Development and Application of Endoscopic Suturing Devices

Hyuk Soon Choi, M.D., Ph.D.
Division of Gastroenterology and Hepatology, Department of Internal Medicine, Institute of Gastrointestinal Medical Instrument Research, Korea University College of Medicine, Seoul, Korea

Introduction

In recent years, novel flexible endoscopic approaches in the treatment of refractory intractable gastrointestinal diseases as well as established gastrointestinal diseases have evolved noticeably. The role of endoscopy is to diagnose and treat gastrointestinal diseases including cancer. However, recent developments and advances in flexible endoscopy enable the treatment of unresolved gastrointestinal diseases, as well as those associated with metabolic syndrome, including obesity and diabetes.

Suturing is a key modality in surgery, and is considered critical to many procedures in gastroenterology. An essential component of any new endoscopic therapy for applicable diseases is an endoscopic suturing device. The American Society for Gastrointestinal Endoscopy (ASGE) and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) Working Group at the 2005 Natural Orifice Surgery Consortium for Assessment and Research reported a consensus that successful closure of intentional lumen defects is an absolute necessity for natural orifice transluminal endoscopic surgery (NOTES) to progress and eventually replace other traditional surgical approaches. [1] The development of an endoscopic suture device allows endoscopists to perform minimally invasive endoscopic surgery, NOTES, and endoluminal bariatric procedures with flexible endoscopy. This report discusses the development and application of endoscopic suturing devices with current and future availability.

Application of Endoscopic Suturing Device

NOTES is well-known for endoscopic surgery through natural orifices such as the mouth, vagina, and anus. However, some technical difficulties still exist in performing NOTES procedures. One of the most important issues to overcome is the development of a secure perforation closure method for approaching the visceral cavity. The success of NOTES depends on reliable and safe closure of a gastrostomy. [2] Many research groups have developed novel endoscopic suturing devices to continuously close a viscerotomy of the stomach and overcome limitations of previous suturing devices. However, the complex suturing mechanisms and tools of current suturing devices not only increase the operation time but also decrease the feasibility of NOTES.

Minimally invasive endoscopic surgery has progressively developed for the treatment of various medical dis-
eases because it minimizes operative damage, thus improving the recovery time and cosmetic outcome for patients. Nonsurgical closure of the gastrointestinal wall by an endoscopic suture device may be desired in the setting of inflammatory or neoplastic fistulae, dehiscence of surgical anastomoses, and spontaneous or iatrogenic perforations. In recent studies, endoscopic suture fixation of gastrointestinal stents showed good results in preventing migration. [3,4]

Gastroplasty with an endoscopic suture device involves reduction of gastric volume through the creation of mucosa-to-mucosa tissue apposition, gastric sleeve mucosa-to-mucosa apposition, or a gastric sleeve similar to surgical sleeve gastrectomy. This resulted in significant body weight reduction after placement in previous studies.

Development of Endoscopic Suturing Device

The currently available endoscopic suturing devices for human and animal studies are as follows: EndoCinch™ (C.R. Bard Inc., Murray Hill, NJ, USA), TOGA system (Satiety Inc., Palo Alto, CA, USA), Esophyx (Boston Scientific Corp., Natick, MA, USA), KUMC Successive Suturing Device (Korea University, Chun HJ, Seoul, Korea), overstitch endoscopic suturing system (Apollo Endosurgery, Austin, TX, USA), G Prox (USGI Medical, San Clemente, CA, USA), NDO plicator (NDO Surgical, Mansfield, MA, USA), T-anchors (Ethicon Endo Surgery, Cincinatti, OH, USA), Looped T-anchors (Cook Endoscopy, USA), OTSCs (Aponos, Kingston, NH, USA), and Double-arm-bar suturing system (Hirohito Mori, Zeon Medical Co., Tokyo, Japan). [5,8] BaroSense (Redwood City, CA, USA) has developed the Trans-oral Endoscopic Restrictive Implant System™ (TERIS) for obesity treatment, but there is limited data on use in humans and long term efficacy. [9,10]

However, each of these devices has several weaknesses involving safety, interrupted sutures, complicated installation, prolonged procedure time, and difficulty performing an endoscopic approach to upper gastric lesions. In addition, suturing methods are problematic for gastric cancer screening after the procedure, and are still in the early stages of development.

Recently, the overstitch endoscopic suturing system research group actively applied several approaches. The KUMC suturing device research group created several devices. In an in vitro model study with suture devices using needles and beads, the consistent closure strength of successive endoscopic suture devices in the stomach demonstrated the reliability and reproducibility of this new closure method. [7] In the endoscopic closure technique, another KUMC suture device, the wound is sutured with a curved needle using a reciprocating movement. The En-closer had closure strength similar to that of Endoclips but showed a more consistent sequence. [2]

In addition, a new anchoring device and suction system were developed for the KUMC successive suturing system. This suturing system was applied in endoscopic bariatric surgeries in 32 porcine stomachs. Bariatric surgery using a new endoscopic system demonstrated 30% stomach volume reduction, which is comparable to clinically proven devices. [11]

Conclusions

A safe, durable, and effective endoscopic suturing method is clearly needed. Recent advancement in endo-
scopic suture device technology for the treatment of obesity and refractory gastrointestinal diseases is promising. Although there are considerable limitations to endoscopic suturing techniques, such as inadequate durability, threshold for treatment, or lack of established parameters for the procedures, advances in endoscopic technology now permit new possibilities for suturing in flexible endoscopy. The development of new endoscopic suturing mechanisms and improvement of existing designs allow clinicians to play an increasingly important role in the endoscopic treatment of various diseases. Future research will allow for widespread clinical use of these suturing devices.

References