Endoscopic Suturing, an Essential Enabling Technology for New NOTES Interventions

Sergey V. Kantsevoy, MD, PhD[a,b,c,*],
Joseph Ramon Armengol-Miro, MD[c,d]

KEYWORDS

- Natural orifice transluminal endoscopic surgery (NOTES) • Full-thickness resection
- Gastrointestinal tract

KEY POINTS

- Reliable closure of the transluminal entrance site is paramount to prevent postoperative leakages and infectious complications.
- The Overstitch (Apollo Endosurgery Inc, Austin, TX) endoscopic suturing device creates a reliable, full-thickness, surgical-quality, airtight closure of transmural gastrointestinal tract defects.
- Endoscopic suturing is an essential enabling technology for new natural orifice transluminal endoscopic surgery interventions.

Peroral transluminal endoscopic surgery was started with a series of animal experiments, which demonstrated the ability to enter the peritoneal cavity through the gastric wall without any damage to organs surrounding the stomach.[1] During the first reported transluminal interventions in animal models, a full-thickness gastric wall incision was made, a flexible endoscope was introduced into the peritoneal cavity to perform liver biopsy, and then the endoscope was withdrawn back to the stomach and the gastric wall defect was completely closed with endoscopic clips.[1] After this report of feasibility of transluminal endoscopic intraperitoneal interventions, numerous abstracts and full-length articles have described in acute and survival

[a] University of Maryland School of Medicine, Baltimore, MD, USA; [b] Institute for Digestive Health and Liver Diseases, Mercy Medical Center, 301 St. Paul Place, POB 7th Floor, Suite 718, Baltimore, MD 21202, USA; [c] World Institute for Digestive Endoscopy (WIDER), Barcelona, Spain; [d] Digestive Endoscopy, Vall D'Hebron University Hospital, Barcelona, Spain
* Corresponding author. Institute for Digestive Health and Liver Diseases, Mercy Medical Center, 301 St. Paul Place, POB 7th Floor, Suite 718, Baltimore, MD 21202.
E-mail address: skan51@hotmail.com

Gastrointest Endoscopy Clin N Am 26 (2016) 375–384
http://dx.doi.org/10.1016/j.giec.2015.12.005 giendo.theclinics.com
1052-5157/16/$ – see front matter

animal studies transgastric peritoneoscopy, gastro-jejunostomy, tubal ligation, cholecystectomy, splenectomy, and other intraperitoneal interventions on live animal models.[2–6] In 2006, the Natural Orifice Consortium for Assessment and Research was formed and the term *natural orifice transluminal endoscopic surgery* (NOTES) was invented.[7,8]

Since that time numerous NOTES procedures in humans were performed, including transgastric peritoneoscopy and liver biopsy, transgastric and transvaginal cholecystectomies and appendectomies, NOTES percutaneous endoscopic gastrostomy rescue procedures, and other interventions.[9–12]

However, peroral and transvaginal interventions on intraperitoneal organs have not demonstrated convincing advantages over traditional laparoscopic surgery.[13]

The authors think that the real potential of NOTES has not yet been explored. The unique advantages of a NOTES approach over traditional and laparoscopic surgery are in procedures such as purely endoscopic full-thickness resection of gastrointestinal (GI) tract lesions. These new NOTES procedures are not possible without reliable, surgical-quality closure of transmural GI tract wall defects.

Table 1 summarizes accessories and endoscopic suturing devices previously used for closure of NOTES entrance sites into the peritoneal cavity.

Through-the-scope endoscopic clips are commercially available devices, which were widely used during initial NOTES animal experiments. Unfortunately, these clips were created for endoscopic hemostasis and not for tissue approximation. Through-the scope clips only provided mucosa-to-mucosa apposition. Endoscopic hemostatic

Table 1
Accessories and devices for closure of the NOTES incision

Type	Name	Manufacturer	Available for Clinical Use
Through-the-scope endoscopic clips	QuickClip2 and QuickClip Pro	Olympus Optical Ltd, Tokyo, Japan	Yes
	Resolution	Boston Scientific, Natick, MA	Yes
	Instinct	Cook Medical, Bloomington, IN	Yes
Over-the-scope clip	Over-The-Scope Clip (OTSC) System	*Ovesco*, Tübingen, Germany	Yes
	Padlock Clip	Aponos, Kingston, NH	Yes
Suction based	EndoCinch	Bard, Murray Hill, NJ	Yes
	LSI Solution	Victor, NY	No
	Spiderman	Ethicon Endo Surgery, Cincinnati, OH	No
Working overtube delivering preloaded stitch	NDO plicator	NDO Surgical, Mansfield, MA	No
T-bars deployment with subsequent cinching	TAS system	Ethicon Endo Surgery, Cincinnati, OH	No
	T-bars	Cook Endoscopy, Winston-Salem, NC	No
	T-bars	Olympus Optical LTD, Tokyo, Japan	No
Flexible stapler	PowerMedical	Acquired by Medtronic, Minneapolis, MN	No
Use of curved needle	G-Prox	USGI Medical, San Clemente, CA	Yes
	Eagle Claw	Olympus Optical LTD, Tokyo, Japan	No
	Overstitch	Apollo Endosurgery Inc, Austin, TX	Yes