J Gastroenterol 2001; 36:226–230

Journal of Gastroenterology



# Relationship between severity of reflux esophagitis according to the Los Angeles classification and esophageal motility

Toshiaki Sugiura, Katsuhiko Iwakiri, Makoto Kotoyori, and Masafumi Kobayashi

Third Department of Internal Medicine, Nippon Medical School, 1-1-5 Sendagi, Bunkyo-ku, Tokyo 113-8603, Japan

***Purpose.*** We investigated the relationship between the severity of reflux esophagitis (RE) according to the Los Angeles (LA) classification and esophageal motility. ***Methods.*** We examined 28 healthy subjects (HS) and 48 RE patients (grade A of the LA classification, 16 patients; grade B, 16 patients; grade C or D, 16 patients). Esophageal manometry was performed by the intraluminal microtransducer method. Resting lower esophageal sphincter (LES) pressure was assessed by the rapid pull-through method. Esophageal contraction after ten repeated 5-ml water swallowings separated by 30-s intervals was measured at 3, 8, 13, and 18 cm above the LES. ***Results.*** The resting LES pressure and the amplitude of esophageal contraction 3 cm above the LES in the grades C + D group were significantly lower than those in the HS group. The amplitude of esophageal contraction 3 cm above the LES in the grade B group was significantly lower than those in the grade A group and the HS group. The frequency of failed peristalsis in the grades C + D group was significantly higher than that in the HS group and the grade A and grade B groups. ***Conclusions.*** The present findings suggested that the severity of RE according to the LA classification would be likely to mainly reflect esophageal volume clearance.

**Key words:** reflux esophagitis, Los Angeles classification, lower esophageal sphincter, esophageal contraction, esophageal motility

## Introduction

Endoscopy is the most widely available investigation for reflux esophagitis (RE). There are a variety of esophagitis classification systems in current use.[1–3] The most popular esophagitis grading systems are the Savary and Miller[1] and the modified Savary and Miller classifications.[2] The extent of esophagitis is an important part of the grading of severity. While many esophagitis grading systems record the circumferential extent, few attempt to define the longitudinal extent.[4,5] It seems logical to assume that the longitudinal extent of esophagitis reflects RE severity, but this has not been proven.

At the World Congress of Gastroenterology held in Los Angeles (LA) in 1994, a consensus grading system[6] was proposed. The advantages of the LA classification are that minor diffuse changes, such as erythema, edema, and friability, are not included, and the term "mucosal break" is introduced to encompass the old terms "erosion" and "ulceration". "Mucosal break" is defined as 'an area of slough or an area of erythema with a discrete lined demarcation from the adjacent or normal-looking mucosa". Another advantage of the LA classification is that, while many esophagitis grading systems record the circumferential extent, of esophagitis, the LA classification records both the longitudinal and circumferential extents. Therefore, the difference between grade A and grade B in the LA classification is the length (less or greater than 5 mm) of the mucosal break confined to the mucosal fold but not continuous between the tops of two mucosal folds.

With regard to esophageal motility in RE, the mean resting lower esophageal sphincter (LES) pressure in patients with severe RE was significantly decreased compared with that in healthy subjects.[7,8] The prevalence of peristaltic dysfunction increases with the increasing severity of RE. Kahrilas et al.[9] reported that 25% of individuals with mild RE and 48% of patients with severe RE had severe peristaltic dysfunction. In

Received: June 28, 2000 / Accepted: December 1, 2000
*Reprint requests to:* K. Iwakiri

the LA classification, mild RE is classified into two groups according to the difference in the length of the mucosal break. However, the differences in esophageal motility between the two groups are unclear.

The aim of the present study was to examine the relationship between the severity of RE according to the LA classification and esophageal motility.

## Subjects and methods

### *Subjects*

We examined 28 healthy subjects (HS) (16 men and 12 women; average age, 54.6 years) and 48 patients with RE (27 men and 21 women; average age, 56.9 years). RE was classified in accordance with the LA classification. Sixteen patients (10 men and 6 women; average age, 57.2 years) had grade A, 16 patients (9 men and 7 women; average age, 55.4 years) had grade B; and 16 patients (8 men and 8 women; average age, 58.0 years) had grade C or D.

We observed the esophagus before carrying out observation of the stomach. Hiatus hernia was defined when the apparent separation of the squamocolumnar junction and the diaphragm impression was greater than 2 cm, determined using endoscopy. None of the HS had a hiatus hernia. Three patients with grade A, 5 patients with grade B, and 13 patients with grade C or D had a hiatus hernia. We measured the length of the mucosal break using an endoscopy scale. The mucosal break in patients with grade B was clearly greater than 5 mm. Patients that were difficult to evaluate as to whether the length of the mucosal break was less than or greater than 5 mm were excluded from the study. Therefore, the length of the mucosal break in patients with grade B was greater than 10 mm. Patients with a very small mucosal break that was difficult to measure using the endoscopy scale were diagnosed as grade A. All HS were free of gastrointestinal symptoms, and none had a history of upper gastrointestinal surgery. All RE patients were new patients without a history of treatment of RE. Each of the subjects gave their written informed consent, and the study was approved by the Human Ethics Committee of the Nippon Medical School.

### *Study protocol*

Each subject fasted for approximately 8 h prior to the study. Smoking and alcohol consumption were prohibited for 12 h prior to the study. Esophageal manometry was performed by the intraluminal microtransducer method. A manometoric catheter (Konigsberg Instruments, Pasadena, CA, USA), with an outside diameter of 4.5 mm, containing four miniature pressure transducers with an opening 5 cm apart and 120° radial orientation, was passed intranasally. The pressure tracing was recorded using an eight-channel recorder (WR3701; Graphtec, Tokyo, Japan), with a paper speed of 2.5 mm/s. LES pressure was measured by the rapid pull-through method, with the subject in the supine position. Resting LES pressure, with reference to the intragastric fundic pressure, was calculated as the mean of three end-expiratory values obtained at intervals of 120°. Esophageal contractions after ten repeated 5-ml water swallowings, separated by 30-s intervals, were measured at 3, 8, 13, and 18 cm above the LES. The esophageal contractions were analyzed for progression and amplitude. An esophageal contraction was defined as an esophageal amplitude of greater than 20 mmHg.

Progression of the esophageal contraction was classified into two types: normal peristalsis and failed peristalsis. Esophageal contraction showing a continuous progression down the lower esophagus was regarded as normal peristalsis. Failed peristalsis was defined as progression of the esophageal contraction that did not fit the definition of normal peristalsis. The amplitude of the esophageal contraction for each subject was expressed as the average of ten recordings obtained at each site. The amplitude was measured from resting and expiratory intraesophageal pressure to the peak of the contraction.

### *Statistical analysis*

Values were expressed as means ± SD. The significance of differences among the HS, and RE grade A, grade B, and grades C + D groups was assessed using the two-tailed Scheffe's test. A $P$ value of less than 0.05 was considered statistically significant.

## Results

Resting LES pressure (Fig. 1). There was no difference in resting LES pressure among the HS and grade A and grade B groups. The resting LES pressure in the grades C + D group (21 ± 8 mmHg) was significantly lower that in the HS (30 ± 10 mmHg; $P < 0.01$), grade A (30 ± 11 mmHg; $P < 0.05$), and grade B (26 ± 10 mmHg; $P < 0.05$) groups.

Amplitude of esophageal contraction (Fig. 2). At 18 cm above the LES, there was no difference in the amplitude of the esophageal contraction among the HS and each of the RE grade groups. At 13 cm above the LES, the amplitude of the esophageal contraction in the grades C + D group (34 ± 22 mmHg) was significantly lower than those in the HS (64 ± 18 mmHg; $P < 0.01$), grade A (55 ± 20 mmHg; $P < 0.05$), and grade B (61 ±

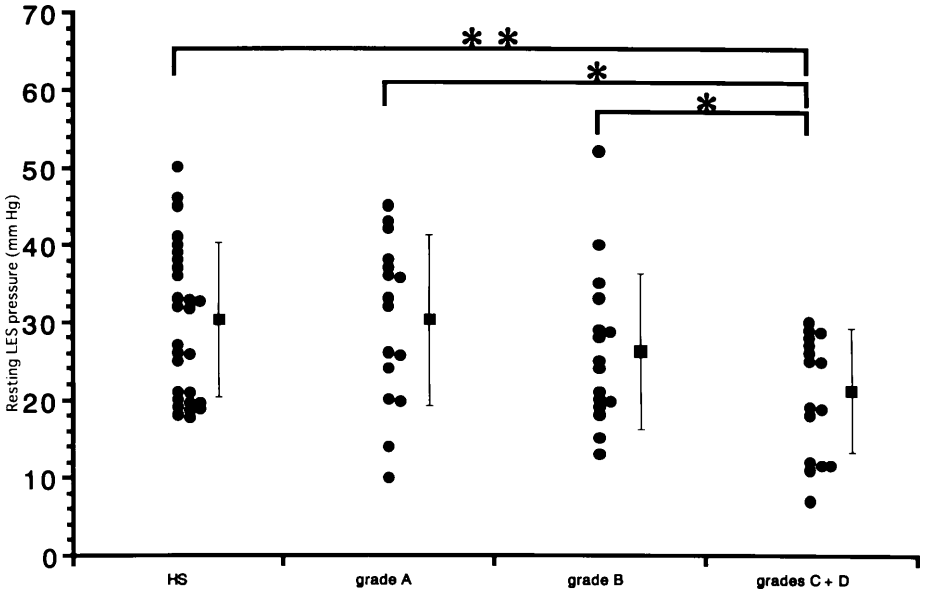


**Fig. 1.** Resting lower esophageal sphincter (*LES*) pressure. Values are means ± SD. *$P < 0.05$; **$P < 0.01$, using two-tailed Scheffe's test. *HS*, Healthy subjects; *grades A*, *B*, *C*, and *D*, see text for explanation

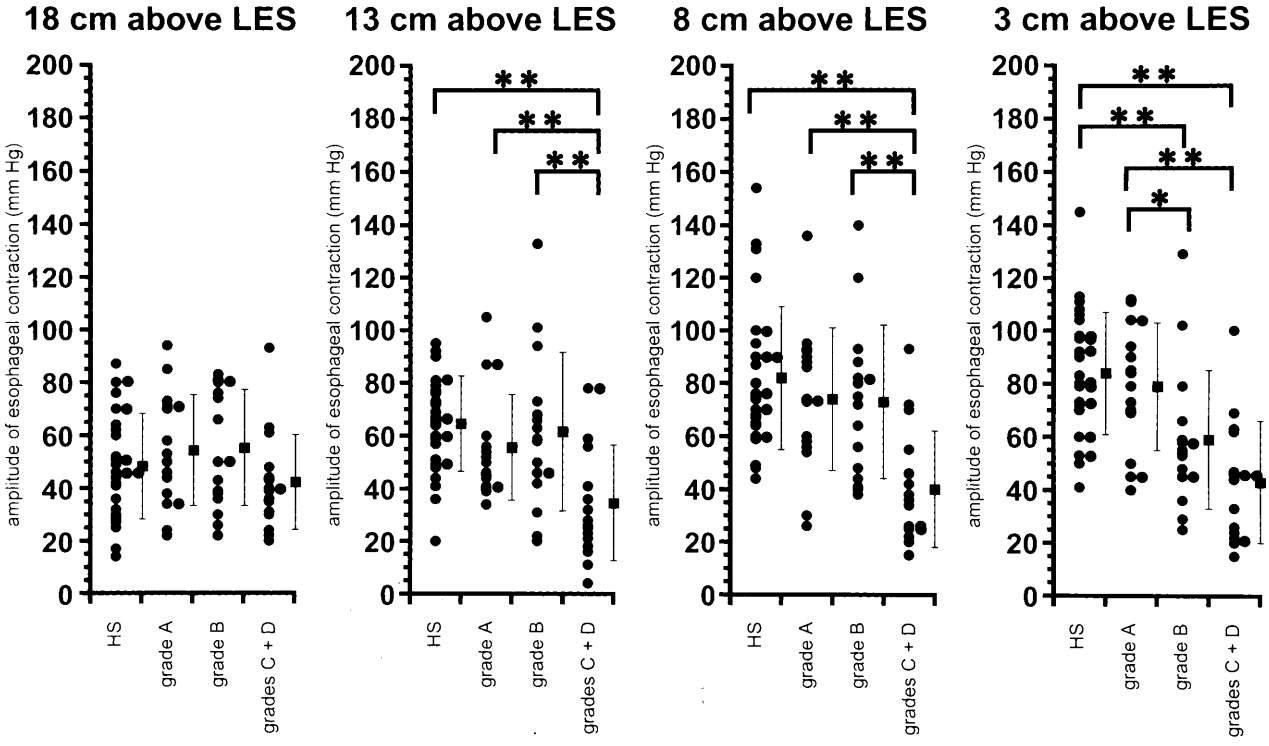


**Fig. 2.** Amplitude of esophageal contraction at 18, 13, 8, and 3 cm above the lower esophageal sphincter (*LES*). Values are means ± SD. *$P < 0.05$; **$P < 0.01$, using two-tailed Scheffe's test. *HS*, Healthy subjects

30 mmHg; $P < 0.01$) groups. At 8 cm above the LES, the amplitude of esophageal contraction in the grades C + D group (40 ± 22 mmHg) was significantly ($P < 0.01$) lower than those in the HS and grade A and grade B groups (82 ± 27, 74 ± 27, and 73 ± 29 mmHg, respectively). At 3 cm above the LES, the amplitude of the esophageal contraction in the grade B group (59 ± 26 mmHg) was significantly lower than that in the HS group (84 ± 27 mmHg; $P < 0.01$) and that in the grade A group (79 ± 24 mmHg; $P < 0.05$), and the amplitude of the esophageal contraction in the grades C + D group (43 ± 23 mmHg) was significantly ($P < 0.01$) lower than those in the HS and grade A groups ($P < 0.01$).

Frequency of failed peristalsis (Fig. 3). The frequency of failed peristalsis in the grades C + D group (43 ±

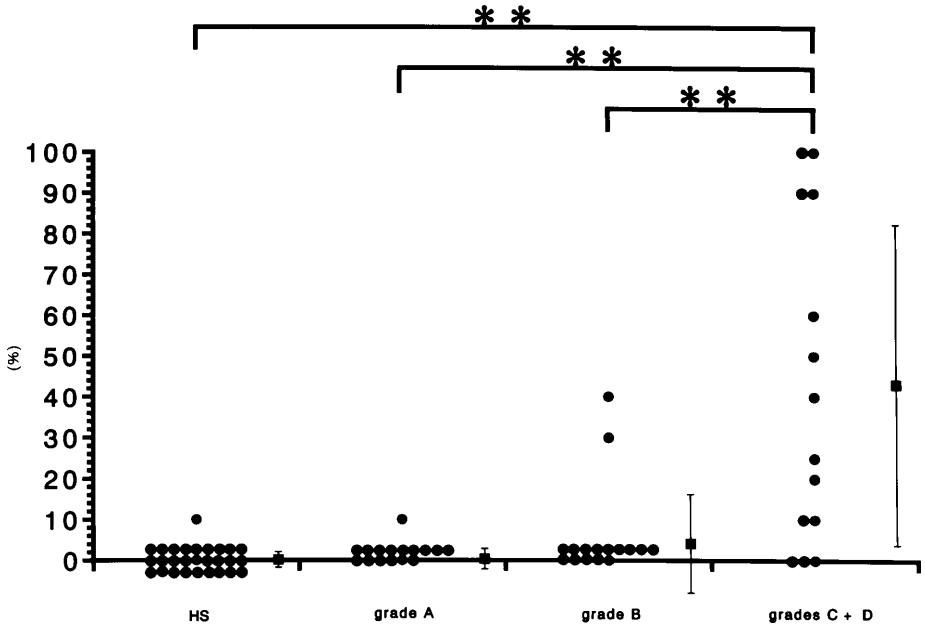


**Fig. 3.** Frequency of failed peristalsis. Values are means ± SD. $^{**}P < 0.01$, using two-tailed Scheffe's test. *HS*, Healthy subjects

39%) was significantly ($P < 0.01$) lower than that in the HS (0 ± 2%) and grade A (1 ± 3%), and grade B (4 ± 12%) groups.

## Discussion

In the examination of resting LES pressure in RE by the LA classification, there was no difference in the resting LES pressure among the HS and grade A and grade B groups. However, the resting LES pressure in the grades C + D group was significantly lower than those in the HS and grade A and grade B groups. In the comparison of individual subjects in each group, the resting LES pressures in each group overlapped considerably. Therefore, in individual subjects, except for those in whom the resting LES pressure was low (less than 10 mmHg), evaluation of LES function by resting LES pressure measurement was not possible. However, as reported previously,[7,8] the mean resting LES pressure of a severe RE group was significantly lower than that in HS. Therefore, it is suggested that the evaluation of the mean resting LES pressure in each group reflects the LES function in each group. Taking these findings into consideration, it is suggested that the LES function in the grades C + D group was significantly lower than that in the HS and grade A and grade B groups.

The esophageal acid exposure time was greater in most patients with RE than in HS.[10–14] Two factors that influence esophageal acid exposure time are the frequency of acid reflux and the length of time necessary to restore esophageal pH to normal after a reflux event.[9] Esophageal peristalsis removes the refluxed acid from the esophagus and brings swallowed saliva to acidified regions of the esophagus.[15,16] Failed and hypotensive peristalsis are ineffective in clearing acid from the esophagus.[17] In the present study, the mean esophageal contraction amplitude in the lower esophagus in the grade A group was significantly higher than that in the grade B group at 3 cm above the LES. Therefore, it was suggested that a longer mucosal break axis reflects the esophageal volume clearance.

In the HS and grade A and grade B groups, esophageal contraction with water swallowing was mostly normal peristalsis. However, the frequency of normal peristalsis with swallowing in the grades C + D group was significantly lower than that in the HS and grade A and grade B groups. These findings suggest that delayed esophageal volume clearance participates in the severity of RE. Therefore, it was suggested that the severity of RE according to the LA classification mainly reflects esophageal volume clearance. No difference was observed between the HS and grade A groups by esophageal manometry. In the grade A group, factors on the stomach side may be a cause of the gastroesophageal reflux.

For a definition of RE with a continuous mucosal break between the tops of two or more mucosal folds, as in grade C or D, it was suggested from the present findings that it was necessary to have a condition with a decrease in resting LES pressure and failed peristalsis. This decrease in resting LES pressure is caused by incomplete tightening of the LES. In other words,

the LES loosens, and an esophageal fold would not be found. In addition, patients with grade C or D are likely to have failed peristalsis. Therefore, the reflux fluid would tend to be in contact with an extensive area of the LES. It was suggested by our findings that the decrease in resting LES pressure in grades C + D group can reasonably explain the occurrence of the continuous mucosal break between the tops of two or more mucosal folds.

There is continuing controversy regarding whether RE causes esophageal dysmotility.[18–20] However, at 18 cm above the LES, where the acid exposure of reflux fluid is rare, there was no difference in esophageal contraction amplitudes among any grades of RE by the LA classification, and the esophageal dysmotility gradually worsened as the RE became more severe. Considering these findings, it is suggested that this pathophysiology is a result of reflux. The resting LES pressure, the frequency of normal peristalsis, and the esophageal contraction amplitude at 13 and 8 cm above the LES in the grades C + D group were significantly lower than those in the grade B group; that is, there was a distinct difference between the grade B and grades C + D groups. To prevent severe RE of grade C or D, it is important to detect mild RE (grade A and grade B) and treat the RE appropriately.

## References


1. Savary M, Miller G. L'Oesophage. Manuel et atlas d'endoscopie. Soleure, Switzerland: Verlag Gassman; 1977. p. 135–42.
2. Ollyo JB, Fontolliet Ch, Brossard E, Lang F. La nouvelle classification de Savary des oesophagitis de reflux. Acta Endoscopica 1992;22:307–20.
3. Armstrong D, Monnier P, Nicolet M, Blum AL, Savary M. Endoscopic assessment of oesophagitis. Gullet 1991;1:63–7.
4. Bate CM, Keeling PWN, O'Morain C, Wilkinson SP, Foster DN, Mountford RA, et al. Comparison of omeprazole and cimetidine in reflux oesophagitis: symptomatic, endoscopic and histological evaluation. Gut 1990;31:968–72.
5. Ogilvie AL, James PD, Atkinson M. Impairment of vagal function in reflux oesophagitis. Q J Med 1985;54:61–74.
6. Armstrong D, Bennett JR, Blum AL, Dent J, Dombal FTD, Galmiche JP, et al. The endoscopic assessment of esophagitis: a progress report on observer agreement. Gastroenterology 1996; 111:85–92.
7. Dent J, Holloway RH, Toouli J, Dodds WJ. Mechanism of lower esophageal sphincter incompetence in patients with symptomatic gastroesophageal reflux. Gut 1988;29:1020–8.
8. Holloway RH, Dent J. Pathophysiology of gastroesophageal reflux: lower esophageal dysfunction in reflux disease. Gastroenterol Clin North Am 1990;19:517–35.
9. Kahrilas PJ, Dodds WJ, Hogan WJ, Kern M, Arndorfer RC, Reece A. Esophageal peristaltic dysfunction in peptic esophagitis. Gastroenterology 1986;91:897–904.
10. Fuchs KH, DeMeester TR, Albertucci M. Specificity and sensitivity of objective diagnosis of gastroesophageal reflux disease. Surgery 1987;102:575–80.
11. Kruse-Andersen S, Wallin L, Madsen T. Acid gastro-oesophageal reflux and oesophageal pressure activity during postprandial and nocturnal periods. Scand J Gastroenterol 1987;22:926–30.
12. Mattoioli S, Pilotti V, Spangaro M, Grigioni WF, Zannori R, Felice V, et al. Reliability of 24-hour home esophageal pH monitoring in diagnosis of gastroesophageal reflux. Dig Dis Sci 1989;34:71–8.
13. Pujol A, Grande L, Ros F, Pera C. Utility of inpatient 24-hour intraesophageal pH monitoring in diagnosis of gastroesophageal reflux. Dig Dis Sci 1988;33:1134–40.
14. Rokkas T, Sladen GE. Ambulatory esophageal pH recording in gastroesophageal reflux. Relevance to the development of esophagitis. Am J Gastroenterol 1988;83:629–32.
15. Helm JF, Dodds WJ, Pelc LR, Palmer DW, Hongan WJ, Teeter BC. Effect of esophageal emptying and saliva on clearance of acid from the esophagus. N Engl J Med 1984;310:284–8.
16. Helm JF, Dodds WJ, Riedel DR, Teeter BC, Hongan WJ, Arndorfer RC. Determinants of esophageal acid clearance in normal subjects. Gastroenterology 1983;85:607–12.
17. Kahrilas PJ, Dodds WJ, Hogan WJ. Effect of peristaltic dysfunction on esophageal volume clearance. Gastroenterology 1988;94: 73–80.
18. Eckardt VF. Does healing of esophagitis improve esophageal motor function? Dig Dis Sci 1988;33:161–5.
19. Russel COH, Pope CE, Gannan RM, Allen FD, Velasco N, Hill LD. Does surgery correct esophageal motor dysfunction in gastroesophageal reflux? Ann Surg 1981;194:290–6.
20. Katz PO, Knuff TE, Benjamin SB, Castell DO. Abnormal esophageal pressure in reflux esophagitis: cause or effect? Am J Gastroenterol 1986;81:744–6.