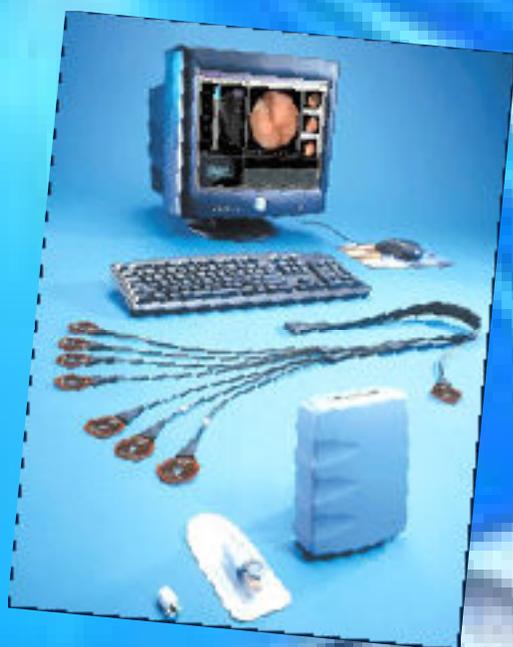


CAPSULE ENDOSCOPY



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EP 601

Year III
semester I

Computing &
Information
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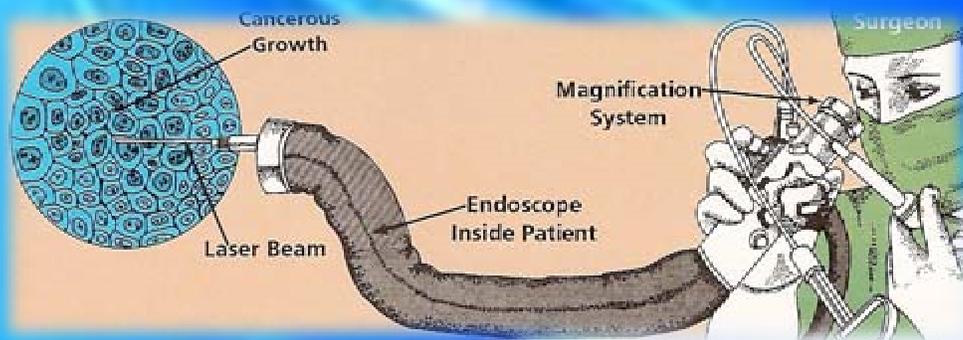


ENDOSCOPE???

An endoscope is a medical device consisting of a long, thin, flexible (or rigid) tube which has a light and a video camera.

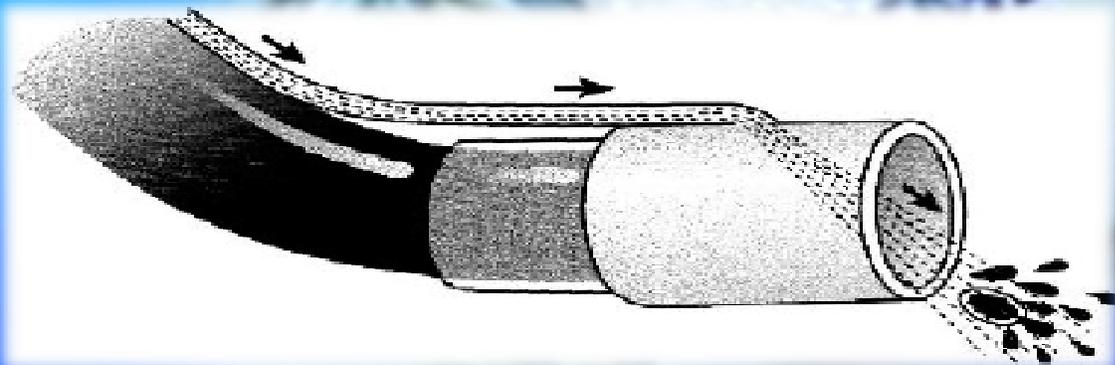
An endoscope can consist of

- A rigid or flexible tube
- A light delivery system to illuminate the organ or object under inspection. The light source is normally outside the body and the light is typically directed via an optical fiber system
- A lens system transmitting the image to the viewer from the objective lens to the viewer, typically a relay lens system in the case of rigid endoscopes or a bundle of **FIBREOPTICS** in the case of a fiberscope
- an eyepiece
- an additional channel to allow entry of medical instruments or manipulators



WHAT IS FIBREOPTICS???

A bundle of flexible glass fibres able to coherently transmit an image.

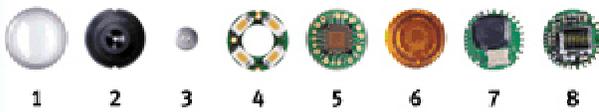
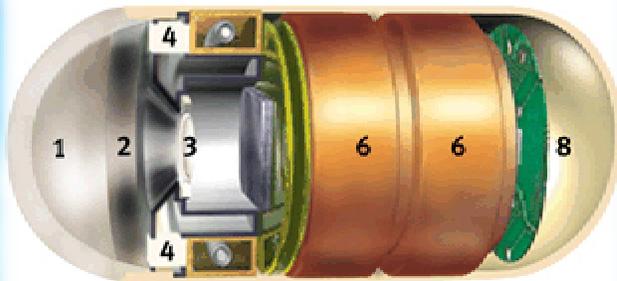


ENDOSCOPY???

A widely used procedure to visualize the interior of the body...

MANY DIFFERENT TYPES OF ENDOSCOPES IN USE...





INSIDE THE M2A™ CAPSULE

1. Optical dome
2. Lens holder
3. Lens
4. Illuminating LEDs (Light Emitting Diode)
5. CMOS (Complementary Metal Oxide Semiconductor) imager
6. Battery
7. ASIC (Application Specific Integrated Circuit) transmitter
8. Antenna

RECENT DEVELOPMENTS....



Capsule Endoscopy!!!!!!!!!!!!!!!

WHAT IS CAPSULE ENDOSCOPY???

A newer endoscopic technique which enables the doctor to examine the lining of the middle part of the gastrointestinal tract, which includes the three portions of the small intestine (duodenum, jejunum, ileum).

- A pill sized video camera is swallowed.
- This camera has its own light source and takes pictures

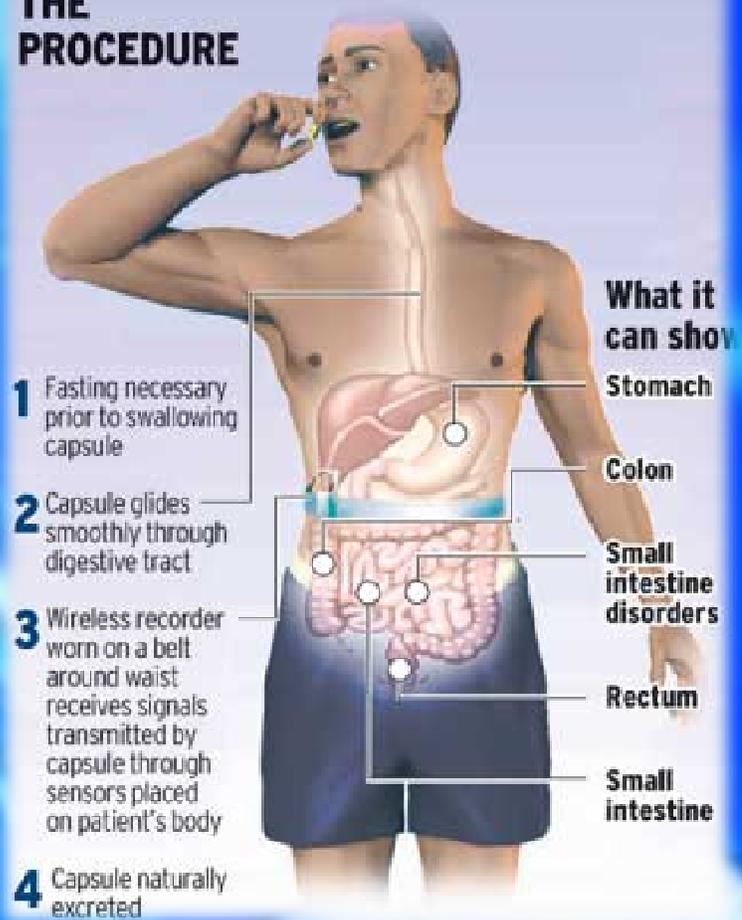
of the small intestine as it passes through. These pictures are sent to a small recording device worn on the body.

HOW IT HAPPENS???

- After the given capsule is swallowed, it moves through the digestive track naturally with the aid of the peristaltic activity of the intestinal muscles.
- The patient comfortably continues with regular activities throughout the examination without feeling sensations resulting from the capsule's passage.

- During the 8 hour exam, the images are continuously transmitted to special antenna pads placed on the body and captured on a recording device about the size of a portable Walkman which is worn about the patient's waist.
- After the exam, the patient returns to the doctor's office and the recording device is removed.
- The stored images are transferred to a

THE PROCEDURE



computer PC workstation where they are transformed into a digital movie which the doctor can later examine on the computer monitor. Patients are not required to retrieve and return the video capsule to the physician. It is disposable and expelled normally and effortlessly with the next bowel movement.

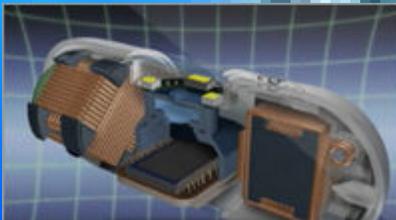
Capsule endoscopy helps the doctor to evaluate the small intestine. This part of the bowel cannot be reached by traditional upper endoscopy or by colonoscopy. The most common reason for doing capsule endoscopy is to search for a cause of bleeding from the small intestine. It may also be useful for detecting polyps, inflammatory bowel disease (Crohn's disease), ulcers, and tumors of the small intestine.

WHY CAPSULAR ENDOSCOPY???

- Because of its unique ability to visualize the mucosa, CE has shown great ability to visualize small bowel ulcers often missed by other imaging modalities.
- In a pooled data analysis, CE had a miss rate for ulcers of only 1%.
- A meta-analysis comparing CE to other imaging modalities of the small bowel for inflammatory bowel disease has established that CE has an incremental diagnostic yield of 25–40% over that of other modalities.
- To study the adverse effects of nonsteroidal anti-inflammatory drugs (NSAID) on the small intestine.
- To evaluate patients with suspected and known Crohn's disease.
- The video capsule is easier to swallow than an aspirin. It seems that the most important factor in ease of swallowing is the lack of friction. The capsule is very smooth, enabling it to slip down the throat with just a sip of water.

SCIENTIFIC BASIS.....

These miniaturized image sensors with low power consumption, allowed the realization of an ingestible wireless capsule for the visualization of the small intestine mucosa. It is based *on complementary metal oxide semiconductor (CMOS) technology*



COMPLEMENTARY METAL-OXIDE- SEMICONDUCTOR (CMOS)

- I a technology for constructing integrated circuits.
- CMOS technology is used in microprocessors, microcontrollers, static RAM, and other digital logic circuits.

- CMOS technology is also used for *several analog circuits such as image sensors (CMOS sensor)*, data converters, and highly integrated transceivers for many types of communication.

Frank Wanlass patented CMOS in 1967.

SOME MORE...

The manufacturer provides a software package (RAPID) to view the Wireless capsular endoscopy (WCE) video, offering a bleeding detector feature based on red color. It provides a position estimator of the capsule inside the digestive tract. Additionally its multi-view feature gives a simultaneous view of two or four consecutive video frames in multiple windows. Finally a library of reference images (RAPID Atlas) is provided so that the user can have easy access to on-screen case images.

BEYOND ENDOSCOPY.....

The development of the small bowel video-capsule endoscopy revolutionized the field of endoscopy in establishing the new concept of wireless endoscopy. When this new technology was launched, some people were questioning whether this method would be a new tool or a new toy. Now, the small bowel video-capsule is recognized to be the first line of diagnostic procedure in case of obscure bleeding and its role has been confirmed in other intestinal diseases such as inflammatory bowel diseases, celiac disease, familial adenomatous polyposis, and other clinical disorders. The appearance of the small bowel video-capsule along with the development of various enteroscopes that have therapeutic capabilities totally changed the approach to the diagnosis of small bowel diseases.

The use of the video-capsule was also extended to the exploration of the esophagus. The main distinguishing feature of the eso-capsule is the presence of a camera at both ends of the capsule capable of emitting 4 images/second, allowing a good visualization of the esophageal mucosa. This device has been mostly assessed in lesions associated with gastroesophageal reflux disease (GERD) and portal hypertension lesions.

Based on the success of the SB capsule and the technical adaptations of the esocapsule, it appears to be challenging to develop a Pillcam colon capsule endoscope (PCCE) that could be an alternative method for CRC screening. Obviously, the development of a wireless endoscope for exploring the colon raised several challenging questions:

- 1) The duration of the colon transit time requires an efficient use of batteries;
- 2) The cleanliness of the colon requires an excellent colon preparation;
- 3) The caliber of the colon lumen takes into account the impossibility of inflating the colon during a colonoscopy.

But now Pillcam colon capsule endoscope (PCCE) is also underdevelopment....

DRAWBACKS OF CAPSULAR ENDOSCOPY

- They move passively by exploiting peristalsis, are not able to stop intentionally for a prolonged diagnosis.
- They receive power from an internal battery with short length.
- Their usage is restricted to one organ, either small bowel or esophagus

FUTURE.....

However the steady progresses in many branches of engineering, including microelectromechanical systems (MEMS), are envisaged to affect the performances of capsular endoscopy. The near future foreshadows capsules able to pass actively through the whole gastrointestinal tract, to retrieve views from all organs and to perform drug delivery

and tissue sampling. In the long term, the advent of robotics could lead to autonomous medical platforms, equipped with the most advanced solutions in terms of MEMS for therapy and diagnosis of the digestive tract.....