Advances in Gastrointestinal Endoscopy

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Advances in GI Endoscopy

• Diagnostic
  – Image enhanced endoscopy
  – New equipment/technique

• Therapeutic
  – EUS guided drainage
  – POEM and submucosal endoscopy
  – RFA
Diagnostic Colonoscopy
### Interval Cancer and Adenoma Detection Rate

#### A  Risk of Interval CRC

<table>
<thead>
<tr>
<th>Quintile</th>
<th>HR</th>
<th>95% CI</th>
<th>No. of CRCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>(reference)</td>
<td>186</td>
</tr>
<tr>
<td>2</td>
<td>0.93</td>
<td>(0.70–1.23)</td>
<td>144</td>
</tr>
<tr>
<td>3</td>
<td>0.85</td>
<td>(0.68–1.06)</td>
<td>139</td>
</tr>
<tr>
<td>4</td>
<td>0.70</td>
<td>(0.54–0.91)</td>
<td>167</td>
</tr>
<tr>
<td>5</td>
<td>0.52</td>
<td>(0.39–0.69)</td>
<td>76</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quintile</th>
<th>Hazard Ratio</th>
<th>No. of cases/10,000 person-yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>9.8</td>
</tr>
<tr>
<td>2</td>
<td>0.93</td>
<td>8.6</td>
</tr>
<tr>
<td>3</td>
<td>0.85</td>
<td>8.0</td>
</tr>
<tr>
<td>4</td>
<td>0.70</td>
<td>7.0</td>
</tr>
<tr>
<td>5</td>
<td>0.52</td>
<td>4.8</td>
</tr>
</tbody>
</table>

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**Adenoma Detection Rate**

<table>
<thead>
<tr>
<th>Rate quintile</th>
<th>No. of cases</th>
<th>Hazard Ratio</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous rate</td>
<td>712</td>
<td>0.97</td>
<td>7.7</td>
</tr>
<tr>
<td>Quintile 1: 7.35–19.05%</td>
<td>186</td>
<td>1.00 (reference)</td>
<td>9.8</td>
</tr>
<tr>
<td>Quintile 2: 19.06–23.85%</td>
<td>144</td>
<td>0.93 (0.70–1.23)</td>
<td>8.6</td>
</tr>
<tr>
<td>Quintile 3: 23.86–28.40%</td>
<td>139</td>
<td>0.85 (0.68–1.06)</td>
<td>8.0</td>
</tr>
<tr>
<td>Quintile 4: 28.41–33.50%</td>
<td>167</td>
<td>0.70 (0.54–0.91)</td>
<td>7.0</td>
</tr>
<tr>
<td>Quintile 5: 33.51–52.51%</td>
<td>76</td>
<td>0.52 (0.39–0.69)</td>
<td>4.8</td>
</tr>
</tbody>
</table>

Corley DA, et al. NEJM 2014
Chromoendoscopy
Narrow band imaging (NBI)
Adenoma Yield and Miss Rate (NBI vs WL)

Pasha SF et al. Am J Gastroenterol 2012
New NBI vs White Light Colonoscopy

Adenoma Detection Rate
Polyp Detection Rate
Adenoma Miss Rate
Polyp Miss Rate

P = 0.01
P = 0.02
P = 0.9
P = 1.0

RCT
360 patients
Tandem Colonoscopy

Endoscopist’s Experience and Adenoma Detection

Third Eye Retroscope

Colonoscop View

Third Eye Retroscope™ View
FULL SPECTRUM ENDOSCOPY (FUSE)

42% Miss Rate with TFV endoscope
8% Miss Rate with Fuse™ endoscope
71% Incremental adenoma find rate with Fuse™
FUSE vs Standard colonoscopy

• Multi-center, tandem colonoscopy trial
• 185 patients completed
• Adenoma miss rate (per-lesion analysis)
  – 7% in FUSE vs 41% in standard (P<0.0001)
• Standard: missed 20 adenomas (3 advanced)
• FUSE missed 5 adenoma (none advanced)

FUSE Colonoscopy
Virtual Histology
# NBI International Colorectal Endoscopic (NICE) Classification

<table>
<thead>
<tr>
<th>NICE Criterion</th>
<th>Type 1</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Same or lighter than background</td>
<td>Browner relative to background (verify color arises from vessels)</td>
</tr>
<tr>
<td>Vessels</td>
<td>None, or isolated lacy vessels coursing across the lesion</td>
<td>Brown vessels surrounding white structures</td>
</tr>
<tr>
<td>Surface pattern</td>
<td>Dark or white spots of uniform size, or homogeneous absence of pattern</td>
<td>Oval, tubular, or branched white structures surrounded by brown vessels</td>
</tr>
<tr>
<td>Most likely pathology</td>
<td><strong>Hyperplastic</strong></td>
<td><strong>Adenoma</strong></td>
</tr>
</tbody>
</table>

Hewett DG et al. Gastroenterology 2012
Confocal Laser Endomicroscopy (CLE)

- Probe based CLE
- Compatible with standard endoscopes
- Applied anywhere in GI tract
  - Barrett’s esophagus
  - Gastric IM
  - Coeliac disease
  - Colitis
  - Colonic polyps
  - Pancreaticobiliary strictures
pCLE for indeterminate pancreaticobiliary strictures

- Sensitivity = 98%
- Specificity = 67%

Meining A et al. GI Endosc 2011
In vivo molecular imaging

Real time, simultaneous imaging at 488 nm and 660 nm

Using different fluorescent dyes and proteins (e.g. AvB3 Integrin dyes, Sytox Green, GCaMP3.

Colon crypts imaged after acryflavin and AngioSense 680 injection:
Vessels are highlighted in red, and crypts in green

www.cellvizio-dualband.com
OPTICAL COHERENT TOMOGRAPHY (OCT)

- Scanning of esophagus
- 3mm deep
- 6cm long segment
- In 90 seconds
Small Bowel Endoscopy
## SB capsule endoscopy systems

<table>
<thead>
<tr>
<th></th>
<th>Pillcam SB2</th>
<th>EndoCapsule</th>
<th>MiroCam</th>
<th>OMOM capsule</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length, mm</strong></td>
<td>26</td>
<td>26</td>
<td>24</td>
<td>27.9</td>
</tr>
<tr>
<td><strong>Diameter, mm</strong></td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td><strong>Weight, g</strong></td>
<td>3.4</td>
<td>3.8</td>
<td>3.4</td>
<td>6</td>
</tr>
<tr>
<td><strong>Frame rate, frames/second</strong></td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>0.5–2</td>
</tr>
<tr>
<td><strong>Image sensor</strong></td>
<td>CMOS</td>
<td>CCD</td>
<td>CCD</td>
<td>CCD</td>
</tr>
<tr>
<td><strong>Field of view</strong></td>
<td>156°</td>
<td>145°</td>
<td>150°</td>
<td>140°</td>
</tr>
<tr>
<td><strong>Illumination</strong></td>
<td>6 white LEDs</td>
<td>6 white LEDs</td>
<td>6 white LEDs</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Antennas (body leads), n</strong></td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td><strong>Real-time (RT) view</strong></td>
<td>RT viewer</td>
<td>VE-1 viewer</td>
<td>Miro-Viewer</td>
<td>RT monitoring</td>
</tr>
<tr>
<td><strong>Recording time, hours</strong></td>
<td>8</td>
<td>9</td>
<td>11</td>
<td>7 – 9</td>
</tr>
</tbody>
</table>

Ladas SD, et al. Endoscopy 2010
Panoramic View Capsule Endoscopy

- 4 camera facing the sides
- 11.3 x 31 mm
- 20 – 12 fps
  - 5fps for each camera (first 2h)
  - 3fps for each camera after 2h
- Battery life up to 15 h
- Stores all images on-board
Magnetic guided CE

Rey et al. Endoscopy 2010
Disposable add-on device attached to endoscopes with balloon and working channel for the advancing balloon
Capsule Endoscopy (PILLCAM Colon 2)

- 2 camera covering 172° each
- Adaptive frame rate
  - 4 fps (stationary)
  - 35 fps (motion)
- Long battery life >10h
- Wireless transmission
NEW IMAGE PROCESSING:
FLEXIBLE SPECTRAL INTELLIGENT COLOR ENHANCEMENT (FICE)
Polyp Size Estimation

14 mm  15 mm  14 mm  14 mm
### Pillcam Colon 2 vs Colonoscopy

**International multicenter study**

**N = 695**

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adenoma</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;= 6mm</td>
<td>88% (82-93%)</td>
<td>82% (80-83%)</td>
</tr>
<tr>
<td>&gt;= 10mm</td>
<td>92% (82-97%)</td>
<td>95% (94-95%)</td>
</tr>
<tr>
<td><strong>Polyp</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;= 6mm</td>
<td>81% (77-84%)</td>
<td>93% (91-95%)</td>
</tr>
<tr>
<td>&gt;= 10mm</td>
<td>80% (74-86%)</td>
<td>97% (96-98%)</td>
</tr>
</tbody>
</table>

Rex D, DDW 2013
Biliary Endoscopy
Indications of Direct Per-oral Cholangioscopy

- Indeterminate biliary strictures
- Indeterminate filling defects
- Equivocal cholangiogram findings
- Bile duct cancer, intraductal papillary mucinous neoplasia or biliary papillomatosis
- Hemobilia of unknown etiology
- Remnant stones after lithotripsy
Cholangioscopy - Spyglass

- Per-oral direct cholangioscope
- Single operator
- Approved by FDA in 2009
Direct Cholangioscopy using Ultraslim Gastroscope

Weigt J et al. GI Endosc 2014
Endoscopic Ultrasound
EUS guided biliary and pancreatic duct drainage

Transduodenal: Extrahepatic approach

Intrahepatic approach

Pancreatic approach

Transgastric

Rendezvous vs Direct access

EUS bile duct rendezvous cannulation
AXIOS stent

- Fully covered
- Large diameter with 2 large flanges
- Create an anastomotic conduit
Treatment of Acute Cholecystitis

EUS guided transgastic placement of lumen-apposing metal stent to gallbladder

Gallstone crushed by BML through gastroscope after 2 wk

Stent removed after confirmed clearance of stone

Itoi T, et al. GI Endosc 2014
Fully Covered Metal Stent for Lumen Apposition

Transgastric EUS guided GB drainage

Moon JH et al. GI Endosc 2014
Endoscopic Management of GIB
Hemostatic powder (Hemospray)

- Peptic ulcer bleeding
- Uncontrolled variceal bleeding
- Post-polypectomy bleeding
- Post-ESD bleeding
Hemospray for post-polypectomy bleeding

Soulellis CA et al. GI Endosc 2013
Endoscopic Closure: Over-the-scope clip (OTSC)
Endoscopic Full-thickness Resection

- 20 patients with small <3cm gastric subepithelial tumors
- Endoscopic resection with laparoscopic control
- Perforation closed with over-the-scope-clip (OTSC)

Schlag C et al. Endoscopy 2012
OTSC for Refractory UGIB

9 patients (GU 3 and DU 6)

Primary success 100%

Rebleeding in 3

ESD Devices - Knife

- Triangular knife
- IT knife
- Hook knife
- Dual knife
- Flush knife
ESD Traction Device & Endoscopic Multitasking Platform

ANUBISCOPE

Cobra system

Endolifter

MASTER system
Per-oral endoscopic myotomy (POEM)
Per-oral endoscopic myotomy (POEM)
Per-oral endoscopic myotomy (POEM)

- Mean myotomy length 9cm
- All patients had relief of dysphagia (a mean of 11.4 month follow up)
- Confirmed by post-op manometry and Ba swallow


- High peri-op and post-op complications:
  - Pneumothorax 25%
  - Subcutaneous emphysema 56%
  - Mediastinal emphysema 29.4%
  - Pleural effusion 48.7%
  - Atelectasis 49.6%

Ren Z. Surg Endosc 2012
Submucosal Endoscopic Tumor Resection

Inoue H et al, Endoscopy 2012
RADIOFREQUENCY ABLATION (RFA) FOR BARRETT’S ESOPHAGUS

Shaleen N et al. NEJM 2009
RFA FOR BARRETT’S DYSPLASIA

Shaleen N et al. NEJM 2009
RFA reduces risk of progression from LGD to HGD and Cancer

Phoa KN, et al. JAMA 2014
Conclusions

• Image enhanced endoscopy offers the opportunity for better identification and characterization of GI mucosal abnormality.
• The FUSE colonoscopy may reduce adenoma missing rate of ordinary colonoscope.
• Despite the availability of many new devices and interventions, controlled clinical trials are needed to verify the ultimate benefits of these advances.