Tools for Polyp Histology Prediction

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KEYWORDS

• Colonoscopy • Advanced imaging • Polyp histology prediction • Adenoma
• Hyperplastic polyps • Electronic chromoendoscopy

KEY POINTS

- Real-time polyp histology prediction during colonoscopy is feasible and can result in significant cost savings.
- Several imaging technologies have been studied and most have shown good accuracy in polyp histology prediction.
- Electronic chromoendoscopy is a practical and easy to use technology that is accurate for real-time histology prediction of polyps.

INTRODUCTION

Colonoscopy is the favored modality for screening and prevention of colorectal cancer in the United States. Removal of adenomatous polyps during colonoscopy can prevent the development of colorectal cancer, because most cancers arise from adenomatous polyps following the adenoma-carcinoma pathway.[1,2] Another type of colon polyp are hyperplastic polyps,[3,4] which are in general not considered to be premalignant, especially those present in the distal colon and 5 mm or less in size.[5] Most polyps (>80%) detected during colonoscopy are diminutive (ie, $\leq$5 mm). Current practice is to remove all polyps detected during colonoscopy, irrespective of their size, and send them to pathology for evaluation. Because diminutive polyps rarely harbor any advanced histology, such as high-grade dysplasia or cancer,[6] histopathologic evaluation of these lesions determines whether they are adenomatous, which then dictates the postpolypectomy surveillance intervals. This practice entails a huge cost burden to the health care system, with limited clinical benefits in return. If the histology of diminutive polyps can be predicted real-time during colonoscopy by the endoscopist, then the cost of histology can potentially be avoided ("resect and discard").

Conflicts of Interest: Research grant support and Consultant from Olympus America (A. Rastogi). No conflict of Interest (S. Saligram).
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Gastrointest Endoscopy Clin N Am 25 (2015) 261–286
http://dx.doi.org/10.1016/j.giec.2014.11.009 giendo.theclinics.com
1052-5157/15/$ – see front matter Published by Elsevier Inc.

Moreover, although histopathologic diagnosis is considered the gold standard, another advantage of predicting polyp histology relates to diminutive hyperplastic polyps. Because these are not considered to have malignant potential, their removal and routine pathologic evaluation are seemingly wasteful and time-consuming endeavors. If these can be accurately characterized during colonoscopy, then they can potentially be left behind ("do not resect"), thereby saving further costs and also decreasing the risks associated with polypectomy. Cost-savings estimates of the "predict, resect, and discard" strategy have ranged from $33 million to $1 billion annually in the United States.[7,8]

Several novel imaging modalities have been developed during the past decade that have expanded the scope of colonoscopy and enabled the endoscopist to predict polyp histology. These imaging systems can be broadly divided into large-field and small-field technologies depending on the area of mucosa that is imaged. Large-field technologies include high-definition white light, chromoendoscopy, electronic chromoendoscopy, and autofluorescence. Small-field technologies include confocal endomicroscopy and endocytoscopy. This article reviews each technology as it relates to predicting polyp histology.

HIGH-DEFINITION WHITE LIGHT ENDOSCOPY

Technology

The older-generation white light endoscopy used a charge-coupled device (CCD) chip with an average of 300,000 pixels. Over the past decade, technology has evolved, with advancements in miniaturization and a specialized design of the CCD chip. CCD chips now have a 3-fold higher pixel density than standard-definition white light endoscopy (ie, >1 million pixels). This resolution, along with a high-definition video processor and a high-definition monitor, produces a high-definition image with 1080 effective scan lines.[9,10] Although some data suggest that high-definition white light (HD-WL) endoscopy may improve the adenoma detection rate, this improvement in technology has not had a significant impact on the ability to characterize the histology of polyps.

Performance

A randomized controlled study reported no difference in the performance between standard-definition and HD-WL endoscopy in characterizing the histology of 293 consecutive polyps smaller than 10 mm, as measured by sensitivity (76% vs 76%; $P = .96$), specificity (59% vs 67%; $P = .44$), and accuracy (70% vs 73%; $P = .6$).[10] Another prospective, randomized controlled trial showed slightly superior accuracy of HD-WL compared with standard-definition endoscopy in predicting adenomatous polyps (73.2% versus 68.5%, $P<.0001$).[11] A third prospective study compared HD-WL endoscopy and narrow band imaging (NBI) in the prediction of histology of 236 polyps in 100 patients. HD-WL endoscopy had a significantly lower sensitivity (38% vs 96%; $P<.0001$) and lower accuracy (61% vs 93%; $P<.0001$) than NBI in distinguishing adenomas from hyperplastic polyps.[12]

CHROMOENDOSCOPY

Technique

Chromoendoscopy involves the spraying of dyes, such as methylene blue, cresyl violet, and indigo carmine, using a spray catheter.[13,14] Methylene blue and cresyl violet stain the surface of a lesion by being actively absorbed and interacting with cell constituents. Contrast dyes such as indigo carmine are not absorbed by the mucosa and pool in the pits and mucosal crevices on the surface of polyps. These dyes can