1-1-2013

Endoscopic innovations

Robert H. Hawes
University of Central Florida

Endoscopic innovations

Author Robert H. Hawes

Institution University of Central Florida College of Medicine, Florida Hospital Institute for Minimally Invasive Therapy, Orlando, Florida, USA

Bibliography
DOI http://dx.doi.org/10.1055/s-0033-1344634
Endoscopy 2013; 45: 766–769

ISSN 0013-726X

Corresponding author:
Robert H. Hawes, MD
Center for Interventional Endoscopy,
Florida Hospital,
601 East Rollins Street,
Orlando, FL 32803.
robert.hawes.md@flhosp.org

This report is published simultaneously in the journals Endoscopy and Gastrointestinal Endoscopy.

Overall, Digestive Disease Week (DDW) 2013 was an excellent year for endoscopic innovation. For this section, the abstracts have been divided into new technologies and new techniques. The abstracts selected for review are ones that represent material that has a reasonable chance of affecting the practice of GI endoscopy.

New technology

The adenoma detection rate is a critical statistic for colonoscopy. Current technology may be limited in its ability to see behind folds, which may result in missed polyps. A new colonoscope was introduced this year called the PeerScope (PeerMedical Ltd, Caesarea, Israel) [1]. It is characterized by having 2 viewing modes: a 160-degree forward-viewing mode and a 330-degree or greater full-spectrum view. The new colonoscope maintains the standard features a colonoscope such as tip deflection, working channel, suction, and irrigation. The general functionality of the colonoscope was tested in 50 patients, and the results revealed a 100 % cecal intubation rate, mean time to the cecum of 3.1 minutes, and a total procedure time of 15 minutes. Intubation of the ileocecal valve was achieved in 46 % of the patients. Forty-four percent of the patients underwent forceps biopsy or snare polypectomy. The abstract suggests that this new colonoscope has functionality comparable to that of standard colonoscopes, but the key issue will be whether this new instrument will improve adenoma detection by reducing the missed polyp rate.

Many gastroenterologists believe that the future of screening and surveillance endoscopy lies with capsule technology. It is unlikely, however, that adequate visualization of the GI tract can be achieved without controlling the direction and transit speed of the capsule. A new capsule technology was introduced this year consisting of a radio-controlled, motor-driven capsule [2]. The prototype is composed of 2 parts: an imaging unit (PillCam SB2, Given Imaging Co, Yokneam, Israel) and a motor-driven unit. The motor drive consists of micro DC motor, and a control signal receiver. The device was tested for suitability and safety in the GI tract of the dog. Experiments showed that maneuverability within the GI tract was adequate but maintaining its position against peristalsis and postural changes was difficult. The force of the motor was inadequate to overcome peristalsis and contraction of the sphincter, and although battery life was limited, evaluation of the stomach and colon was possible. The radio-control system was easy to use, portable, and inexpensive. This technology will need to be refined, but if an inexpensive, remote-control capsule system can be developed, this will rapidly and significantly advance our ability to screen and survey the GI tract noninvasively.

New platforms

Since the beginning of natural orifice transluminal endoscopic surgery (NOTES) and with publication of the first white paper, many therapeutic endoscopists have believed that there is a significant clinical need for a new flexible endoscopic platform. A critical function of the new platform would be the ability to triangulate. This year, we saw the introduction of the Endomina system (MEDI-LINE SA, Liege, Belgium), which is a universal triangulation platform adaptable to a flexible endoscope [3]. The device consists of a 20-mm overtube with 2 integrated articulating arms that can accommodate 9F instruments. Any flexible endoscope can be passed through the overtube. The device is robotized, and the articulating arms have 3 degrees of freedom. The robotized arms can accommodate various accessories and are

moved by a joystick. The system allows the endoscopist to lift and cut and oppose and suture tissue and therefore has the potential to make endoscopic submucosal dissection (ESD) easier and may even be able to perform full-thickness resection. The system has been used to perform complex tissue resection and anterior posterior tissue apposition in various models, and use in humans has begun. A flexible endoscopic system that allows triangulation and complex movements within the GI tract would be a very important advance for therapeutic endoscopy.

As new platforms are developed for NOTES, it will be necessary to develop systems for tactile and kinesthetic feedback. Such a system was reported on this year in which a device consisting, in part, of an external magnetic field source was used to assess indentation depth [4]. Three different silicone-based tissue phantoms were created, each with a unique stiffness. The phantoms were first palpated with the operator's dominant index finger. The phantoms were then palpated by using the novel palpation system in which indentation depth and the exerted force were measured, providing the local elastic module as a quantitative measure of the sample stiffness. The wireless tissue palpation system achieved a precision of 96.9% in reconstructing the achieved indentation depth based on magnetic field measurements. This innovative approach to tissue palpation has the potential to open up a new paradigm in the field of NOTES where no mechanical link between the external platform and the target region exists. Investigators will continue to work on miniaturization and then will begin ex vivo and in vivo trials.

New techniques

Luminal obstruction with inflammation and abscess formation is thought to be the etiology of acute appendicitis. Appendectomy is the standard treatment. This year, a multicenter, retrospective report from China described endoscopic retrograde appendicitis therapy (ERAT) [5]. Thirty-four patients with a clinical suspicion of acute appendicitis were included in this study. Colonoscopy was performed, and positive findings included bulging, edema, and pus drainage. Endoscopic appendiceal intubation was successful in 33 of 34 patients (97%). Four patients had negative findings, and appendiceal decompression was performed in all 29 of the remaining patients consisting of cleansing of the appendiceal lumen in 19 of 29 (66%) and stent drainage in 10 of 29 (34%). Abdominal pain was improved immediately in all treated patients, and rebound tenderness and guarding disappeared within 12 hours in 27 of 29 patients. Recurrent appendicitis developed in 2 patients (6.9%) 1 to 36 months later, and surgical intervention was required. This could become an alternative treatment when surgery is not possible.

Suturing

With the inception of NOTES, it was thought that the development of an endoscopic suturing device would be required. Such a device is available that is capable of performing interrupted or continuous sutures by using a double-channel endoscope (Overstitch, Apollo Endosurgery, Austin, Tex). There were several abstracts this year describing the use of this endoscopic suturing a device. Kantevoy et al [6] reported on closure of large mucosal defects after ESD and suggested that such closure could eliminate the need for hospital admission. Nine patients were included in this report (3 stomach, 6 colon), with an average lesion size of 38 ± 10 mm. All 9 patients had successful closure of the ESD defect, with 7 requiring only 1 stitch (continuous suture) and 2 patients requiring 2 separate stitches. There were no immediate or delayed adverse events.

There were 2 reports on the use of Overstitch to fix esophageal stents. In 1 report, 14 patients underwent anchoring of esophageal stents [7]. The technical success rate for stent placement and fixation was 100% by using 1 to 5 sutures. There were no adverse events specifically related to suturing. Stent migration occurred in 3 patients (21%). However, stent migration was prevented in 5 of 7 patients (71%) in whom previous stent placement had resulted in migration.

In the other report [8], 30 patients underwent placement of a fully covered esophageal stent. Twelve patients received sutures to fix the stent. One or 2 sutures were placed, and suturing was technically successful in 100% of patients. Stent migration was noted in 1 of 2 patients (8%) in whom sutures were placed and in 10 of 17 patients (59%) with no sutures (P=.04). These reports suggest that when placing a fully covered esophageal stent, migration can often be prevented by anchoring the stent with sutures.

Submucosal tunneling

The development of peroral endoscopic myotomy (POEM) has opened up a new discipline of submucosal endoscopic surgery. This year, there were multiple abstracts describing the use of the submucosal tunneling technique to resect submucosal tumors, divide the pyloric sphincter, or sever the muscular propria to treat achalasia. The first article describes the use of the technique to resect submucosal tumors at the esophagogastric (EG) junction originating from the muscularis propria [9]. This study from China described 57 patients who underwent resection of the EG junction for leiomyomas or GI stromal tumors by using the tunneling technique. Their experience indicates that maintaining proper direction of the tunnel and mucosal integrity is imperative. The average lesion size was 21.5 mm, and en bloc resection was successful in 100% with negative lateral and deep tumor-free margins in all cases. There were no delayed hemorrhages, and pneumothorax developed in 2 patients requiring chest tubes, but surgery was avoided. There was no local recurrence or distant metastases during 12 months follow-up.This technique is elegant and offers a less invasive technique compared with surgery. The long tunnel provides secure sealing of the gut even if the muscularis propria is resected.

Another report from China described tunneling to resect submucosal tumors in 151 consecutive patients [10]. The mean tumor size was 21 mm, the histology included GI stromal tumors and leiomyomas, and most were located in the esophagus or EG junction (72.4% and 19.7%, respectively). The en bloc resection rate was 86% with complete R0 resection in 83% and an adverse event rate of 35.5%. Virtually all of the adverse events were related to air insufflation and consisted of pneumothorax in 17%, subcutaneous/mediastinal air in 28%, and pneumoperitoneum in 14.5%. The mean procedure time was 1 hour. This larger study certainly establishes the feasibility of removing submucosal tumors arising from the muscularis propria by using the submucosal tunneling technique. It has become standard of practice to use CO_2 for all cases, which significantly reduces the adverse events, as described in this study.

This same tunneling technique has now been described to perform peroral endoscopic pyloromyotomy [11]. A submucosal bleb followed by a mucosal incision was made 10 cm proximal to the pylorus in a swine model. Tunneling was performed by stand-

ard submucosal dissection technique until the pylorus was traversed. A TT knife (Olympus America Inc, Center Valley, Pa) along with spray coagulation (50 W, E2; ERBE, Marietta, Ga) was used to hook and divide the inner transverse and oblique muscle fibers leaving the outer longitudinal fibers intact. The procedure was performed on 5 pigs followed by euthanasia and autopsy. In the first 2 pigs, an incomplete pyloromyotomy was found, but the pyloromyotomy was complete in the remaining 3 pigs. The investigators measured the "ease of passage" of the endoscope before-and-after myotomy, and this measure improved from a mean score of 3.8 to 1.6. The results of this report suggest that this technique is promising, but additional animal survival data will be required to validate the technique before it is ready for human testing.

EUS-guided therapies

The use of EUS to guide novel therapies is gaining momentum. This year at DDW, there were several abstracts describing novel treatments delivered by EUS guidance. The first abstract described the treatment of 8 patients, 6 with cystic neoplasms and 2 with cystic degeneration of neuroendocrine tumors by using radiofrequency (RF) energy [12]. The investigators used a novel RF device (1.2-mm Habib EUS-RF ablation catheter, Emcision Ltd, London, UK) passed through a 19- or 22-gauge needle. The RF energy was applied at increasing dosimetry beginning at 5 W and ending at 25 W delivered over 90 seconds. The median number of applications per session was 4.5 (range 2 – 7). Among the 6 patients with cystic neoplasms, imaging at 3 to 6 months demonstrated complete resolution of the cyst in 2 patients, whereas in 3 patients, there was a 48 % reduction in size. In the 2 neuroendocrine tumor patients, a change in vascularity and central necrosis was demonstrated, but the tumors did not disappear. The challenge in applying this technology for cystic neoplasms will be to get even and sufficient distribution of energy into a complex 3-dimensional structure to achieve a complete ablation.

There have been multiple trials investigating EUS-guided injection therapy (fine-needle injection [FNI]) primarily in pancreatic cancer. Regrettably, all to date have failed to show benefit in survival. This year there was a report of new EUS-guided intratumoral therapy by using a recombinant pox viral vaccine (Panvac) that encodes tumor antigens (carcinoembryonic antigen and Muc1 and 3) and 3 immune costimulatory antigens [13]. The study enrolled 13 patients with locally advanced inoperable pancreatic adenocarcinoma who received 2 EUS-guided FNI treatments given 2 weeks apart at 2 different dose levels (dose 1 and 2). The results showed in the lower dose cohort that 2 of 7 patients had to be removed from the study because of rapid disease progression. Mild pancreatitis developed in 1 patient (but treatment continued), and 2 patients are alive at 15 and 30 months into follow-up. In the higher dose cohort, 3 patients are alive at 2, 8, and 10 months, respectively. These are very preliminary, phase 1 results, and we have seen multiple other trials with similar encouraging results early on. We must wait for results from a phase 2 study that has been initiated.

There been several previous reports on EUS-guided intravascular therapy. This year, there was a study of 25 patients with liver metastases secondary to colorectal cancer treated with 5-flurouracil or 5-fluorodeoxymidina injected into the hepatic artery either under EUS guidance (n = 12) or by the conventional approach with an implanted infusion pump (n = 13) [14]. The investigators looked at technical outcomes, treatment response, and safety profile. Responses were similar for tumor response (85 % vs 90 %) and median survival (9 – 19 months vs 12 – 17 months) for FNI and the conventional approach, respectively. However, the number of adverse events was significantly higher with the conventional approach (33 % vs 76 %, $P = .03$), which included abdominal pain, port infection emboli, and thrombosis. The adverse events for the conventional approach seem high in this report and may be related to an indwelling device versus repeated applications with EUS. Costs were not included in this study, but would seem likely to be higher for EUS because of the need for repeated applications. Nevertheless, EUS-guided vascular interventions deserve further study [15 – 24].

Competing interests: The author disclosed no financial relationships relevant to this publication.

References

1 *Gralnek IM, Segol O, Suissa A* et al. A prospective feasibility study in human subjects evaluating a novel colonoscope featuring "full spectrum view" (abstract). Gastrointest Endosc 2013; 77: AB466 – AB467
2 *Ohta H*. The dawn of internet linked robotic capsule endoscopy; a radio-controlled and motor-driven capsule endoscope that can be controlled via the internet (abstract). Gastrointest Endosc 2013; 77: AB465 – AB466
3 *Cauche N, Hiernaux M, Chau A* et al. Endomina: the endoluminal universal robotized triangulation system: description and preliminary results in isolated pug stomach (abstract). Gastrointest Endosc 2013; 77: AB204 – AB205
4 *Beccani M, Di Natali C, Valdastri P* et al. Restoring tactile perception in natural orifice transluminal endoscopic surgery (NOTES) through wireless tissue palpation (abstract). Gastrointest Endosc 2013; 77: AB163 – AB164
5 *Liu B, Feng J, Ma S* et al. Endoscopic retrograde appendicitis treatment (Erat): a multicenter retrospective study in China (abstract). Gastrointest Endosc 2013; 77: AB146
6 *Kantsevoy S, Bitner M, Turnbough L* et al. Endoscopic closure of large mucosal defects post endoscopic submucosal dissection (ESD) eliminates the need for hospital admission (abstract). Gastrointest Endosc 2013; 77: AB187 – AB188
7 *Fujii L, Bonin EA, Gostout CJ* et al. Use of an endoscopic suturing system to prevent stent migration (abstract). Gastrointest Endosc 2013; 77: AB206
8 *Sharaiha RZ, Doukides TP, Gonda TA* et al. Esophageal stenting with sutures: time to redefine our standards? (abstract) Gastrointest Endosc 2013; 77: AB205 – AB206
9 *Wang X-Y, Xu M-D, Yao L-Q* et al. Submucosal tunnel endoscopic resection for submucosal tumors of the esophagogastric junction originating from the muscularis propria layer: a feasibility study (abstract). Gastrointest Endosc 2013; 77: AB190 – AB191
10 *Xu MD, Chen T, Yao LQ* et al. Submucosal tunneling endoscopic resection for upper GI submucosal tumors: a feasibility study of 152 consecutive cases (abstract). Gastrointest Endosc 2013; 77: AB194 – AB195
11 *Ali A, Yang RD*. "Pop" the pylorus! Per oral pyloro-myotomy- a novel submucosal endoscopy technique (abstract) Gastrointest Endosc 2013; 77: AB147
12 *Pai M, Senturk H, Lakhtakia S* et al. Endoscopic ultrasound guided radiofrequency ablation (EUS-RFA) for cystic neoplasms and neuroendocrine tumors of the pancreas (abstract). Gastrointest Endosc 2013; 77: AB143 – AB144
13 Phase I trial of endoscopic ultrasound (EUS) guided intratumoral vaccination with recombinant Panvac-F and systemic Panvac-V in patients with locally advanced pancreatic cancer (abstract). Gastrointest Endosc 2013; 77: AB143
14 *Artifon EL, Cunha MAB, Da Silveira EB* et al. EUS-guided or interventional radiology to hepatic intra-arterial chemotherapy: a prospective trial (abstract). Gastrointest Endosc 2013; 77: AB142 – AB143
15 *Kiesslich R, Murthy S, Pompetzki LS* et al. A new cleaning device (Jetprep) significantly improves the detection of right sided colorectal neoplasia–results of a randomized controlled trial (abstract). Gastrointest Endosc 2013; 77: AB164
16 *Kanai N, Kobayashi S, Yamato M* et al. Development of novel endoscopic delivery devices for cell sheets transplantation (abstract). Gastrointest Endosc 2013; 77: AB147

17 *Dryden GW*, *Goderwis J*, *Hay J* et al. Successful validation of a novel open-loop SNARE design for the removal of giant pedunculated polyps (abstract). Gastrointest Endosc 2013; 77: AB199
18 *Nakamura M*, *Shiroeda H*, *Tahara T* et al. Usefulness of a nanoshooter as a tool for ESD of narrow organ lumen with a transnasal endoscope (abstract). Gastrointest Endosc 2013; 77: AB195
19 *Chung MJ*, *Yi SW*, *Lee KJ* et al. Endoscopic gastrojejunostomy using a lumen-apposing metal stent in a porcine gastric outlet obstruction mode (abstract). Gastrointest Endosc 2013; 77: AB147 – AB148
20 *Choi HS*, *Kim K*, *Kim B* et al. An endoscopic transoral approach for obesity treatment: animal experiment with an endoscopic suture device (abstract). Gastrointest Endosc 2013; 77: AB460
21 *Goto O*, *Uraoka T*, *Hori J* et al. Feasibility of endoscopic hand-sewn suturing as a new method of closure for an iatrogenic gastric mucosal defect in porcine models (abstract). Gastrointest Endosc 2013; 77: AB154 – AB155
22 *Eguia V*, *Gonda TA*, *Sethi A*. A stitch in time, by an endoscopist (abstract). Gastrointest Endosc 2013; 77: AB115
23 *Shinoura S*, *Samarasena JB*, *Choi KD* et al. Peroral endoscopic myotomy (POEM) with a novel submucosal lifting gel–can we throw the knife away? (abstract) Gastrointest Endosc 2013; 77: AB113
24 *Stavropoulos SN*, *Modavil RJ*, *Mehta CS* et al. Per oral full thickness endoscopic resection of muscularis based subepithelial tumors: first cases at a US center (abstract). Gastrointest Endosc 2013; 77: AB116