Appendix. Lower Esophageal Sphincter Narrow Zone Motion Parameters

During each distension volume, the lower esophageal sphincter (LES) narrow zone motion parameters were defined as:

(1) LES narrow zone length, $L(t)$:

$$L(t) = B_{lower}(t) - B_{upper}(t) \hspace{6cm} [1]$$

where $B_{upper}(t)$, $B_{lower}(t)$ are upper and lower edges of the narrow zone during the distension, the peak-to-peak amplitude of the $L(t)$ (maximum value - minimum value in a cyclic fluctuation) was calculated as the shortening of the LES narrow zone in a given contraction cycle.

(2) The LES narrow zone upper and lower boundary baseline, $\overline{B_{upper}(t)}$ and $\overline{B_{lower}(t)}$:

$\overline{B_{upper}(t)}$ is the averaged $B_{upper}(t)$ during each distension volume.
$\overline{B_{lower}(t)}$ is the averaged $B_{lower}(t)$ during each distension volume.

(3) The proximal, middle, and distal locations of the narrow zone:

Proximal narrow zone: $L_{proximal}(t) = B_{upper}(t) + 0.25 * L(t)$
Middle narrow zone: $L_{middle}(t) = B_{upper}(t) + 0.5 * L(t)$
Distal narrow zone: $L_{distal}(t) = B_{upper}(t) + 0.75 * L(t)$ $\hspace{3cm}$ [2]

(4) The axial movement of the LES narrow zone, $L_{movement}(t)$:

$$L_{movement}(t) = (\overline{B_{lower}(t)} - B_{lower}(t)) \hspace{5cm} [3]$$

The peak-to-peak amplitude of the $L_{movement}(t)$ (maximum value - minimum value in a cyclic fluctuation) was calculated as the upward movement of the LES narrow zone in a contraction cycle.

(5) The bag pressure change during the distension, $P(t)$:

The peak-to-peak amplitude of the $P(t)$ (maximum value - minimum value in a cyclic fluctuation) was calculated as the contraction pressure change of the LES narrow zone in one contraction cycle.

(6) The diameter change

The diameter change during the distension in the distal, middle and proximal parts of the LES narrow zone, were denoted as: $D_{distal}(t)$ (the diameter at $L_{distal}(t)$), $D_{middle}(t)$ (the diameter at $L_{middle}(t)$), and $D_{proximal}(t)$ (the diameter at $L_{proximal}(t)$). The peak-to-peak amplitude of the $D_{middle}(t)$ (maximum value - minimum value in a cyclic fluctuation) was calculated as the contraction diameter change of the LES narrow zone in one contraction cycle.

(7) Peristaltic velocity v

For distension-evoked secondary peristaltic contractions, the peristaltic velocity v was calculated as: $v = (L_{distal} - L_{proximal})/(t_{distal} - t_{proximal})$, where t_{distal}, $t_{proximal}$ were time at the minimum D_{distal} and $D_{proximal}$ during a contraction cycle, and L_{distal} and $L_{proximal}$ were the 25% and 75% LES narrow zone length at t_{distal} and $t_{proximal}$.