contractions					
	15 cm	10 cm	5 cm	15 cm	10 cm	5 cm
Men	2	9	7	6	12	19
Women	10	28	30	12	38	43
	Synchronous contractions					
	15 → 10 cm		10 → 5 cm	15 → 10 cm		10 → 5 cm
Men	6		0	21		22
Women	17		9	30		31

Table 5 - Index of variance of amplitude, duration and velocity of esophageal contractions after the deglutition of a 5-ml bolus of water and dry swallows, in men (N = 20) and women (N = 20).

The index of variance for each subject was the variance of the ten swallows divided by the mean. The results are reported as mean ± SEM of the index of variance for the 20 subjects in each group.

	Water			Dry swallows		
	Amplitude					
	15 cm	10 cm	5 cm	15 cm	10 cm	5 cm
Men	4.5 ± 0.7	4.2 ± 0.9	5.4 ± 0.8	5.6 ± 1.1	5.4 ± 0.9	13.4 ± 2.4
Women	4.8 ± 0.6	5.6 ± 1.0	10.4 ± 3.3	6.3 ± 1.6	9.9 ± 2.0	15.7 ± 2.9
	Duration					
	15 cm	10 cm	5 cm	15 cm	10 cm	5 cm
Men	0.1 ± 0.0	0.1 ± 0.0	0.2 ± 0.0	0.1 ± 0.0	0.3 ± 0.1	0.3 ± 0.0
Women	0.2 ± 0.0	0.2 ± 0.0	0.3 ± 0.1	0.2 ± 0.0	0.2 ± 0.0	0.4 ± 0.1
	Velocity					
	15 → 10 cm		10 → 5 cm	15 → 10 cm		10 → 5 cm
Men	0.4 ± 0.1		0.4 ± 0.1	0.8 ± 0.1		1.0 ± 0.2
Women	0.3 ± 0.1		0.5 ± 0.2	0.8 ± 0.1		0.9 ± 0.3

In an experimental study which evaluated the effect of chronic administration of ethanol on esophageal motility using the cat as an animal model, it was found that ethanol significantly affected the esophageal contraction amplitude and LES pressure only in males (18). *In vitro* studies demonstrated an inhibitory effect of progesterone on the smooth muscle of ureter, large bowel and stomach (16). Another study also demonstrated the inhibitory effect of progesterone on contractile force in rat gastrointestinal smooth muscle (17). Thus, it is possible that hormonal differences between men and women may cause changes in digestive motility. Nevertheless, hormones do not have an important role in esophageal motility (13).

The results for men and women were virtually the same as previously described (11,12).

In conclusion, there are differences in esophageal motility between men and women in terms of duration and velocity of esophageal contraction. Since the subjects studied were asymptomatic normal volunteers these differences seem to be of no clinical significance.

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