Capsule Endoscopy: Present & Future

Dr Barrie Rathbone

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1932 Rudolf Schindler developed a flexible endoscope
Flexible Fibroscope, using Static Scanning.

H. HOPKINS & N. S. KAPANY1.

- Department of Physics, Imperial College of Science and Technology, London, S.W.7. Nov. 22.

Abstract. An optical unit has been devised which will convey optical images along a flexible axis. The unit comprises a bundle of fibres of glass, or other transparent material, and it therefore appears appropriate to introduce the term 'fibrescope' to denote it. An obvious use of the unit is to replace the train of lenses employed in conventional endoscopes. The existing instruments of this kind, for example, cystoscopes, gastroscopes and bronchoscopes, etc., consist of a train of copying lenses and intermediate field lenses. They are either rigid or have only limited flexibility. Moreover, the image quality of these systems is poor, since they consist only of positive lenses which give rise to a very large curvature of field. In existing gastroscopes the total number of lenses employed may be as many as fifty, and in consequence the light transmission is poor, due to the total glass path and the number of air-glass surfaces, in spite of blooming. Even more important in this respect, however, is the need to use small relative apertures for such instruments, this being necessary if acceptable definition is to be obtained with such large field curvature.
1957 Hirschowitz, Curtiss and Peters developed first fibreoptic gastroscope
1960 First commercial upper GI fibreoptic endoscope
• 1960-62 major redesign
• 1991 first report on clinical use
• 1963 controllable tip
• 1966 Ampulla of Vata seen
• 1968 first cannulation of ampulla
• 1969 first commercial colonoscope
1983 first video endoscope produced
Small bowel imaging

- Barium meal/enema
- CT
- Enteroscopy
- 1990+ Ultrasound
- 2000+ CT enteroclysis
- 2000+ MRI bowel
- 2000+ capsule endoscopy
Pillcam SB 3: Third Generation

Complete redesign of optical dome
Min 11 hour battery (mercury free)
New imager implemented
911 patients with obscure GI bleeding
(Lepileur et al 2012)

- 22% small bowel angioectasia
- 10% small bowel ulcerations
- 7% small bowel tumours
- 3% small bowel varices
- 8% blood in small bowel with no lesion
- 11% oesophageal gastric lesion
- 2% colonic angioectasia
Detection of small bowel Crohn’s disease

- Increasing indication
- Beware of strictures
- Higher pick up than other imaging
- Refractory coeliac
Pros and cons of small bowel capsule technology

- Safe
- Well tolerated
- Not frightening as a concept or in reality
- High definition magnified images

- Prep dependant
- Sensitivity/specificity
- Pathology localisation
- No histology
- Boring and time consuming analysis
What about capsules in the colon?
Colon capsule
Colon capsule vs colonoscopy in detecting >6mm polyps

<table>
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<th>626 mixed pts 1st generation</th>
<th>545 asmpt 1st generation</th>
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<tr>
<td>Sensitivity %</td>
<td>69</td>
<td>39</td>
<td>84</td>
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<tr>
<td>Specificity %</td>
<td>86</td>
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<td>Sacher-Huvelin 2010</td>
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Pros and cons of current colon capsule technology

- Safe
- Well tolerated
- Not frightening as a concept or in reality
- High definition magnified images
- Prep dependant
- No lens cleaning
- No air insufflation
- Sensitivity/specificity
- Pathology localisation
- No histology
- Not steerable
- No therapy
- Boring and time consuming analysis
Drivers for future development

- Commercial incentives
- Patient preference and compliance issues
- Technological advances in capsules
Potential technological advances in capsules:

- Steerable
- Motile
- Biopsying
- Insufflating
- Injecting and resecting
- Ultrasound
- Narrow band etc
- Suite of capsules
Provided by The Leicester Gondar Link Collaborative Teaching Project

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