Electronic Imaging to Enhance Lesion Detection at Colonoscopy

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KEYWORDS

• Colonoscopy • Colorectal cancer • Colonic polyps • Surveillance • Adenoma
• Lynch syndrome • Inflammatory bowel disease • Molecular imaging • Lectins

KEY POINTS

- Electronic imaging has shown no utility in enhancing adenoma detection in average risk patients.
- Patients with Lynch syndrome or serrated polyposis syndrome may benefit from electronic imaging.
- Electronic imaging seems to offer limited benefit for patients undergoing surveillance for longstanding inflammatory bowel disease.
- The addition of molecular imaging probes may be needed to fully realize the benefits of electronic imaging for polyp detection in the colon.

INTRODUCTION

Colorectal cancer (CRC) can be considered a heterogenous disease appearing in various clinical contexts, such as sporadically, in those with an inherited predisposition, or in chronic inflammatory processes of the colon such as inflammatory bowel disease (IBD).

There are multiple molecular pathways that can lead to CRC,[1–3] reviewed in the article Colorectal Neoplasia Pathways: State-of-the-Art by Ijspeert and colleagues elsewhere in this issue. Adenomatous polyps undergo sporadic accumulation of genetic mutations in multiple molecular pathways, including the adenomatous polyposis coli tumor suppressor gene and DNA mismatch repair genes,[4] which can lead to mutations in the KRAS oncogene and p53 suppressor gene. Sessile serrated adenomas/

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polyps develop into CRC via a separate molecular pathway involving BRAF mutations and DNA methylation.[5,6] Recent data suggest that traditional serrated adenomas develop through a pathway driven by epithelial over expression of the bone morphogenic protein antagonist GREM1.[7]

Hereditary or familial syndromes give rise to approximately 3% of cases of CRC. The most common is hereditary nonpolypsis CRC or the Lynch syndrome, where a germline mutation in DNA mismatch repair genes occurs leading to microsatellite instability. The less well-recognized serrated polyposis syndrome is characterized by multiple serrated polyps, defined as patients with more than 20 serrated polyps throughout the colon or 5 or more serrated polyps proximal to the sigmoid with 2 or more that are at least 10 mm in size.[8] Other genetic syndromes are either less common or produce so many polyps that advanced endoscopic imaging is not needed, for example, in familial adenomatous polyposis.

IBD has long been recognized to be associated with CRC, related to the carcinogenic effect of chronic inflammation combined with a genetic predisposition. A meta-analysis has estimated the cumulative probability of developing CRC in any patient, 30 years after a diagnosis of ulcerative colitis, at 18%[9]; however, population-based studies suggest that for patients with IBD overall, the risk may in fact be minimally elevated.[10,11] There are no large studies confirming that surveillance reduces the mortality of ulcerative colitis–associated CRC. However, the benefit of continued surveillance has been described[12] and it remains recommended practice in all international guidelines,[13–17] with increasing focus on risk stratification to target efforts on higher risk patients.

Recognition of lesions with malignant potential is crucial, because detection and early removal of polyps reduces CRC mortality compared with population risk estimates.[18] No randomised studies for colonoscopy for CRC prevention are available; however, a meta-analysis looking at 4 randomised, controlled trials and 10 observational studies found that flexible sigmoidoscopy for population screening showed a reduction in CRC rates in the distal colon.[19] Variation in adenoma detection correlates with the incidence of postcolonoscopy CRC and death from CRC.[20] Current white light techniques for colonoscopic detection of polyps and neoplasia yield a high miss rate of up to 22% of all adenomas[21] and 2% to 6% of advanced colorectal adenomas and cancers.[22]

It is, therefore, imperative to maximize polyp detection rates and to avoid missing polyps to maximize cancer prevention and minimize the risk of postcolonoscopy CRCs. Missed polyps and subsequent cancers can arise through suboptimal mucosal visualization,[23] failure of complete polyp resection,[24] or failed polyp detection.[25]

In this review, we assess the potential benefits of additional electronic imaging above and beyond standard white light to improve polyp detection at colonoscopy.

HISTORY OF COLONIC POLYP DETECTION

The ability to reliably detect subcentimeter polyps is a relatively new phenomenon that has come with the advent of increasingly sophisticated endoscopic equipment. Before the 1950s, barium radiographic studies and rigid sigmoidoscopy were used for investigation of the colon. Flexible endoscopic visualization of the mucosa of the gastrointestinal tract was made possible by the development of a coherent optical fiber bundle by Hopkins and Kapany.[26] This led to the development of the first flexible gastroscope "fiberscope" reported in 1958, which was developed commercially by 1960.[27] Combined with the use of fluoroscopy, endoscope location could be confirmed and correlated with the endoscopic findings.[28] The next major development in endoscopy came when Sivak and Fleischer[29] published findings of a new endoscope where the optical