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Artificial intelligence and colorectal cancer: How far can you go?

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Abstract

Artificial intelligence is an emerging technology whose application is rapidly increasing in several medical fields. The numerous applications of artificial intelligence in gastroenterology have shown promising results, especially in the setting of gastrointestinal oncology. Therefore, we would like to highlight and summarize the research progress and clinical application value of artificial intelligence in the diagnosis, treatment, and prognosis of colorectal cancer to provide evidence for its use as a promising diagnostic and therapeutic tool in this setting.

Key Words: Artificial intelligence; Colorectal cancer; Diagnosis; Treatment; Prognosis

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Core Tip: In this editorial, we would like to highlight and summarize the research progress and clinical application value of artificial intelligence in the diagnosis, treatment, and prognosis of colorectal cancer to provide evidence for its use as a promising diagnostic and therapeutic tool in this setting.

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INTRODUCTION

Colorectal cancer (CRC) is a major healthcare concern worldwide. It is the third most common cancer in males, the second most common cancer in females and the fourth leading cause of cancer death worldwide[1-3]. Furthermore, up to 60%-70% of recognized cases in symptomatic patients are diagnosed at an advanced stage[4-6].

Artificial intelligence (AI) is a form of machine technology in which intelligent agents perform functions associated with the human mind, such as learning and problem solving[7-9]; AI algorithms are primarily used for disease diagnosis, treatment and prognosis[10,11].

In the setting of endoscopic diagnosis, AI has been primarily evaluated in 3 clinical scenarios: Polyp detection, polyp characterization (adenomatous vs nonadenomatous), and the prediction of invasive cancer within a polyoid lesion[12].

With regard to polyp detection, the adenoma detection rate (ADR), defined as the proportion of patients with at least one colorectal adenoma detected at the first screening colonoscopy among all the patients examined by an endoscopist, represents a pivotal quality measure for colonoscopy[6,13]. In fact, it has been reported that a 1% increase in the ADR is associated with a 3% decrease in interval CRC incidence[6,14,15].

The outcomes reported by different mono- and multicenter randomized clinical trials are highly promising; the overall ADR of these studies was significantly higher when computer-aided diagnosis (CAD) systems were incorporated (up to 80%)[16-20].

With regard to polyp characterization, CAD systems can achieve thresholds of preservation and incorporate valuable endoscopic innovations for diminutive, non- neoplastic rectosigmoid polyps according to various studies[6,21-25].

With regard to differentiation between invasive cancer and nonmalignant adenomatous polyps, an accuracy of 94.1% and 81.2%, respectively, was achieved in two recent studies[26,27].

AI has also been evaluated in the classification and diagnosis of biopsy samples. In a recent systematic review performed by Thakur and coworkers, the authors concluded that artificial intelligence showed promising results in terms of accuracy in diagnosing CRC with regard to tumor classification, tumor microenvironment analysis, and prognosis prediction. However, the scale and quality of the training and validation datasets of most of these studies are insufficiently adequate, limiting the applicability of this technique in clinical practice[28].

With regard to surgical approaches, robot-assisted colorectal surgery has shown better performance than human-alone surgery, in terms of short- and long-term outcomes[10,29].

Additionally, with regard to the pharmacological approach, some studies evaluated targeted drug delivery[30], drug pharmacokinetics[31] and prediction of the rate of drug toxicity[32].

Furthermore, the personalization and precision of cancer treatments have become major themes in oncology research. For example, “Watson for Oncology” is an AI system that can assist in the precision medicine-based treatment of tumors[10,33]. It can automatically extract medical language from doctors’ records and translate them into a practical language for learning[10]. This model can be used to identify new cancer sub-populations, analyze their genetic biomarkers, and find effective drug combinations[10].

Finally, the emergence of AI has allowed clinicians to predict the prognoses of CRC patients more easily and precisely by using several approaches. For example, in one study, genetic markers of CRC were used to train a model based on different algorithms[34]. In another study, a computer-aided analysis method for tissue sections based on multifractal analyses of cytokeratin-stained tumor sections was proposed to evaluate the complexity of tumor-stroma interfaces[35]. Other studies have evaluated cytokeratin immunohistochemical images to predict lymph node metastasis[36,37] and the infiltration of immune cells in influencing CRC prognosis[38].

In the near future, AI technology will help doctors diagnose and treat their patients and provide CRC patients with personalized and accurate prognosis evaluations.

CONCLUSION

In conclusion, AI could play a pivotal role in gastrointestinal oncology, especially in the setting of CRC, for tailoring patient treatments and predicting their clinical outcomes[9].
Future randomized studies could directly increase the overall value (quality and costs) of AI by examining its effects not only in diagnosis (by evaluating colonoscopy findings, endoscopy durations, polyps and ADRs) but also in prognosis and therapy.

Since AI science continues to grow and evolve, the current limitations must be considered as a future challenge; these limitations are also inherited by the medicine applications of AI, including the difficult predictability of situations characterized by some degree of uncertainty[6]. Table 1 shows the applications of AI in CRC.

Future applications of AI could be implemented in all the settings of CRC management, such as the determination of the potential role of noncoding RNAs in tumor diagnosis and treatment[10].

Finally, the integration of AI in human-based medicine has to considered. AI has never been nor will ever be considered a substitute for the physician; on the contrary, it seems to be an extremely helpful tool to be used by the physician who, given his or her ability and skills, is the only one able to process and interpret all the information extracted by the AI to make decisions on patient management.

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