Artificial intelligence-assisted colonoscopy in the detection and characterization of colorectal lesions: Randomized controlled clinical trial

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INTRODUCTION

According to GLOBOCAN, colorectal cancer (CRC) currently has an incidence of 19.5 individuals per 100,000 inhabitants in both sexes, being the third most common neoplasm in men and the second in women, representing the third cause of death in both men as in women.

According to the GLOBOCAN registry of the World Health Organization (WHO), it is estimated that CRC is the third most common type of cancer in the world, responsible for 10% of new cancer cases diagnosed, corresponding to 1,931,590 cases in 2020, preceded only by lung (11.4%) and breast (11.7%). It corresponds to second in mortality (9.4%; 935,173 cases in 2020), behind only lung cancer, with 18% of cases worldwide.

In Brazil, according to INCA data, CRC is similar to the global incidence, being the second most common neoplasm by sex.
Colonoscopy represents the most accurate CRC screening method, and can reach 100% sensitivity in detecting colorectal lesions.(1) Of colorectal lesions, according to Corley et al., (2) for every 1% increase in the detection rate of adenoma, there is a 5% decrease in mortality from CRC, revealing the importance of performing colonoscopy to detect colorectal lesions, especially adenomas.
Consequently, with advances in technology, new high-definition endoscopes with virtual chromoendoscopy and image magnification capabilities were developed with the purpose of increasing the detection rate of adenomas and, more recently, colonoscopy assisted by artificial intelligence, which have been gaining role prominent in helping to prevent CRC in some medical centers around the world, such as Japan, for example.
Repici and collaborators, (3) in a multicenter study with 700 patients in 2019, demonstrated a significantly higher adenoma detection rate with colonoscopy assisted by artificial intelligence, when compared to standard colonoscopy (54.8% versus 40.4%) . Subsequently, Wang and colleagues(4) carried out a randomized, double-blind clinical study with 1058 patients, comparing standard colonoscopy to artificial intelligence-assisted colonoscopy, the result of which was an adenoma detection rate of 29% for colonoscopy. intelligence-assisted and 20% for standard colonoscopy, the difference being statistically significant. Two other studies comparing artificial intelligence-assisted colonoscopy and standard colonoscopy showed similar results. (5,6)
However, when analyzing the accuracy of artificial intelligence systems in characterizing colorectal lesions, different results are noted in the literature. On the one hand, Japanese studies (7–9) report accuracies above 90% in the characterization of neoplastic and non-neoplastic lesions using artificial intelligence, while other studies, such as the Dutch one conducted by Kuiper and collaborators (10) and the German one conducted by Rath and collaborators, (11) found an accuracy of 74.4% and 84.7% respectively, significantly lower results in relation to Japanese studies.
Therefore, not only observing the difference in the results obtained by different authors, as well as the population difference together with the scarcity of studies with

colonoscopy assisted by artificial intelligence in developing countries, the objective of this work is to evaluate the detection rate of adenomas of colonoscopy assisted by artificial intelligence and also evaluate the accuracy of artificial intelligence in characterizing colorectal lesions.

METHODOLOGY

Study Design

A controlled open prospective and randomized, single-center clinical study is proposed in a Brazilian referral hospital for colorectal cancer in the city of São Paulo, São Paulo, where, over a period of 12 consecutive months, patients who agree to participate in the study , will undergo a colonoscopy procedure.

Population and randomization

All patients aged 18 years or over, with an indication for elective colonoscopy, who sign the informed consent form agreeing to participate in the study, will be included.

The exclusion factors are:

- History of inflammatory bowel disease.
- History of colorectal cancer.
- Personal history of colorectal surgery.
- Contraindication to endoscopic biopsies.
- History of intestinal polyposis syndromes.
- Urgencies or emergencies.
- Presence of serious, decompensated comorbidities or with a score greater than or equal to 3 by the American Society of Anesthesiologists (ASA). (12)
- Incomplete colonoscopy, which does not reach the cecum.
- Insufficient or inadequate preparation, with a score of less than 6 on the Boston scale. (13)

Eligible patients will be randomly allocated (1:1), using numbers generated by *research electronic data capture* (**REDCap,** Tenesee, USA),(14) to the high-definition colonoscopy group without the aid of artificial intelligence (control) or to the high-definition colonoscopy group with the aid of artificial intelligence (intervention). , through randomization stratified by the age variable, after sedating the patient.
Patients will be randomized between the three strata according to the age variable, described below:

- Stratum 1: Patients aged 18 years to 44 years.
- Stratum 2: Patients aged 45 years to 75 years.
- Stratum 3: Patients aged 76 or over.

Endoscopists

Four endoscopists with extensive experience in high-definition colonoscopy (more than 1000 colonoscopies performed), chromoendoscopy and image magnification will be selected.

Equipment

Colonoscopies will be performed with the ELUXEO 7000 system, which consists of a light source, a processor and special endoscopes developed by Fujifilm (EC-760ZP and EC-760 R, Fujifilm, Tokyo, Japan).
The artificial intelligence equipment used will be the CAD EYE (Fujifilm, Tokyo, Japan), and it is a device similar to a system processor and a light source device. When CAD EYE detects a lesion, an alarm sounds to attract the examiner's attention, which can be recognized on the monitor through a dynamic marking that delimits the lesion. CAD EYE also allows the diagnosis of the lesion detected in two categories: “NEOPLASTIC” or “HYPERPLASTIC”, in BLI-LASER/LED mode activated via a button on the endoscope, so CAD EYE will show the result at the bottom of the monitor when an injury is recognized. Simultaneously, yellow or green curved lines, signaling “neoplastic” and “hyperplastic” lesions, respectively, are shown around the monitor in the lower right window, indicating that CAD EYE has detected a lesion. The diagnostic result defined by CAD EYE will be recorded when it appears at the bottom of the monitor in a stable manner, for a period longer than 1 second.

Procedure

Colonoscopies will be performed under moderate sedation, classified as 2, 3 or 4 on the Observer's assessment of alertness/sedation [OAA/S] scale, (15) under continuous frequency monitoring. heart rate and oxygen saturation.
After sedation, the patient will be randomized to undergo colonoscopy with the aid of artificial intelligence (intervention group) or without the aid of artificial intelligence (control group).
After the endoscopist reaches the cecum and cecal intubation is confirmed by identifying the appendicular ostium, colonoscopy will begin to identify colorectal lesions.
All identified lesions will be characterized by endoscopists as hyperplastic, low-grade adenomas, high-grade adenomas, serrated lesions or advanced lesions, through evaluation of the crypt pattern using chromoendoscopy and image magnification. (16,17)
After characterization, the lesions will be resected and stored in dedicated vials and sent for histopathological analysis.
In the intervention group, the conclusion of the CAD EYE, that is, neoplastic or hyperplastic lesion, will also be recorded.
The location of the lesion will also be recorded, its size estimated using a known reference (an open forceps or polypectomy loop), the morphology of the lesion according to the Paris classification, (18) the time taken to remove the device and the preparation of the colon according to the Boston scale.

Histological Analysis

The lesions will be analyzed by experienced pathologists, who will be blinded to both optical and artificial intelligence diagnosis of the lesions detected during the colonoscopy procedure. Samples will be collected in paraffin and processed using standard procedures. Histological findings will be classified according to the revised Vienna classification for gastrointestinal neoplasia. (19) Sessile serrated lesions will be defined when they present at least two irregular and dilated crypts, including dilation of the base of the crypts. (20) Histological findings will be considered standard -gold.

Statistical analysis

The number of lesions detected in each group will be described using summary measurements (mean, standard deviation, median, minimum and maximum) and compared between groups using the Mann-Whitney test. After biopsy of the lesions, the diagnostic measurements (sensitivity, specificity, positive predictive value and negative predictive value) of the lesions found in each group and the neoplastic lesion in the CADEYE group will be calculated. The procedure time and cervix preparation will be described according to groups and compared using Mann-Whitney tests.
In the group without CADEYE, the lesions found during the examination will be characterized and the results will be compared with the anatomopathological results and the agreement of the characterization will be verified using the Kappa coefficient with the respective 95% confidence interval.
The IBM-SPSS for Windows version 22.0 software will be used to carry out the analyzes and the Microsoft Excel 2013 software will be used to tabulate the data. The tests will be carried out with a significance level of 5%.

Ethical aspects

Written informed consent will be obtained from all patients prior to the colonoscopy examination. This project was registered on Plataforma Brasil under number 64060322.7.0000.0068.

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