Transient lower esophageal sphincter relaxations (TLESRs) underlie most acid reflux episodes in normal subjects (1–3) and in patients with mild and moderate gastroesophageal reflux disease (GERD) (4–7). Acid reflux, however, is not detected during every TLESR. In normal subjects, 35% of TLESRs are associated with acid reflux compared to 65% in patients with GERD (6, 8). The mechanisms responsible for this difference remain unclear. Several factors have been proposed: different distribution of gastric contents, abdominal straining, presence of hiatal hernia, esophageal shortening, and duration of the TLESRs.

Recent studies using multiple esophageal pH sensors have shown that acid reflux episodes have a higher proximal extent in patients with GERD than in healthy controls (9). A factor that may partially limit the proximal extent of the refluxate and therefore the detection of acid reflux 5 cm above the LES during a
TLESR can be the level of resistance of the esophageal body to gas and/or liquid retrograde flow.

The esophageal body exhibits phasic propagated motor activity and also tone (10). Esophageal peristalsis is critical for appropriate clearance of refluxed gastric contents; however, little is known about esophageal tone in GERD and its role during gastroesophageal reflux events. We have previously developed a manometric technique to study tonic motor activity in the human esophageal body by using an intraesophageal balloon to create an artificial high pressure zone (HPZ) (11). With this technique, we have studied the tonic contractile activity of the esophageal body during TLESRs in healthy subjects (12). During a TLESR, acid reflux without esophageal distension either caused no change or provoked an increase in esophageal tonic contractility, whereas reflux associated with abrupt distension of the esophageal body on most occasions inhibited esophageal tonic activity as evidenced by relaxation of the artificial HPZ.

Recent manometric studies have demonstrated abnormal peristalsis immediately after reflux in a group of patients with GERD (13). We hypothesized that esophageal tonic contraction in response to reflux might also be affected in these patients. The aim of this study, therefore, was to investigate the esophageal muscular tonic contractile response to reflux during TLESRs in patients with esophagitis.

**MATERIALS AND METHODS**

**Subjects**

Simultaneous esophageal motility and pH studies were performed in 11 patients with gastroesophageal reflux disease (seven men, four women; age range 23–78, median 50 years). The patients had typical reflux symptoms and erosive esophagitis of Savary-Miller grade I (five patients), grade II (three patients), and noncomplicated Barrett’s esophagus (three patients). Six patients had a hiatus hernia proven endoscopically. None of the patients had undergone previous gastrointestinal surgery or was taking any medication known to influence esophageal motor function. Acid suppression medication was stopped at least 72 hr before the study. The data from patients with GERD were compared with earlier data from 10 healthy asymptomatic subjects (controls) (seven men, three women; age range 18–30, median 24 years) in whom the studies were performed in an identical fashion and whose data were the basis of a previously published report (12). The study was approved by the university hospital ethics committee.

**Esophageal Catheter Assembly and Recording Technique**

A manometric assembly with a 6-cm sleeve sensor (Arndorfer, Milwaukee, Wisconsin) was used to monitor pressures in four esophageal sites, LES, and gastric fundus simultaneously. A pH glass electrode with combined reference electrode (Ingold 440-M3) was attached to the catheter 3 cm above the upper end of the sleeve. A flaccid latex balloon with a separate polyvinyl tube was attached to the catheter assembly so that the middle of the balloon was located opposite the side opening at 8 cm above the upper end of the sleeve. The balloon was fixed tightly to the manometric assembly in order to eliminate any displacement (Figure 1). Air was inflated into the balloon at 1-ml increments by means of a calibrated syringe via a separate catheter and a three-way stopcock. The catheter assembly was passed by mouth and positioned so that the sleeve monitored the LES pressure. The balloon was fixed tightly to the manometric assembly in order to eliminate any displacement (Figure 1). Air was inflated into the balloon at 1-ml increments by means of a calibrated syringe via a separate catheter and a three-way stopcock. The catheter assembly was passed by mouth and positioned so that the sleeve monitored the LES pressure. In this position, the motor activity of the esophageal body was monitored by pressure measurements obtained through side holes at the proximal margin of the sleeve and 3, 8, and 13 cm proximal to the sleeve. The assembly was perfused by means of a low-compliance pneumohydraulic perfusion system (Arndorfer Medical Specialties Inc., Greendale, Wisconsin) at a flow rate of 0.4 mL/min and connected to external pressure transducers (Siemens Elema 746, Siemens, Iselin, New Jersey). Swallowing was monitored with a separate water-filled, nonperfused catheter in the hypopharynx above the upper esophageal sphincter. The pH electrode was calibrated in buffers of pH 1 and 7 before and after each study. Signals from the pressure transducers and the pH meter (Radiometer, Copenhagen, Denmark) were recorded on a polygraph (Siemens Elema Mingograph 82) at a speed of 5 mm/sec.