Endoscopy – A Better Way?

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Endoscope

Esophagogastroduodenoscopy
(EGD or upper endoscopy)

- Esophagus
- Endoscope
- Light
- Stomach

Interior of Stomach
Endoscope
Light
Stomach Lining

National Cancer Institute 2008 (left)
Choa.org (right)
Gastrointestinal Diseases

- Bleeding
- Cancer/Precancerous changes
- Foreign bodies
- Infections
- Inflammatory disease
- Malabsorptions
- Obstruction
- Polyps
- Ulcers
Estimated Cancer Deaths in the US in 2014

<table>
<thead>
<tr>
<th>Cancer Site</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung &amp; bronchus</td>
<td>310,010</td>
<td>275,710</td>
</tr>
<tr>
<td>Prostate</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>8%</td>
<td>9%</td>
</tr>
<tr>
<td>Pancreas</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Leukemia</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Esophagus</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>All other sites</td>
<td>24%</td>
<td>23%</td>
</tr>
</tbody>
</table>

26% Lung & bronchus
15% Breast
9% Colon & rectum
7% Pancreas
5% Ovary
4% Leukemia
3% Uterine corpus
3% Non-Hodgkin lymphoma
3% Liver & intrahepatic bile duct
2% Brain & other nervous system
23% All other sites

American Cancer Society 2014
New cancer cases in 2010

- Esophageal: 16,640
- Stomach: 21,000
- Small intestine: 6,960
- Colon: 102,900
- Rectal: 39,970
Endoscopy (EGD, Colonoscopy)

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NIH (left) and Atlanta South Gastroenterology, P.C. (right)
Virtual Colonoscopy with CT Scan

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Snyder, G; Minnesota Radiology (left)
MedicineWorld.org (right)
An alternative method:

- Design a *video capsule for small intestine evaluation and treatment*.
- What should it do?
- How will it do these things?
- Who should use it?
- What are its advantages?
- What are its limitations?
- Any other issues to consider?
Endoscope Capsule
Capsule Navigation

- Propelling direction
- Permanent magnet
- Rotational magnetic field
- Spiral
- Capsule
- Magnetic field
- Pair coils

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Olympus
Magnetically Guided

Antenna Sensor Array

Capsule Technologies

- Compact, low power-consumption imaging technology, wireless data transmission.
- Guidance system and self-propulsion navigates capsule freely within the gastrointestinal tract.
- Wireless power supply system eliminates constraints on operating time and energy levels.
- Administration of drugs directly to the affected area.
- Body fluid sampling technology for diagnosis and analysis.
- Ultrasound capability for scanning from inside the body.
Fig. 1 Angiodysplastic lesion of the small bowel mucosa.
Fig. 2 Crohn’s disease: small bowel ulcers.
Fig. 3  Celiac disease: Layering or stacking of folds.
Fig. 4 Celiac disease: Nodular appearance of the small bowel mucosa.
Fig. 5 Familial adenomatous polyposis: small adenomatous polyp in the small bowel.

Fig. 6 Bleeding tumor in the terminal ileum.
Summary

- Gastrointestinal endoscopy
  - Upper esophagogastric duodenoscopy
  - Colonoscopy
- Virtual Colonoscopy
  - CT scan
  - Less invasive, no biopsy or treatment
- Capsule Endoscopy
  - Video/image capture
  - “Steering” potential
  - Biopsy, ultrasound and drug delivery potential