

Virtual Chromoendoscopy with I-Scan and its Application for Detection and Characterization of Colon Polyps

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Abstract

The limitations of white light colonoscopy result in missing 6% of advanced neoplasias in 6% and up to 25% of adenomas. This has motivated the development of techniques such as virtual chromoendoscopy including the i-Scan system to detect larger numbers of polyps as a strategy for preventing colon cancer. This review summarizes the current application of this technique for detection and characterization of adenomas. The new system is a possible alternative in our environment to the better known NBI and FICE which are already being used here.

Key words

i-Scan, colonoscopy, polyp.

INTRODUCTION

Performance of polypectomy to remove adenomas detected during colonoscopy has reduced the incidence of colorectal cancer, (1-3) but it has been found that up to 6% of neoplasias and 25% of polyps cannot be seen during colonoscopy. (4, 5) This has led to several diagnostic modalities including chromoendoscopy with vital stains which can detect greater numbers of polyps and can be used to characterize them with the Kudo classification. (6-8) Nevertheless, routine use of this technique is not recommended because of its expense and because it can prolong the exploration time. These disadvantages make new techniques of virtual chromoendoscopy more attractive. (9) They have the advantages of being reversible, fast, clean and without any adverse effects due to dyes. (10) There are currently five virtual chromoendoscopy programs: Narrow Band (Olympus), the composite band imaging system (CBI) (Ahuoa), Fujifilm Intelligent Color Enhancement (FICE),

the iScan system (Illumina), and the SPIES (Storz) system which was just recently introduced. (11, 12)

This is the first review of the iScan system in Colombia. Our objectives are to learn about this technology and to provide an additional point of view about high definition colonoscopy and virtual chromoendoscopy. When we searched Pubmed until January 2016 using the keywords iScan and endoscopy, we found 68 articles. We did not include those designed for applications other than the detection and characterization of colon neoplasms. We also reviewed the references of the selected papers and have included the most relevant in our bibliography.

WHAT IS THE ISCAN SYSTEM?

The high-definition iScan, developed by Pentax (HOYA, Japan), is based on processing of the image taken by the CCD (charge coupled device) of the endoscope to increase the contrast of the vascular structures and the patterns of

the mucosa of the digestive tract. (13, 14) It can produce optical resolutions up to 1,300,000 pixels. (15-18)

The iScan consists has three modes based on several algorithms: surface enhancement (SE), contrast enhancement (CE) and tone enhancement (TE). The first two have three levels: low, medium and high. Three objectives can be obtained with TE: the esophagus, the stomach and the colon. The three modes (SE, CE and TE) are arranged in series so that two or more can be applied consecutively in real time, without delays and at the touch of a button. (11, 19-21)

HOW IS ISCAN USED?

Various authors recommend iScan modes for the scenarios listed below. (15, 21, 22)

- iScan 1 (SE) should be used for detection of lesions. It refines the image of subtle surface abnormalities without altering the brilliance of the endoscopic image.
- iScan 2 (TE plus SE) should be used for characterization of lesions. It combines surface and tone enhancement and enhances minute changes of the mucosa and vascular structures.
- iScan 3 (TE plus CE) should be used for demarcating lesions. It digitally adds blue color and darkens the edges of the endoscopic image.

USE OF ISCAN FOR COLON POLYP DETECTION

The first prospective randomized study that compared detection of polyps with the iScan methodology standard white-light endoscopy has shown that iScan found significantly more colorectal neoplasias than did traditional endoscopy (38% versus 13%, $p < 0.001$). (23) Another prospective randomized study compared the detection of adenomas of iScan with tone enhancement against detection with high definition white light colonoscopy. (24) iScan with tone enhancement found more adenomas (20 versus 6, $p = 0.006$) and identified a greater number of polyps omitted per subject (0.5 versus 0.15, $p = 0.006$). It was concluded that iScan with tone omitted fewer adenomas than did white light. Bowman found significantly similar findings with a larger number of patients. (25)

Another prospective study of 389 asymptomatic patients sought to determine percentages of adenomas detected. (26), Based on multivariate analysis, it concluded that iScan failed to document a significant performance in the detection of omitted adenomas which is contrary to the studies already mentioned. Nevertheless, it reported that The SE/TE-CE modes of iScan tended to outperform high-definition white light endoscopy in the detection of adenomas. This study's limitation is that it was performed in a single center with only a few endoscopists.

ISCAN CHARACTERIZATION OF POLYPS

A group from Mainz, Germany was the first to study detection and characterization of tiny polyps smaller than 5 mm. They used comparisons with histology to demonstrate that adenomas can be predicted with the iScan technique with a sensitivity of 9/11 (82%) and a specificity of 52/54 (96%). (27)

Another prospective study predicted histological outcome with a high degree of certainty (96.85%) through Kudo classification. (23) Successful studies in which this was the primary or secondary objective have demonstrated the high level of iScan's accuracy for classification adenomatous and non-adenomatous polyps. (16, 28, 29, 30)

A meta-analysis that included NBI, iScan, FICE, confocal endomicroscopy and autofluorescence imaging found that iScan had a sensitivity of 89.3% (83.3-93.3) and a specificity of 88.2% (80.3-93.2) for predicting polyps with a negative real-time predictive value of 86.5% (78-92.1). (31) These data were similar to those of other modalities, so it was concluded that these methods, including iScan, could be used routinely.

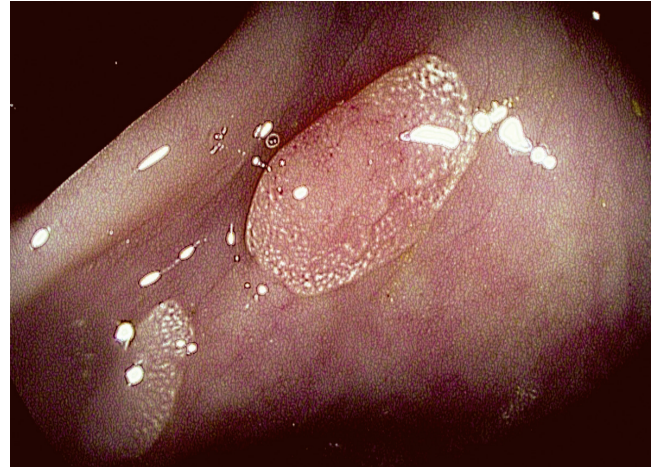
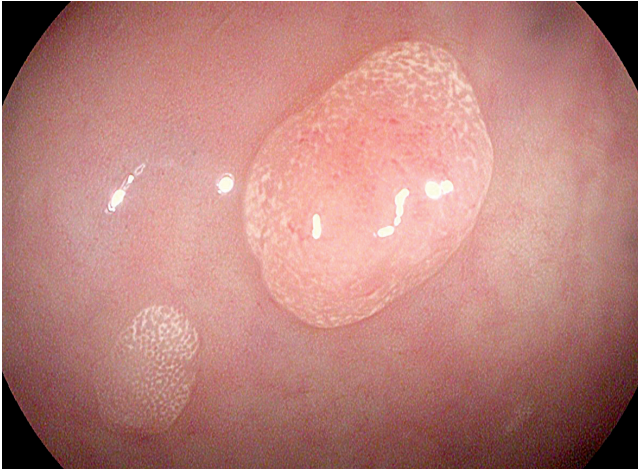
A comparison of iScan with NBI, another virtual chromoendoscopy technique, showed no obvious differences between the two for real-time prediction of polyps of less than 5 mm (sensitivity of 88.8% versus 94.6%; Specificity of 86.8% versus 86.4%; certainty of 87.8% versus 90.7%, respectively). (29) On the other hand, Bouwens has proposed a simple classification (ICE classification) for characterization of polyps that provides certainty 84% (Table 1 and Figures 1 to 10). (32) In addition, Lee has proposed a unified classification for NBI and iScan which combines the vascular pattern with the description of the mucosal surface of a polyp. Both classifications constitute practical tools for real-time optical diagnosis and characterization of adenomatous polyps. (29)

Table 1. Classification of nonadenomatous and adenomatous polyps using the iScan system (ICE classification) (32)

	Nonadenomatous	Adenomatous
Color	Pale Similar to adjacent mucosa Irregular edges	Reddish Differing from adjacent mucosa Clearly marked edges
Surface pattern	Uniform sized, rounded pits	Oval, tubular or branched pits
Glass pattern	Isolated, delicate, lace-like	Dilated, irregular

Learning Curve for Characterization of Polyps

According to the findings of a prospective study, after brief instruction eleven endoscopists with various levels of expe-



Figures 1 and 2. Characterization of 0I sessile polyps smaller than 5 mm with pale surfaces, rounded crypts of uniform size and isolated capillaries (non-adenomatous according to ICE classification). Figures 1 and 2 observed with high definition white light and iScan 3 virtual chromoendoscopy filter, respectively.

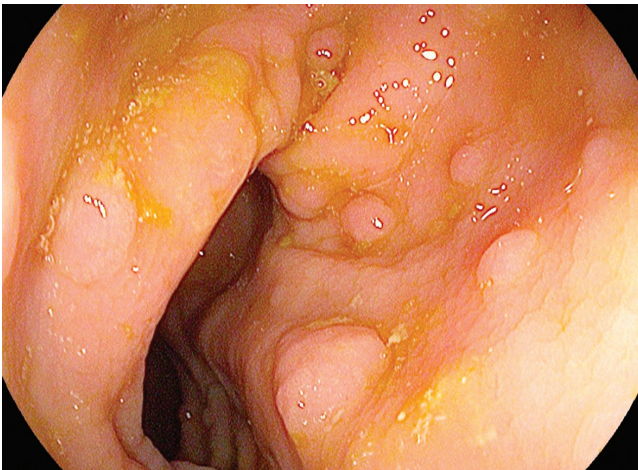


Figure 3. Several tiny sigmoid colon polyps observed with iScan high-definition white light, characterized by ICE classification as non-adenomatous.

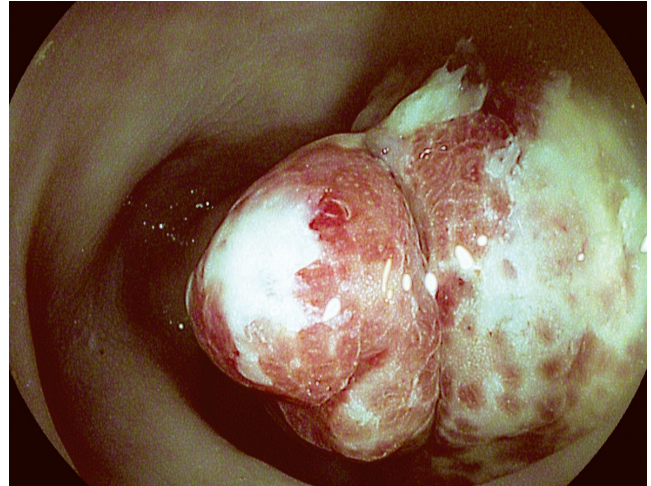
rience were able to predict the histological results with an accuracy of 84%. (30) Similarly, Neuman found that an accuracy of 94.3% could be obtained and that the learning curve can be quickly assimilated. (33) Routine use of iScan would allow less skilled examiners to achieve results comparable to those achieved by experienced endoscopists.

Position of the ASGE regarding the Characterization of Colonic Polyps and Virtual Chromoendoscopy

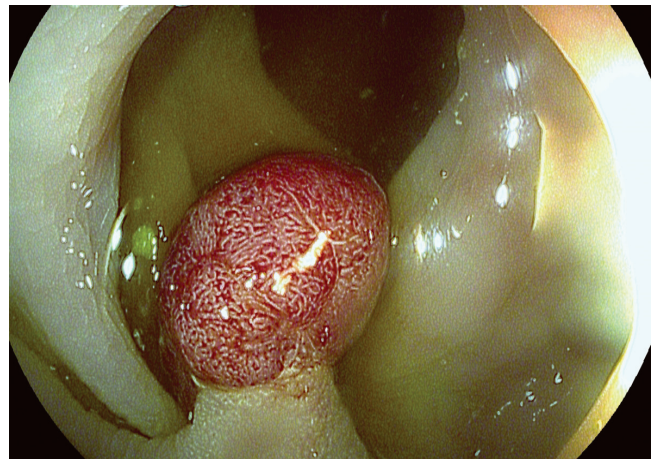
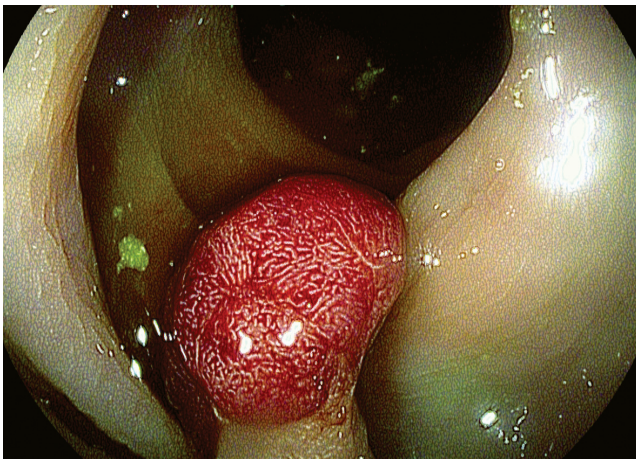
Preservation and Incorporation of Valuable endoscopic Innovations (PIVI) is an American Society of Gastrointestinal Endoscopy (ASGE) program that, in this particular case, addresses real-time assessment of diminutive polyps (less than 5 mm). It recommends two different strategies depending on the location of the polyps.



Figures 4 and 5. Endoscopic characterization of sessile polyp less than 5 mm, pattern of round crypts of equal size observed with high-definition white light and then with iScan 2. Classified according to ICE as non-adenomatous.



Figures 6 and 7. Characterization of 0Ip pedunculated polyp of 15 mm. Adenomatous characteristics according to ICE classification with oval and tubular pits. Figures 6 and 7 observed with iScan virtual chromoendoscopy 1 and 2, respectively.



Figures 8 and 9. Characterization of 10-mm reddish 0Ip pedunculated polyp observed with iScan virtual chromoendoscopy 2 and 3, respectively. Adenomatous according to ICE classification.

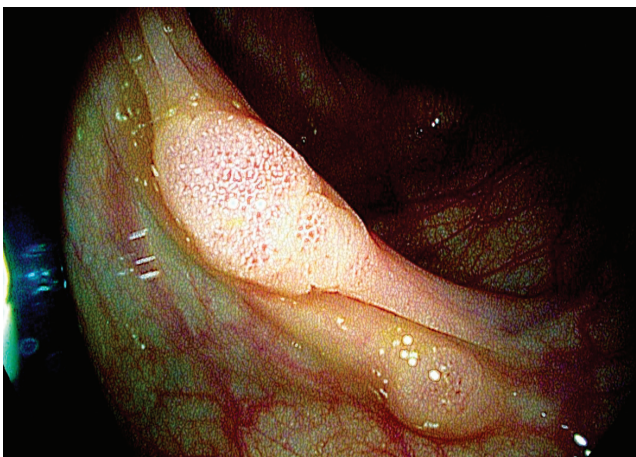


Figure 10. Characterization of sessile 0Is polyps of less than 5 mm, with oval and tubular crypts, pattern of dilated capillaries. Observed with iScan 2 virtual chromoendoscopy. Adenomatous ICE classification.

For diminutive polyps that are not located in the rectum or sigmoid colon, and that can be characterized by virtual chromoendoscopy with high reliability, the ASGE recommends that they be predicted, resected and discarded. For diminutive polyps that are located in the rectum or sigmoid colon, and that can be characterized by virtual chromoendoscopy with high reliability, the ASGE recommends that they be predicted, but not resected. To use these strategies, it is necessary to emphasize the reliability of optical diagnosis and reduction of interobserver variation. (35, 36) A recent review and meta-analysis by the ASGE, similar to the HISCOPE study, suggests that the thresholds proposed by PIVI can potentially be reached by the iScan system, but large randomized studies are necessary to test it. (37, 38) In addition, training and accreditation are needed that guarantee the quality of optical diagnosis. (39)

However, it is important to note that the iScan colonoscopy system is a tool that is complementary to good technique and quality indicators in colonoscopy: cecal intubation, adequate withdrawal time, percentage of adenomas detected and optimal colon cleansing. (40 , 41)

Position of the ESGE regarding Characterization of Colonic Polyps and Chromoendoscopy

The recent European Society of Gastrointestinal Endoscopy (ESGE) guidelines for the use of new technologies for detection and characterization of colon neoplasias has several recommendations. (42)

- Routine use of high magnification endoscopy with white light to detect colorectal neoplasms in the average population
- Routine use of high definition systems and conventional or virtual pan-chromoendoscopy (NBI, iScan) in patients known or suspected to have Lynch syndrome
- Conventional or virtual chromoendoscopy (NBI, FICE or iScan) should be strictly controlled for real-time diagnosis of polyps less than or equal to 5 mm in order to replace the histopathological diagnosis. In addition, photo documentation should be done by properly trained experienced endoscopists.

FUTURE RESEARCH AREAS

A consensus of the current classification systems of gastrointestinal mucosal lesions found with high definition endoscopes is needed for easy use in clinical settings. In addition, the relative value of digital chromoendoscopy compared to the histology of polyps raised by ASGE's PIVI should be studied in order to develop training certification modules. (43, 44)

CONCLUSIONS

The high definition iScan system can be considered as an alternative to the known virtual chromoendoscopy systems for detection of colon neoplasias.

With iScan technology, the histological prediction of adenomatous or hyperplastic polyps in real time during colonoscopy is safe. The learning curve can be quickly acquired which could lead to routine use outside of referral centers.

Conflict of Interests

The author states that he has no conflicts of interest.

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