

3D-printed model in the guidance of tumor resection: a novel concept for resecting a large submucosal tumor in the mid-esophagus



► **Fig. 1** The submucosal tumor in the mid-esophagus, as shown by endoscopy.



► **Fig. 2** The submucosal tumor (arrow) and its adjacent organs, as shown by computed tomography.



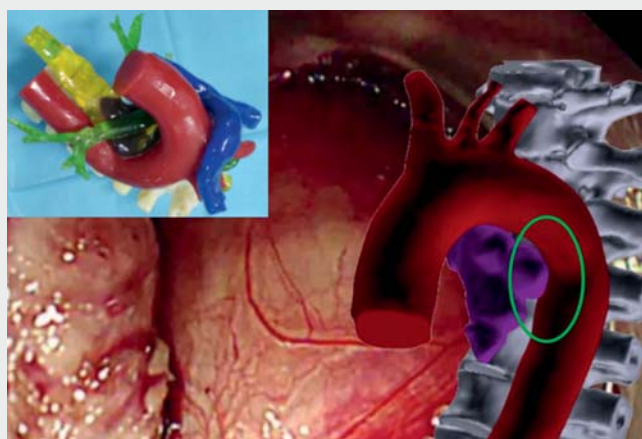
► **Fig. 3** The submucosal tumor and its adjacent organs, as shown by 3D-printed model.

Although most large submucosal tumors in the esophagus such as leiomyomas are benign, obstructive symptoms may develop owing to their size [1]. Endoscopic resection of large tumors in the esophagus remains difficult [2], and exophytic tumors in the mid-esophagus are the worst. The main problem is the presence of important adjacent organs such as bronchus, aorta, and spine. We report a novel concept for facilitating endoscopic resection: 3D-printed model in the guidance of tumor resection (3DM-GTR). The 3D-printed model, based on enhanced computed tomography, could clearly display the tumor anatomy and details of adjacent structures, playing a role in planning and implementing endoscopic resection.

A 47-year-old man with intermittent dysphagia for 2 months was diagnosed with a large submucosal tumor in the mid-esophagus (► **Fig. 1**). Enhanced computed tomography showed that the lesion was close to the bronchus, aorta, and spine (► **Fig. 2**). The 3D-printed model directly demonstrated the tumor

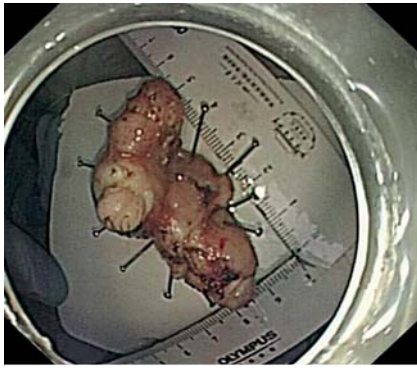
and its adjacent organs (► **Fig. 3**). Under the guidance of the model (► **Video 1**), we successfully resected the tumor (► **Fig. 4**), without obvious intraoperative bleeding or other injuries to adjacent organs (► **Fig. 5**). The mucosal entry was closed using endoclips. The pathology confirmed the diagnosis of leiomyoma. Fasting and prophylactic antibiotics were prescribed for 2 days. Proton pump inhibitors and nutritional support were given. The mild cervical subcutaneous emphysema detected during the procedure resolved spontaneously. The patient began drinking after 3 days and was discharged on postoperative Day 5. At 3-month follow-up, the patient had not experienced discomfort and upper endoscopy confirmed healing of the mucosa.

3DM-GTR seems a good and promising method, especially for large tumors in complex locations. The simulation model can remind the endoscopist in real time about what to expect in the next step; thus, it could reduce unexpected injuries to important adjacent organs.

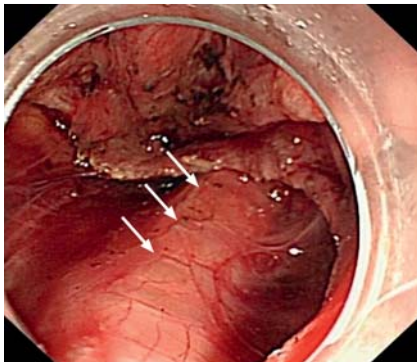


► **Video 1** 3D-printed model in the guidance of endoscopic resection of a large submucosal tumor in the mid-esophagus.





► Fig. 4 The resected tumor.



► Fig. 5 The exposed aorta after tumor resection (arrows).

Endoscopy_UCTN_Code_TTT_1AO_2AN

Acknowledgment

We acknowledge the support from Sichuan Province Science and Technology Department (China) (2017SZ0009).

Competing interests

The authors declare that they have no conflict of interest.

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DOI <https://doi.org/10.1055/a-1090-6940>

Published online: 29.1.2020

Endoscopy 2020; 52: E273–E274

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Stuttgart · New York

ISSN 0013-726X

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