

ADVANCES IN ENDOSCOPY

Current Developments in Diagnostic and Therapeutic Endoscopy

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Current Status of Capsule Endoscopy

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G&H When was capsule endoscopy developed?

DF The idea of performing an endoscopy without a tube attached to a cord has been in people's minds for years. Dr. Gabriel Iddan, an Israeli scientist, worked on developing this technology for 15–20 years before its approval by the US Food and Drug Administration in August of 2001. Dr. Paul Swain, a London-based gastroenterologist, was also at the forefront of developing capsule endoscopy. The 2 physicians were initially working independently and unknowingly on the same technology, but now hold the patent jointly.

G&H How does capsule endoscopy work?

DF Capsule endoscopes are approximately 2.6 cm in length, the size of a large pill. The currently approved capsule (Given Imaging) has a camera at one end that takes 2 images per second as the capsule travels through the digestive tract. The capsules are propelled from the mouth to the anus by the peristalsis of the digestive tract, and the images are transmitted to a recorder worn by the patient. Approximately 50,000 images are collected during the 8 hours that the capsule is traveling through the body, and these are then downloaded to a computer. The associated computer program is configured to erase duplicate images, so that if the capsule is in one location for 15 minutes, not all of the images from that location will be downloaded. A physician, nurse, or technologist then reviews the images, which takes approximately 1 hour, and a clinical decision is made based on what the images reveal.

G&H Is capsule endoscopy always an outpatient procedure?

DF The vast majority of capsule endoscopies are done on an outpatient basis. Typically, the patient ingests

the capsule in the morning and waits at the clinic for 20–30 minutes to ensure that the equipment is working properly. Patients may ingest liquids after 2 hours and solids after 4 hours. Daily activities are not restricted by the endoscope; individuals can proceed through their day as they normally would.

G&H In what disease settings is capsule endoscopy most commonly used?

DF The most common condition in which capsule endoscopy is used is obscure gastrointestinal bleeding, where prior evaluation with endoscopy, x-ray, and/or colonoscopy has been unrevealing. In this case, a capsule endoscopy is used in order to investigate the small intestine, since neither upper endoscopies, used to evaluate the esophagus, stomach, and beginning of the small intestine, nor colonoscopies enable a clinician to see the entire small intestine. The capsule is able to traverse the entire 15 to 20-foot area of the small intestine and feed back the images.

G&H In what other diseases is capsule endoscopy used?

DF For individuals in whom Crohn's disease is suspected but other test results have been negative, capsule endoscopy can confirm whether or not this disease is in fact present. In addition, the activity of Crohn's disease can be assessed.

Capsule endoscopy has also been used to evaluate individuals with celiac disease and with familial adenomatous polyposis. With the latter condition, capsule endoscopy enables the detection of polyps in the small intestine, which would not be found with colonoscopies. Capsule endoscopy has also been used for conditions such as diarrhea and abdominal pain, but yielding fewer findings.

G&H What benefit does capsule endoscopy have for patients with Crohn's disease beyond what traditional endoscopy offers?

DF Capsule endoscopy would be employed if an individual is suspected of having Crohn's disease but tests were negative. Capsule endoscopy is more sensitive in the

small intestine than an x-ray, previously the only available modality for seeing the small intestine. Also, if a patient with Crohn's disease is not responding as expected to a certain treatment, it is possible to evaluate whether the part of the small intestine where the disease is most commonly located is responding to therapy. In other words, one can examine whether the Crohn's disease is improving, regardless of whether the patient is improving.

Rarely, patients with Crohn's disease experience bleeding. Here, capsule endoscopy could be used to determine whether the bleeding is due to the disease or to another condition in the small bowel. Finally, patients with Crohn's disease have a higher incidence of cancer of the small intestine compared to a healthy population. Although seldom employed for this purpose, capsule endoscopy can be used to detect cancer in the small intestine. All of these applications represent advancements over traditional endoscopy.

G&H What are the potential complications with capsule endoscopy?

DF The most common complication is the capsule becoming stuck as it travels through the digestive tract and therefore not being evacuated. This complication is paradoxical for the following reason. If capsule endoscopy is being performed to investigate a previously undetected symptom and the capsule is not able to pass through a narrow section, surgery may be necessary in order to remove the capsule. However, this surgery would also reveal the underlying problem, and thus the stuck capsule, although a complication, has a beneficial result. Capsules may also become lodged in the throat or other locations, but the small bowel is the most common site of this complication.

There is some concern that the capsules may interfere with pacemakers and implanted cardiac defibrillators because of the radio frequency used to transmit the images from the camera to the storage device. However, this concern has not been borne out in clinical experience thus far.

G&H Are new types of capsule endoscopes being developed?

DF Yes. Several companies are currently developing new devices. The currently approved device takes 2 images per second, which works well for imaging the small bowel. However, a newer capsule, released in the past year by Given Imaging, has been designed strictly for the esophagus. Capsule endoscopes pass through the esophagus very quickly, and 2 images per second are not enough to obtain

useful information. The new device takes 14 pictures per second, enabling, for example, screening for conditions such as Barrett's esophagus without traditional endoscopy.

G&H Is it difficult to transition from interpreting images from traditional endoscopes to interpreting capsule endoscopy images?

DF There is a learning curve involved in this transition, but trained endoscopists usually become accustomed to capsule endoscopy images fairly quickly. The American Society for Gastrointestinal Endoscopy recommends observing at least 10 different readings before reading images on one's own.

G&H What other potential applications of capsule endoscopy are on the horizon?

DF Currently, capsule endoscopy is being used in the esophagus and intestine, but not in the stomach or colon. Different viewing lenses and/or internal construction could enable clinicians to view these areas, and studies are ongoing to evaluate whether such technologies could replace colonoscopy for colon cancer screening. In addition, as mentioned above, the currently approved device moves through the body by peristalsis. New capsules are being developed that are controlled externally or that have some type of motor that moves it through the digestive tract.

G&H How does capsule endoscopy differ from magnetic resonance imaging?

DF Magnetic resonance imaging is a form of cross-sectional imaging that can demonstrate the bowel, its wall, and related structures in 2 dimensions. The capsule takes pictures within the lumen of the bowel (endolumenal), but cannot "see" beyond it.

Suggested Reading

Remedios ML, Appleyard, M. Capsule endoscopy: current indications and future prospects. *Intern Med J.* 2005;35:234-239.

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Leighton JA, Srivathsan K, Carey EJ, et al. Safety of wireless capsule endoscopy in patients with implantable cardiac defibrillators. *Am J Gastroenterol.* 2005;100:1728-1731.

De Leusse A, Landi B, Edery J, et al. Video capsule endoscopy for investigation of obscure gastrointestinal bleeding: feasibility, results, and interobserver agreement. *Endoscopy.* 2005;37:617-621.