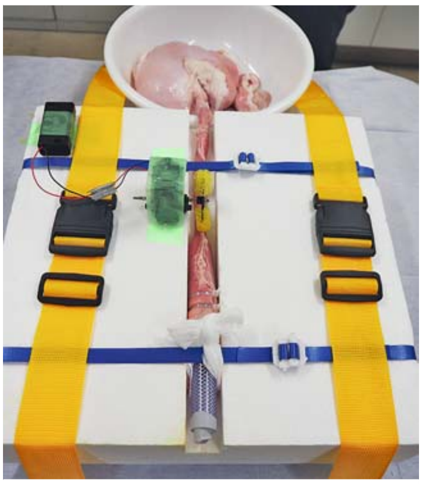
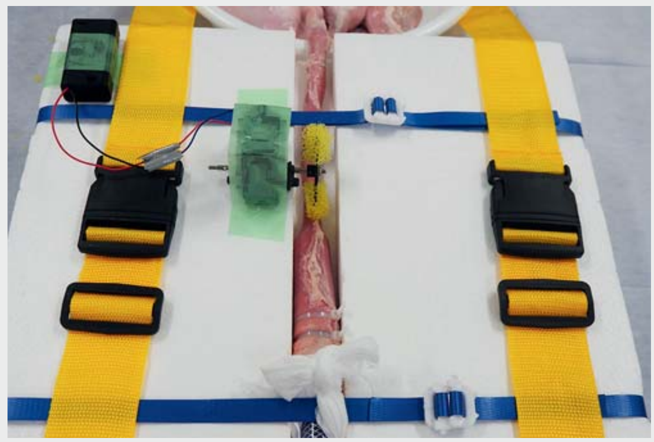
Development of an animal model that reproduces pulsations for training in esophageal endoscopic submucosal dissection



▶ **Fig. 1** Training setup of prepared hose, polystyrene box, isolated pig organs, belts, and motor device.



Video 1 Heartbeat simulation enables realistic training in esophageal endoscopic submucosal dissection.

In recent years, endoscopic submucosal dissection (ESD) has been increasingly used in early esophageal cancer. ESD is superior to endoscopic mucosal resection in terms of en bloc resection, curative resection, and recurrence rates [1]. However, performing esophageal ESD is technically demanding because of the thin wall and narrow lumen of the esophagus, respiratory fluctuations, and pulsations. The perforation rate is approximately 3.3 % [2]. Because the morbidity of esophageal cancer is lower than that of gastric and colon cancers [3], clinicians have limited opportunities to practice esophageal ESD, and therefore many clinicians consider this technique challenging. Studies to date have reported animal models for esophageal ESD training [4, 5], but these models do not simulate the respiratory fluctuations or pulsations that make the procedure challenging in real-world practice. This report outlines our more realistic novel training model.

Commercially available isolated pig organs, belts, a 40-cm square polystyrene box with a central height of 8 cm and a trench in the center (trench dimensions: 4 cm in width and depth), hose, and motor device that rotates at 80 cycles/minute (approximately a normal human heart rate) were obtained. The hose was inserted into the oral side and fixed firmly to the organs above. Belts were used to fix the organs in place in the box and hold the hose ("duodenum") firmly in place. The motor device was approximately 30 cm from the incisors (▶ **Fig. 1**). A virtual lesion was marked, followed by performance of a standard ESD involving local injection, mucosal incision, and dissection. The heartbeat simulation enabled realistic ESD training (▶ **Video 1**). Furthermore, the portability of the motor device allows for multiple training sessions using one pig's organs, while the model's heart rate can be changed by switching gears on the motor. Training using our ex vivo animal model may help clinicians acquire the practical skills needed for ESD.

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Competing interests

The authors declare that they have no conflict of interest.

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