Virtual Colonoscopy in colorectal cancer screening

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Patient AA

- 78 year-old female
- Iron-deficiency anemia
- Scheduled for upper GI endoscopy and colonoscopy but cancelled due to apprehension
- Episodic rectal bleeding
- Agreed to undergo virtual colonoscopy with conventional colonoscopy follow-up
Occult or Lower GI Bleeding

• Occult:
  – Upper GI bleed (varices, gums)
  – Peptic Ulcers
  – Angiodysplasia
  – Benign Polyps
  – **Colorectal Cancer**
  – etc.

• Lower GI Bleed
  – **Colorectal Cancer**
  – Diverticula
  – Ischemic Bowel
  – Angiodysplasia
  – Benign Polyps
  – Hemorrhoids
Colorectal Cancer

- 2nd most common cause of cancer-related death in US
- everyone > 50 years should be screened
- only <40% of ‘eligible’ persons have been screened
- Progress from adenomatous polyps – detection and resection is curative. 6 mm threshold for malignant potential.
Screening Options

- Fecal occult blood testing – 3 serial samples done at home and sent away for analysis
- Double contrast barium enema
- Sigmoidoscopy – half the colon, misses 50% of neoplasms
- Colonoscopy – currently gold standard for screening with high sensitivity and specificity
- Stool-based molecular screening
- Virtual colonoscopy
Virtual Colonoscopy Basic Technique

1. Bowel prep
2. Air insufflation of colon
3. Ensure full length insufflation with scout CT
4. Supine uninterrupted volume of data through abdomen – 32 second breath hold.
   Thin slices ~ 1-2.5 mm.
5. Postprocessing – 3D reconstruction with surface, volume and/or perspective rendering
Scout CT

After air insufflation

After a little more air

Courtesy Dr. Morrin
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Axial CT

- Cecum
- Sigmoid Colon
- Polyp

Courtesy Dr. Morrin
Axial CT

- Transverse Colon
- Ascending Colon
- Descending Colon
- Polyp

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3D reconstruction

Frontal cutaway

Air-soft tissue interface surface rendering

Polyp

Courtesy Dr. Morrin
Endoluminal Perspective

Polyp

Haustra

Courtesy Dr. Morrin
Endoluminal Navigation

Frames from fly-through sequence showing polyp (arrow)

Courtesy Dr. Morrin
Follow-up on same-day Optical Colonoscopy

Courtesy Dr. Morrin
A less subtle diagnosis...

3.6 cm polyp

Courtesy Dr. Morrin
A less subtle diagnosis...

Multiple adenomas
- familial adenomatous polyposis

3.6 cm polyp

Courtesy Dr. Morrin
Virtual Colonoscopy
pros and cons

• Visualization of entire colon
  – Explore beyond colonic obstruction and both sides of haustral folds
• Reduced patient discomfort and anxiety
  – Non-invasive
  – Fast and does not require sedation
• Lower risk of procedural complications
• Sensitivity > 90% (in many studies even better than conventional colonoscopy)

• Specificity was low (until now), due to residual bowel fluid, fecal residue
• Still requires bowel prep
• Not therapeutic
• Ionizing Radiation
• Cost
Screening in High Risk Patients

- Personal or family history of Colorectal Cancer
- Current symptoms
  - iron-deficiency anemia
  - heme positive stool
  - hematochezia
- Prior occurrence of polyps

Clearly established as an effective alternative when compared to conventional colonoscopy:

Sensitivity for polyps > 10 mm: 89-92% in studies with > 100 patients. *(using same-day conventional colonoscopy as gold standard)*

Sensitivity for patients with polyps: 92-100%
Specificity for patients with polyps: 72-97%

*but high prevalence of polyps in this population keeps PPV high*
False Positive

• Main culprits are residual fecal material and fluid due to incomplete bowel prep

Techniques to reduce false positives:

• Scanning both supine and prone:
  – exclusion of shifting material

• IV contrast:
  – exclusion of non-enhancing material

• Fecal tagging:
  – exclusion of enhancing material
False Positive

- Main culprits are residual fecal material and fluid due to incomplete bowel prep

Stool shift - not a polyp!

Courtesy Dr. Morrin
size, size, size

- 50% > 50yrs have polyps - so what’s the screening threshold?
- > 1.0 cm polyps have majority of malignant potential
- detection of polyps 5-10 mm may be useful as clusters of small polyps also have increase potential
  - sensitivity for these polyps in high risk cohorts: 70-82%
- flat adenomatous lesions also have malignant potential

Techniques to increase sensitivity for small polyps:
- thinner slices: 1 - 3 mm
- IV contrast: enhance smaller lesions in background of residual fluid
IV Contrast for Increased Sensitivity

Submerged polyp seen with contrast on prone scan.

Courtesy Dr. Morrin
Screening in Average Risk Patients

- 1233 patients in prospective multicenter trial with same-day conventional colonoscopy as standard
  - high risk patients excluded
  - 24 hour bowel prep with phosphosoda, bisacodyl, barium, diatrizoate meglumine
  - 1.25 - 2.5 mm collimation, supine and prone
  - 3D endoluminal display read prior to conventional colonoscopy
  - stool tagging and digital fluid subtraction

- Sensitivity by patient: 10mm -- 93.8%
- Specificity by patient: 10mm -- 96%
- Conventional colonoscopy sensitivity:
  - 87.5% (prior to unblinding)

Conclusion: VC more sensitive than conventional colonoscopy, with high specificity: threshold of 8mm for f/u therapeutic endoscopy

Pickhardt et al 2003 (NEJM in press)
as reported at 4th Intern. Symp. on VC
Modifications and Frontiers

- IV contrast
- Fecal tagging
- MRI virtual colonoscopy
- Computer aided detection
- Prepless or minimal prep procedures
References

Acknowledgements

Thank you!!

- Martina Morrin, MD
- Larry Barbaras
- Gillian Lieberman, MD
- Pamela Lepkowski