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Original article

Real-Time Use of Artificial Intelligence During Colonoscopy for Detection and Characterization of Colorectal Polyps

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Abstract

Introduction: Colorectal cancer represents a significant public health concern in Colombia and worldwide. The detection and resection of adenomatous polyps via colonoscopy have contributed to reducing the incidence and mortality associated with colorectal cancer. Recently, numerous studies have been published regarding the use of artificial intelligence (AI) for detecting adenomatous polyps during colonoscopy; however, data on this topic in South America remain scarce. **Materials and Methods:** We conducted a prospective, descriptive study including patients over 45 years of age who underwent colonoscopy for colorectal cancer screening assisted by a real-time polyp detection system (Computer-Aided Detection, CAD EYE, Fujifilm, Tokyo, Japan) at two tertiary referral centers between May 2023 and June 2024. Demographic and procedural variables were recorded. The diagnostic performance of this tool was assessed through analysis of sensitivity, specificity, likelihood ratios, adenoma detection rate (ADR), polyp detection rate (PDR), and receiver operating characteristic (ROC) curves for lesion characterization (neoplastic and non-neoplastic). **Results:** A total of 86 patients were included in the final analysis. Of these, 80.2% (n = 69) were female, with a mean age of 63 years (± 9.83). The PDR with CAD EYE was 58.1%, whereas the ADR was 38.4% The concordance rate between AI and histopathology for lesions classified as neoplastic or hyperplastic was 73.13%. AI-based categorization of colorectal lesions as neoplastic demonstrated a sensitivity of 78.8% and specificity of 83.1%, with an area under the curve (AUC) of 0.73 (95% confidence interval [CI]: 0.686–0.882). Compared with the ADR previously reported by two of the study authors, the use of AI increased adenoma detection by more than 10%. **Conclusion:** This is the first study in Colombia evaluating the use of real-time AI software during colonoscopy, demonstrating a significant improvement in both ADR and PDR. Current evidence, alongside the findings of this study, indicates a promising discriminative ability for AI-assisted characterization of colonic polyps.

Keywords

Artificial intelligence, colonoscopy, adenoma, Colombia, diagnosis.

INTRODUCTION

Colorectal cancer (CRC) is the third most prevalent type of cancer worldwide and the second leading cause of cancer-related death globally[1]. The combination of molecular events leading to colon adenocarcinoma is heterogeneous and includes genetic and epigenetic abnormalities, among which the classic adenoma-carcinoma sequence is responsible for up to 80% of sporadic colon tumors. The detection and resection of precursor lesions, such as adenomatous

polyps via colonoscopy, have been shown to reduce the prevalence and mortality of CRC, which is why colonoscopy is currently considered the gold standard for screening this disease[2].

The adenoma detection rate (ADR) is one of the most studied quality indicators and the one best correlated with the prevention of CRC and interval cancer, both for screening colonoscopies and for colonoscopies performed for other indications[3]. However, various studies have reported that up to 27% of polyps present at the time of the examination are not detected by this method[4], a high error rate that could be explained by various factors, such as inadequate patient preparation, blind spots during the examination, interobserver variability, and human error, among others[5]. In response to this, quality indicators and strategies to improve intraprocedural quality have been proposed, among which the ADR is the clinically most relevant and best-validated quality indicator[5].

In recent years, thanks to technological advances, interest has grown in the use of artificial intelligence (AI) as a "second observer" to improve the ADR. Currently, real-time computer-aided detection (CADe) systems exist, with performance close to that of expert endoscopists, which, according to available scientific evidence, appear to improve the ADR and the characterization of detected lesions compared to conventional colonoscopy[6,7].

The objective of this study was to prospectively evaluate the performance of a real-time AI-assisted detection system during colonoscopy for the detection and characterization of colorectal polyps, as well as adenomas, in a real-world clinical setting in the Colombian population.

MATERIALS AND METHODS

Study Population

After approval of the study by the Research Ethics Committee (CIR), all patients over 45 years of age who underwent a colonoscopy for CRC screening assisted by a real-time automatic polyp detection system (Computer-aided detection, CAD EYE, Fujifilm, Tokyo, Japan) between May 2023 and June 2024 were included. This prospective study was conducted at two reference centers in Bogotá, Colombia (Clínica Universitaria Colombia and Clínica Reina Sofía). Patients with inadequate preparation, defined as a Boston score less than 6, were excluded. The ethical criteria of the Declaration of Helsinki were met, and the study was conducted with CIR approval.

This is a descriptive, prospective, real-world study. The data collection instrument included demographic characteristic variables such as age and sex, and procedure variables including lesion location in the colon, Boston score, procedure time, CAD EYE characterization of lesions, and the histopathological findings described in the pathology report.

Statistical Analysis

Descriptive statistics were performed for all study parameters. Data were analyzed using the licensed version of Stata 17. Continuous data were summarized according to their nature. Categorical data were summarized by frequency and proportion. The CAD EYE system categorizes detected lesions as "neoplastic" or "hyperplastic"; therefore, for histopathological analysis, detected lesions were grouped into neoplastic and non-neoplastic. A diagnostic test was performed to establish sensitivity, specificity, and likelihood ratio. The correlation between CAD EYE findings and histological evaluation was reported in terms of proportions. An ROC curve was generated between CAD EYE findings and histological findings for neoplastic lesions, and the area under the curve (AUC) was provided.

RESULTS

Out of a total of 86 patients who underwent CAD EYE-assisted colonoscopy, a total of 110 colorectal lesions were detected and resected. Women constituted the majority of the population at 80.2% (n = 69), with a mean age of 63 years (± 9.83). The median Boston score was 9 points, and the withdrawal time was 10.13 minutes (± 3.68).

The ADR was 38.4% and the polyp detection rate (PDR) was 58.1%. Of these lesions, the CAD EYE system characterized 55.41% as hyperplastic lesions and 44.59% as neoplastic lesions. Following histopathological analysis, the most frequently found lesions were tubular adenomas with low-grade dysplasia, at 48.65%, followed by hyperplastic polyps, at 39.19% (**Table 1**).

The CAD EYE system demonstrated a sensitivity of 66.67% and a specificity of 80%. The correlation between CAD EYE and histological findings was 72.97%. An ROC curve was generated with this data (**Figure 1**), which determined an area under the curve (AUC) of 0.73, showing a promising discriminatory capability for the histological characterization of colorectal polyps.

DISCUSSION

The impact of colonoscopy on CRC depends on several factors, including some related to the conditions under which the procedure is performed, the characteristics of the polyps themselves, and operator-dependent variables. In response to this, quality indicators and strategies to improve procedural quality have been proposed, among which the ADR is the clinically most relevant and best-vali-

Table 1. Results of CAD EYE-assisted colonoscopies

Characteristics	Results
Sex, % (n)	
- Women	69 (80.2)
- Men	17 (19.8)
Age, years (SD)	63 (9.83)
Boston Score (IQR)	9 (6;9)
Withdrawal Time, minutes (SD)	10.13 (3.68)
Lesions Categorized by AI (%)	
Hyperplastic	55.41
Neoplastic	44.59
Histopathological Classification (%)	
- Neoplastic	52.70
- Non-neoplastic	47.30
Pathological Findings	
- Neoplastic (%)	
Tubular Adenoma with Low-Grade Dysplasia	48.65
Tubular Adenoma with High-Grade Dysplasia	4.05
- Non-neoplastic (%)	
Normal Mucosa	2.70
Hyperplastic Polyps	39.19
Inflammatory Polyps	5.41
Adenoma Detection Rate (%)	38.4
Polyp Detection Rate (%)	58.1

SD: standard deviation; AI: artificial intelligence; IQR: interquartile range. Table prepared by the authors.

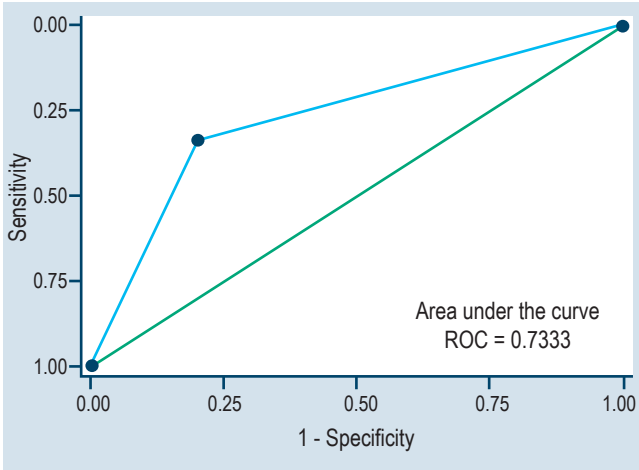

Figure 1. ROC curve and AUC data. Image property of the authors.

dated quality indicator[8]. It has been established that each percentage point increase in the detection rate is associated with a 3% decrease in the CRC rate[9,10].

Numerous studies have been published on the use of AI for the detection of adenomas and polyps during colonoscopy. Repici et al.[11,12] demonstrated in two randomized clinical trials the positive impact of using AI on the adenoma detection rate in both expert and non-expert hands (30% to 46%). Similarly, Xu et al., in another randomized clinical trial, showed how the use of real-time AI during colonoscopy could help detect adenomas that would be missed in conventional colonoscopy[13]. Furthermore, a recent meta-analysis favors the use of AI for adenoma detection with a higher detection rate (relative risk [RR]: 1.43; 95% confidence interval [CI]: 1.33-1.53; p <0.001; inconsistency index [I^2] = 36%), confirmed with a pooled analysis of ADR (35.4% vs. 24.9%), compared to conventional colonoscopy[6].

These findings are consistent with those we observed, documenting how the ADR can significantly improve when the procedure is performed with an AI-assisted system (ADR 38.4%), data comparable to that reported in the previously mentioned meta-analysis[13]. Likewise, the PDR was close to that reported by Schöler et al. (58.1% vs. 61%)[14].

Our study compares the characterization of colorectal polyps detected by CAD EYE with the histopathological findings of the analyzed samples, demonstrating a correlation of 72.97%. The correlation rate was 78.79% for lesions categorized as neoplastic and 68.29% for lesions categorized as non-neoplastic, thus showing a greater discriminatory capacity for neoplastic lesions. As a diagnostic test, CAD EYE has a sensitivity of 66.67% with a specificity of 80% and a likelihood ratio of 3.33 for lesion characterization, with an acceptable AUC value of 0.733. These data highlight the importance of using real-time AI for the detection and characterization of colorectal polyps in our population, results that align with the evidence available to date[2,15].

It is important to emphasize that two of the authors of this work have previously published their ADR of 28% in the same hospital settings and in patients under conditions similar to our current study[16]. The present work demonstrates that with the use of AI, this rate was improved by 10%, a percentage similar to that found in several published articles.

The limitations of our study include the small sample size and the absence of a comparative group with conventional colonoscopy. Meanwhile, our study shows a correlation between CAD EYE and the reference method (histopathological findings), which adds to the available evidence on the use of AI in the detection and characterization of adenomas during colonoscopy.

CONCLUSIONS

This is the first descriptive, prospective study conducted in Colombia reporting the polyp and adenoma detection rates in a group of patients undergoing CRC screening; furthermore, it shows that the use of real-time AI during colonoscopy significantly improves the ADR. Likewise, current evidence and the results of our study demonstrate a promising discriminatory capability for the characterization of colorectal polyps using AI-assisted systems. These data reinforce the current available evidence on the use of these systems for the early detection and prevention of CRC. Further prospective studies with larger samples and comparative groups are needed to confirm our results.

Ethical Approval and Consent to Participate

After approval by our Institutional Review Board and the ethics committee, all procedures performed in studies involving human participants were conducted in accordance with the ethical standards of the institutional or national research committee and with the 1964 Helsinki Declaration.

Data and Materials Availability

The datasets used or analyzed during the current study are available from the corresponding author upon reasonable request.

Conflicts of Interest

None of the authors declare any conflicts of interest.

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