

ADVANCES IN ENDOSCOPY

Current Developments in Diagnostic and Therapeutic Endoscopy

Section Editor: John Baillie, MB ChB, FRCP

Natural Orifice Transluminal Endoscopic Surgery (NOTES)

Anthony N. Kalloo, MD
Professor of Medicine
Chief, Division of Gastroenterology and Hepatology
The Johns Hopkins Medical Institutions

G&H Can you describe the evolution of the NOTES technology to date?

AK Natural orifice transluminal endoscopic surgery (NOTES) is an experimental procedure whereby the peritoneal cavity, or the abdominal cavity, is entered through the gastrointestinal tract using a natural orifice. This is in distinction to traditional open surgery, where a large incision is made in the abdominal wall, or laparoscopic surgery, where a small incision allowing a laparoscope is made in the abdominal wall. As gastroenterologists, we regularly perform endoscopic procedures where we pass an endoscope through the natural orifice to perform diagnostic and therapeutic intervention within the gastrointestinal tract. Over the last decade, there has been interest among gastroenterologists in performing more invasive, therapeutic procedures in the gastrointestinal tract, some of which, including drainage of pancreatic pseudocysts, routinely breach the gastrointestinal wall.

Approximately 10 years ago, in a talk I gave at Digestive Disease Week (DDW) regarding the future of endoscopy, I presented the concept of breaching the gastric wall or the wall of the stomach to enter the peritoneal cavity and perform surgery. Following that presentation, I started work here at Johns Hopkins on NOTES procedures in animal models. Our first presentation on this work was made at DDW in 2000, where we demonstrated the feasibility of a transgastric approach to the peritoneal cavity for liver biopsy that could be survived long-term in an animal model. This work was not published until 2004, but it was initially presented 4 years earlier. Since then, ours and many other centers have reproduced these results and shown the validity of this approach. Currently,

there is tremendous industry interest in NOTES, much of which has been seeded by reports of NOTES procedures in humans from Drs. Rao and Reddy of the Asia Institute of Gastroenterology in Hyderabad, India, who have produced video footage demonstrating that the transgastric approach to appendectomy and fallopian tubal ligation is technically feasible in a human patient.

Recently, the American Society for Gastrointestinal Endoscopy (ASGE) and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) have formed a joint working group called the Natural Orifice Surgery Consortium for Assessment and Research (NOSCAR). The primary mission of NOSCAR is the development of NOTES technology in a safe and responsible fashion. In the early days of laparoscopic surgery, there were many complications because of the learning curve for practicing endoscopists. The way NOTES is developing, under the guidance of NOSCAR, will hopefully prove safer and less complicated as the procedure is taken to clinical trials.

G&H What are the advantages of the NOTES procedure over open and/or laparoscopic surgeries?

AK With NOTES, any incision of the abdominal wall is avoided. Therefore, from a cosmetic standpoint, the procedure is perfect, leaving no scar. Complications that commonly occur from abdominal wall incisions, such as hernias or wound infections, are also eliminated.

Further, having performed these procedures for many years, I believe that the flexible endoscope utilized in NOTES will allow access to remote areas of the peritoneal cavity more easily and quickly than a rigid laparoscope or even the hands in open surgery. In a porcine model, we have successfully dissected the spleen, and by using the scope, have been able to access areas that historically could not be examined with a standard rigid laparoscope.

In addition, obese patients with large abdominal walls can be approached via the natural orifice, which is a much simpler way to enter the peritoneal cavity in these cases.

G&H Can you describe how the NOTES procedure is performed?

AK NOTES works in the same manner as any endoscopic procedure using an upper endoscope or a colonoscope. Most studies to date have utilized a transgastric approach, passing the endoscope through the mouth to the stomach, then puncturing the stomach wall, and either dilating the initial puncture via balloon or making a larger incision. Through this hole or incision, the endoscope is advanced into the peritoneal cavity.

It should be noted that puncturing a hole in any part of the gastrointestinal lining is considered a grave complication, if done inadvertently during endoscopy. When I first started exploring the possibilities of the NOTES procedure, it required a huge psychological leap to intentionally create this “complication.” However, as research has been done and experience accrued, it has been easier to conceptualize. Further, with increasing frequency, gastroenterologists who perform endoscopic mucosal resections and find a perforation can usually close it quite successfully using endoscopically administered clips. This technology has emboldened gastroenterologists with the idea that it is possible in most procedures to intentionally create a perforation that is safe and technically feasible for therapeutic procedures.

Once the endoscope is in the peritoneal cavity, any intervention that a surgeon might do with a laparoscope or through open surgery can conceivably be performed. At Hopkins, we have performed surgical procedures including gastroduodenoscopy, tubal ligation, and hernia repair, all utilizing a standard endoscope. Other investigators have done cholecystectomy or removal of the gallbladder, removal of the uterus, and removal of the fallopian tubes. Ultimately, there are no boundaries as to what can be performed utilizing these techniques.

G&H Will the NOTES technology be primarily used by gastroenterologists or surgeons?

AK This question is much debated. My firm belief is that NOTES is an evolution of endoscopy more than of laparoscopic surgery. In the general field of gastroenterology, some practitioners perform only diagnostic procedures, others resect polyps, and still others perform endoscopic retrograde cholangiopancreatography (ERCP) and advanced therapeutic procedures. Another specialized

group has evolved in the last decade with the ability to perform endoscopic ultrasound.

I believe that just as we have these subspecialties in terms of endoscopic intervention, there will be another group of endoscopists specializing in NOTES, as well as a group of laparoscopic surgeons who will perform NOTES. The limiting factor for either group will be the complexity of the procedures. I don't think that gastroenterologists, at least not in the near future, will perform organ removal, but laparoscopic surgeons may. Ultimately, I believe that for some physicians, the two specialties will merge and there will be a subgroup who are trained both as endoscopists and laparoscopic surgeons, specializing in NOTES procedures exclusively. Younger physicians, both gastroenterologists and surgeons, who are interested in a career in endoscopy, should think carefully about the impact of NOTES in their future practice.

G&H What do you see as the next steps in NOTES research and development?

AK The next steps are encompassed by precisely what is currently taking place. I do not think there should be a rush to do patient trials. More work is required in the laboratory to further refine the equipment, devices, techniques, and approaches that are used in NOTES, so that when clinical trials do commence, we have a firm understanding of the physiologic variables, the types of equipment necessary, and the nuances of the NOTES procedure. The work that is currently taking place with NOSCART is exactly how laparoscopic surgery should have evolved. Within the current working group, subgroups and subcommittees are approaching different potential problems and figuring out how to deal with them. This is the best, most proactive way to develop a procedure before releasing it for use in a patient population.

Suggested Reading

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