New Endoscopes, New Imaging Techniques

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Objectives

• Learn about what the new technologies are for enhanced endoscopic imaging and how they compare to older technology.
• Learn endoscopic characteristics of Barrett’s esophagus and colon polyps using new technologies.
• Discuss the data for using these technologies (i.e. when are they superior to standard endoscopy and when are they not)
What’s old?

• White light, standard definition endoscopes
What’s new?

• High definition video – utilizes CCDs with over a million pixels compared to older CCDs with an average of 300,000.
What’s new?

• Virtual chromoendoscopy:
  – Narrow-Band imaging (NBI; Olympus America, Center Valley, PA)
    • Uses filter to illuminate mucosa at specific wavelength
  – Fujinon Intelligent Color Enhancement (FICE; Fujinon, Inc, Wayne, NJ)
  – I-Scan (Pentax Medical, Montvale, NJ)
    • Both use computer processing to enhance mucosal detail
What’s new?

- Autofluorescence Imaging (AFI; Olympus America, Center Valley, PA)
  - uses a blue light to excite tissue fluorescence that can be detected and displayed as different colors during endoscopy.
Narrow Band Imaging

Utilizes an optical filter to only allow passage of 415 nm and 540 nm blue and green light.

The blue light highlights superficial capillaries, which display a brown color, while the green light highlights subepithelial veins, which display in cyan.
Narrow Band Imaging – Barrett’s

Non-dysplastic Barrett’s under HDWL (A&C), and NBI (B&D), note regular villous and vascular patterns

Kara, et al. GIE 2006
Narrow Band Imaging – Barrett’s

High-grade dysplasia under HDWL (A&C), and NBI (B&D). Note disordered villous and vascular patterns.

Kara, et al. GIE 2006
Narrow Band Imaging – Barrett’s
Narrow Band Imaging – Barrett’s
Narrow Band Imaging – Barrett’s
Narrow Band Imaging – polyps

Hyperplastic polyps

A. Fine capillary network but absent mucosal pattern.
B. Circular pattern with dots – central dark area surrounded by light outer area.

Rastogi, et al. GIE 2009
Narrow Band Imaging – polyps

• Adenomas

A. Round/oval pattern – central light area surrounded by dark outer area

B. Tubulogyrus pattern – presence of tubules, either linear or convoluted

Rastogi, et al. GIE 2009
Post-processing techniques

- FICE
- i-Scan
Post-processing 101

My Face
Surface enhancement (a.k.a. sharpening)
Contrast enhancement
Contrast enhanced

My face before

My face contrast-enhanced
Combination of both

My face before

My face SE & CE
Tone enhancement
Combination of all three
FICE

FICE

Traditional white light endoscopic image of a duodenal adenoma (a), followed by images using FICE technology at standard magnification (b) and magnified 1.8X which shows border between normal and altered villous pattern (c).

Figure 1  Influence of the spectral specification of computed virtual chromoendoscopy (CVC) and chromoendoscopy with indigo carmine on the contrast of the subepithelial capillary network within scar tissue after resection of early gastric adenocarcinoma. The images show a view taken using the conventional system (a), views with set 1 (b), set 2 (c), set 3 (d), set 4 (e), set 5 (f), and set 6 (g) of the CVC system, and with the conventional system after application of indigo carmine (h).
i-Scan

(A) Standard endoscopic image of stomach, (B) SE image, (C) CE image, (D) combined

i-scan

Standard WL

SE & CE image

SE, CE, and TE-e image

Principles of AFI: When short wavelength blue light is shone on mucosal tissue, green fluorescence occurs. A difference in the intensity of this fluorescence is seen between normal healthy and unhealthy tissue.

When blue light reaches the submucosal layer, strong fluorescence is emitted. If there is any change, such as abnormal aggregation of capillaries in the superficial layer or thickening of the mucosa, the light is blocked, attenuating the fluorescence.

Thanks to a high-sensitivity CCD, the Olympus autofluorescence videoscopes can detect these differences in autofluorescence and display them as distinct colour tones on the monitor, making it possible to distinguish between healthy and unhealthy tissue.
AFI

(a) Standard WL, (b) AFI, (c) NBI images of high grade dysplasia within Barrett’s epithelium. Note purple color of lesion compared to surrounding green on AFI. On NBI image, note irregular vascular pattern.
Data

• Colon adenoma detection
  – HD vs. SD
    • East, et al: Prospective cohort study of 130 patients, all using 140 degree scopes.
      – % with ≥ 1 adenoma: HD 71%, SD 60%, p=0.2
      – # of adenomas detected: HD 93, SD 88, p=0.12
      – Nonflat <6mm: HD 78, SD 60, p=0.03
    • Tribonias, et al: RCT of 390 patients, using HD 170 degree scopes vs. SD 140 degree.
      – Increased overall polyp detection, but significance due to higher detection of small hyperplastic polyps
      – Trend toward increased detection of small adenomas between 5 and 10 mm.
Data

• Colon adenoma detection
  – NBI vs. HD
    • Rex, et al: no significant difference, overall high detection rate – HD 67%, NBI 65%
    • Inoue, et al: Significant increase in small adenoma detection
      – Patients ≥ 1 polyp: HD 39%, NBI 51% (p=0.06),
      – total # adenomas found: HD 65, NBI 102 (p=0.02)
      – Patients ≥ 1 adenoma: HD 34%, NBI 42% (p=0.2)
    • Kaltenbach, et al: 276 tandem colonoscopy patients in VA setting
      – 12.6% miss rate in NBI, 12.1% in WL (NS)
Data

• Adenoma detection
  – FICE:
    • Aminalai, et al: 1318 patients randomized to FICE vs. WL on withdrawal
      – No difference in ADR or withdrawal time
    • Chung, et al: Randomized, tandem study of 359 patients in Korea – FICE vs WL
      – No difference in ADR
  – iScan:
    • No trials have been reported
Data

• Polyp diagnosis – adenomas vs hyperplastic
  – Rastogi, et al. 100 patients, 236 polyps: NBI – 96 and 93% sensitivity and accuracy in adenoma prediction; HDWL – 38 and 61%, p>0.0001.
Data – Barrett’s

• Differentiation of neoplastic from non-neoplastic
  – NBI – Systematic review – 5 studies, 149 neoplastic lesions, 607 non-neoplastic: Sens 97%, Spec 94%, Acc 96%¹
  – FICE – 87% sensitivity – equivalent to chromoendoscopy with acetic acid solution²
  – i-Scan – no published literature at this point
  – AFI/trimodal:
    • AFI has a high false positive rate, which requires review with NBI to further characterize lesions (FP reduced 71→48%).
    • Higher targeted yield than HDWL, but still missed 17% of HGD/IMCa found with random biopsies.³

Summary

• Multiple new endoscopic technologies easily incorporated into all major endoscope lines to enhance mucosal detail.
• Neither NBI nor FICE have been found helpful in significantly increasing ADR on colonoscopy compared to HDWL (at least with very high polyp detectors).
• Good data to support diagnosis of polyp types using NBI and FICE.
• Good data to improve targeted biopsy yield to detect HGD and IMCa in Barrett’s but poor data that overall yield of targeted technique is better than random biopsies.
Thank you