Capsule endoscopy – looking ahead

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Imaging the small bowel

- The **large small bowel** – a big white spot on the map
  - Upper endoscopy
  - Colonoscopy
  - Enteroscopy
  - Small bowel follow-through x-ray
  - Scintigraphy
  - Surgery
Enter: The capsule!

Wireless capsule endoscopy
Iddan, Meron, Glukhovsky, Swain
Colon imaging

- Small bowel pathology is rare
- Colon polyps and cancer are not
- Capsule imaging of the colon is an interesting alternative to colonoscopy and other diagnostic modalities
Colonoscopy

- Complete optical investigation of the colon with a flexible tube
- Offers maximal diagnostic performance and therapeutic capabilities
- Detects flat, small, and large polyps as well as cancers

“You don’t need a colonoscopy, but I’m sending you for one because, quite frankly, I don’t like you.”
The colonoscopy alternatives

- **High Accuracy**
  - Detects Cancer & Over 50% Sensitivity for Large Polyps
  - CTC
  - PillCam COLON 2

- **Low Accuracy**
  - Detects Only Cancer & 50% or Less Sensitivity for Large Polyps
  - DCBE
  - Double Contrast Barium Enema

- **Minimally-Invasive**
- **Invasive**

- sDNA
- FIT
- gFOBT
- Blood Test

Legend:
- Blue circles = Direct visualization
- Green squares = Radiology, indirect visualization
- Purple triangles = Indirect information
Specifics of colon capsule

- Battery life more critical
- Bowel cleansing more critical – and more arduous
- Double cameras and variable frame rate needed
- More time and better capsule readers needed
- Still – sensitivity and specificity remains a problem
Current issues

- Bowel cleansing
- Gastric trapping
- Small bowel strictures
- Sensitivity
- Reading time and reader competence
Role of AI and machine learning?

- Visual characteristics of polyps can be taught
  - Automated video analysis
  - «Augmented detection» overlay on standard video files
  - Detection and/or characterisation
    - Safe to leave
    - Removable by endoscope
    - Cancer
AI concerns

- Blood detection algorithms in the small bowel close to useless
- Videorecordings of polyps depend on the polyp being detected
  - How to surpass the endoscopists
  - Self-fulfilling system?
- False security
- Characterization: Another ballgame
Future of capsule endoscopy

- Improved image quality
- Resolution of cleansing barrier
- Improved reading software
- Improved self-reading
- Improved battery capacity/recharging
- "chemical" sampling
  - Inflammation
  - Cancer
- Navigation
Conclusion

- Capsule endoscopy is a useful disruptive technology for endoluminal GI imaging
- AI for capsule video reading would carry important benefits
- It would not resolve all capsule issues