

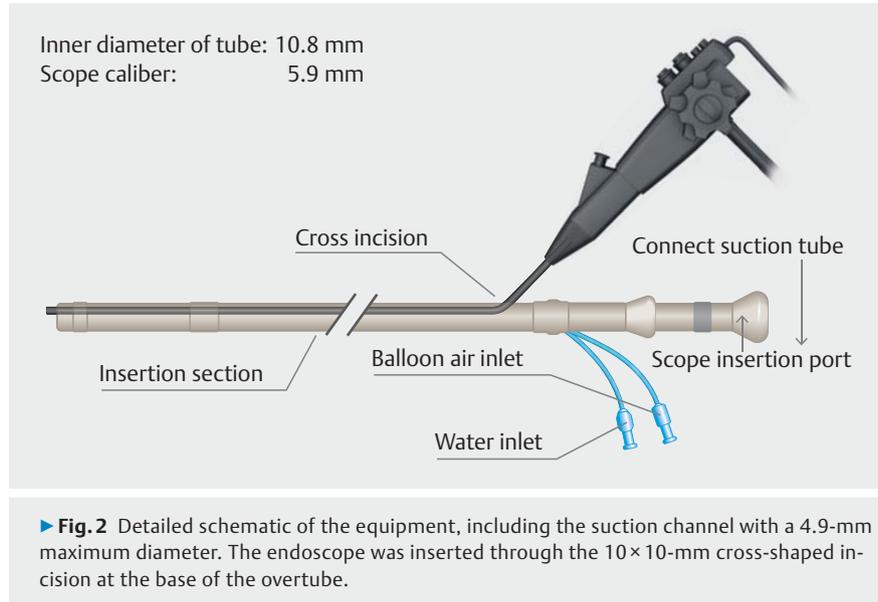
## Novel method using small-caliber endoscope and balloon overtube for removing gastrointestinal residue



► **Fig. 1** The suction equipment used for this procedure, which includes a nasal endoscope and overtube.

The presence of gastrointestinal blood clots and food residue often makes emergent endoscopic procedures difficult [1, 2]. Removal procedures are conventionally performed using grasping forceps, but these techniques require long procedure times and leave behind large amounts of residue. Although a tube-assisted suction method has been recently reported [3], the ability to pass through a narrow space and the adequacy of suction with side-scope navigation seem limited due to poor followability. For this reason, we developed a novel method of gastrointestinal residue removal using existing instruments.

We conducted an experimental study on two beagle dogs with food jelly filling the upper and middle stomach (► **Video 1**). The equipment used consisted of a balloon overtube (TS-12140; Fujifilm, Tokyo, Japan) and a small-caliber endoscope (EG-L580NM7; Fujifilm) (► **Fig. 1**). First, a 10×10-mm cross-shaped incision was made at the base of the overtube (► **Fig. 2**), and the endoscope was fixed 2 mm from the distal tip of the overtube through the incision hole and connected



► **Fig. 2** Detailed schematic of the equipment, including the suction channel with a 4.9-mm maximum diameter. The endoscope was inserted through the 10×10-mm cross-shaped incision at the base of the overtube.

at four points using silk thread (► **Fig. 3**). The maximum diameter of the suction channel was 4.9 mm, which is larger than the 3.2-mm forceps channel in a conventional endoscope. Next, the overtube was inserted into the stomach under visual observation via the endoscope. With this configuration, large amounts of residue were effectively aspirated through the channel (► **Fig. 4**). Suctioning the superficial mucosa, which is unavoidable unless preventive measures are taken, interrupts the smooth suctioning procedure. We therefore found it useful to push the mucosa using a biopsy forceps to maintain a clear view throughout the procedure (► **Fig. 5**). This procedure was successful in creating a clear operation field without any complications in both animals. The procedure time was 6 min on average.

This experiment demonstrates that this novel method may be efficient for removing upper gastrointestinal residue.

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► **Fig. 3** The endoscope was fixed 2 mm from the distal tip of the overtube and connected to the overtube at four points using silk thread.

### Competing interests

The authors declare that they have no conflict of interest.



▶ **Video 1** Suction equipment and procedure for the proposed novel, rapid, and safe method of removing upper gastrointestinal residue.

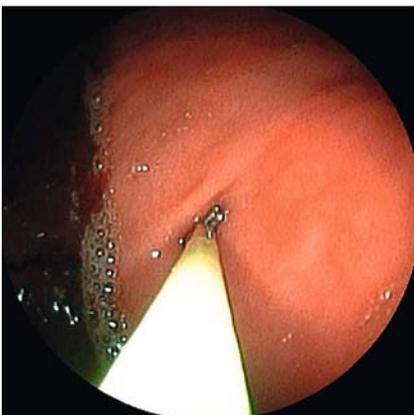


**a** Before removing residue



**b** After removing residue

▶ **Fig. 4** Endoscopic images showing the operation field before and after the suction method was applied: **a** before, **b** after.



▶ **Fig. 5** Pushing the mucosa using a biopsy forceps was useful to maintain a continuously clear view.

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