

# Submucosal Tunneling Endoscopic Resection vs Thoracoscopic Enucleation for Large Submucosal Tumors in the Esophagus and the Esophagogastric Junction

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- BACKGROUND:** Submucosal tunneling endoscopic resection (STER) is regarded as a promising method for resection of submucosal tumors (SMTs); however, little is known about a comprehensive comparison of STER and thoracoscopic enucleation (TE). The aim of this study was to compare the clinical outcomes of STER and TE for large symptomatic SMTs in the esophagus and esophagogastric junction, as well as to analyze the factors that affect the feasibility and safety of STER.
- STUDY DESIGN:** We enrolled 166 patients with large symptomatic SMTs in the esophagus and esophagogastric junction from September 2011 to March 2016 in this retrospective study. The clinicopathologic features and treatment results were collected and analyzed.
- RESULTS:** En bloc resection was achieved in 84.6% of the patients in the STER group and 86.7% of the patients in the TE group ( $p = 0.708$ ). Notably, the procedure time and hospital stay in the STER group were considerably shorter than those in the TE group. Tumor transverse diameter is a significant risk factor for piecemeal resection, adverse events, and technical difficulties. No recurrence or metastasis was found during a mean follow-up period of more than 2 years.
- CONCLUSIONS:** Submucosal tunneling endoscopic resection is effective and safe for large SMTs in the esophagus and esophagogastric junction. This procedure has the advantage of being more minimally invasive with a shorter procedure time and hospital stay compared with TE. Submucosal tunneling endoscopic resection for tumors with a transverse diameter  $\geq 3.5$  cm and an irregular shape is associated with relatively high risk for piecemeal resection, adverse events, and technical difficulties. (*J Am Coll Surg* 2017;■:1–11. © 2017 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

Submucosal tumors (SMTs) are generally covered with normal gastrointestinal mucosa and account for <1% of all esophageal neoplasms.<sup>1</sup> In general, small SMTs are

asymptomatic and found incidentally; large ones are more likely to be symptomatic and require intervention.<sup>2,3</sup> In the past decade, thoracoscopic enucleation (TE) has been the standard treatment for SMTs in the esophagus and esophagogastric junction (EGJ).<sup>4</sup> With the development of NOTES, endoscopic resection has become regarded as a more minimally invasive method that is recommended for upper gastrointestinal SMTs.<sup>5</sup> We developed a new technique, submucosal tunneling endoscopic resection (STER), to use the submucosal space for resection of the upper gastrointestinal SMTs originating from the muscularis propria (MP) layer.<sup>6</sup> This technique combines submucosal tunneling and endoscopic submucosal dissection (ESD). Compared with conventional ESD and its derivate techniques, such as endoscopic submucosal excavation and endoscopic full-thickness resection, STER can resect SMTs under direct vision, maintain mucosal integrity, and, consequently, the risks for

**Disclosure Information:** Nothing to disclose.

**Support:** This study was supported by the National Natural Science Foundation of China (81370588) and Shanghai Committee of Science and Technology (17140901100, 15JC1490300, and 14441901500).

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Received July 23, 2017; Revised September 1, 2017; Accepted September 1, 2017.

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**Abbreviations and Acronyms**

EGJ	= esophagogastric junction
ESD	= endoscopic submucosal dissection
GIST	= gastrointestinal stromal tumor
MP	= muscularis propria
SMT	= submucosal tumors
STER	= submucosal tunneling endoscopic resection
TE	= thoracoscopic enucleation

postoperative gastrointestinal tract leakage and secondary infection are theoretically reduced.<sup>7,8</sup>

Recently, reports about STER have been increasing and the technique has been widely applied for endoscopic resection of SMTs in the esophagus and EGJ,<sup>9</sup> however, there are few studies that provide a comprehensive comparison of STER and TE. In addition, it is unclear whether STER is feasible for large upper gastrointestinal SMTs, as current studies are limited to the investigations of STER for SMTs with a relatively small diameter.<sup>10-12</sup> The aim of this study was to compare the clinical outcomes of STER and TE for large symptomatic SMTs in the esophagus and EGJ, as well as to analyze the clinicopathologic factors that affect the feasibility of STER. We believe the data and conclusions provided in this study can become a useful reference tool for doctors and researchers in this field.

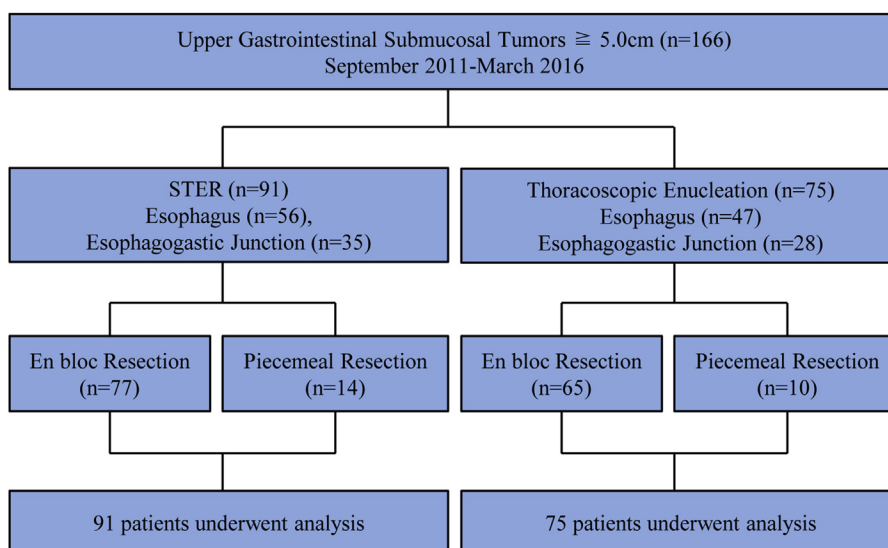
**METHODS****Patients**

A total of 166 patients with large symptomatic SMTs originating from the MP layer in the esophagus and

EGJ were enrolled and analyzed between September 2011 and March 2016 in this retrospective study (Fig. 1). Lesions were defined by endoscopic ultrasonography and CT.<sup>11</sup> The inclusion criteria for enrollment were as follows: patients who reported typical or atypical upper gastrointestinal symptoms, suffered from severe anxiety of a potentially malignant tumor, and specifically requested aggressive treatment; tumor originated from the MP layer; tumor had a long diameter  $\geq 5.0$  cm; and patients consented to undergo an STER or TE procedure at our hospital. When SMT was suggested to be high risk or malignant, a surgical approach was recommended to ensure en bloc resection. The study was approved by the IRB of Zhongshan Hospital (no. 2009135), and informed consent was obtained from the patients for all of the procedures and interventions described.

**Operative approach and technique**

Patients were placed under general anesthesia with endotracheal intubation and STERs were performed. During the procedure, a CO<sub>2</sub> insufflator was used for carbon dioxide gas insufflation. Diluted indigo carmine was used for submucosal injection. The procedure began with the creation of a fluid cushion by orally injecting the mixed solution 3.0 to 5.0 cm to the proximal margin of the SMT, according to the tumor location. A 1.5- to 2.0-cm longitudinal mucosal incision was made using a hook knife or hybrid knife at the top of the fluid cushion to provide mucosal entry to the submucosal space. The submucosal tunnel was created between the mucosal and muscular layers, ending about 1.0 cm distal to the tumor to ensure a satisfactory endoscopic view of the SMT



**Figure 1.** Flow chart of the study profile. STER, submucosal tunneling endoscopic resection.

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