Artificial intelligence for polyp characterisation: easy as ABC

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The concept of real-time optical diagnosis (OD), utilising enhanced imaging techniques to predict histopathology, has been pursued for over a decade. Sound principles have guided this enthusiasm, with the most robust case existing for diminutive (<5mm) colorectal polyps, which constitute the most commonly identified and excised lesions for histopathological assessment. Abandoning histopathology, and instead relying on OD, represents a paradigm shift, often referred to as a 'resect and discard' strategy for diminutive adenomas and a 'leave in strategy' for diminutive rectosigmoid hyperplastic polyps. This is highly attractive, considering the significant economic and environment burden of the current approach. Moreover, diminutive lesions have an extremely low risk of harbouring invasive neoplasia. Due to a number of barriers, the uptake of OD for diminutive colorectal polyps has been poor. In particular, evidence suggests that OD is operator dependent, with non-experts unable to consistently achieve the performance thresholds required.

Computer aided characterisation (CADx) of colorectal polyps, leveraging artificial intelligence (AI), has rekindled optimism for the incorporation of OD into clinical practice. This has been partly fuelled by the exponential growth of AI publications relating to colonoscopy. The challenge lies in separating hype from reality. The majority of published CADx studies are pre-clinical and subject to potential selection bias, leading to an over-estimation of performance. Furthermore, the endoscopist and AI combined final diagnosis is often neglected, despite being most relevant to real-world application. A common statement in the medical AI arena, is that the field is high on promise but relatively low on proof. The authors in this study by Rondonotti et al. should be commended for providing much needed high-quality prospective evidence [1].

In this study, the authors conducted a multi-centre, prospective study across four endoscopy departments in Italy, including 9 expert and 9 non-expert endoscopists . The primary aim was to determine whether high confidence AI assisted OD using a CADx system (CAD-EYE, Fujifilm Co., Tokyo, Japan) could achieve the ≥ 90% negative predictive value (NPV) for adenomatous

diminutive rectosigmoid polyps, according to Preservation and Incorporation of Valuable endoscopic Innovations (PIVI)-1 threshold [2]. Secondary aims included comparative analyses for endoscopist and AI alone OD performance, whilst finally determining if the OD based post-polypectomy surveillance achieved ≥ 90% agreement rate according to United States Multi Society Task Force (USMSTF) and European Society of Gastrointestinal Endoscopy (ESGE) guidelines according to the PIVI -2 threshold. A sequential diagnostic process was conducted for diminutive rectosigmoid polyps (DRSPs). The first step involved the endoscopist alone making an OD according to the Blue Light Imaging Adenomas Serrated International Classification (low or high confidence), then the AI system was switched on to provide an AI alone OD in the second step, before a final third step was concluded which involved the endoscopist making a final AI-assisted OD (low or high confidence) by combining the first two steps.

AI assisted OD was made with high confidence in 550 DRSPs with performance meeting both PIVI-1 and PIVI-2 thresholds, achieving a NPV of 91.0% (95%CI [87.1-93.9]%) for adenomatous pathology and agreeing with post-polypectomy surveillance intervals in 97.4% (95% CI [95.7-98.9]%) and 92.6% (95% CI [90.0-95.2]%) according to ESGE and USMSTF guidelines respectively. There were no significant differences in accuracy parameters when comparing the three sequential diagnostic steps.

These findings are of importance, particularly since this study design is arguably the closest to mirror real-life practice. AI assistance met required thresholds for implementation, and crucially did not lead a detrimental effect on the endoscopist, including non-experts. The study also demonstrated a similar accuracy in OD when comparing proximal and distal diminutive polyps, in contrast to other published studies, which reported inferior accuracy proximally, where it has been suggested that perhaps visual characteristics may not correlate as well with histopathology [3].

Interestingly, the AI alone performance in this study did not meet the required PIVI-1 threshold. An AI assisted OD was also not feasible in 9% of polyps due to unstable predictions or inability of the system to provide a recordable output. These shortcomings will be readily addressed with improved iterations of the AI software. In addition, the non-experts in the cohort did not meet the required PIVI-1 threshold, with no significant improvement demonstrated with AI assistance. However, approximately only one third of polyp optical diagnoses were performed by non-experts, and the study was not necessarily powered to investigate this. Future studies should focus on non-experts, where the clearest use-case exists for AI assistance. It is noteworthy that the NPV for last 50 diminutive rectosigmoid polyps evaluated by non-experts did meet PIVI-1 criteria in this study.

There are few published prospective clinical studies that evaluate CADx in combination with endoscopists. Two recently published studies using non-magnification narrow band imaging and white light respectively, suggest that both PIVI thresholds can be met, however the incremental independent benefit of AI was not strictly evaluated [4][5]. Another multi-centre, international trial, evaluating CADx alongside ultra-magnification endocystoscopy, suggested that CADx assistance did not significantly improve the diagnostic sensitivity of diminutive neoplastic polyps [6]. Standardisation of study design, including agreed clinical endpoints

defined by consensus, has recently been highlighted as a key research priority for AI in colonoscopy [7].

There is now valid optimism that AI assistance will bridge the performance gap between experts and non-experts. However, clinical effectiveness represents just one barrier to OD implementation. The perceived medico-legal risk of a resect and discard strategy still needs to be addressed, the addition of AI assistance could introduce more complexity when one considers accountability for medical error, although conversely it may add some protection for the endoscopist against litigation by acting as a decision support tool alongside photo documentation [8]. Re-imbursement policies need to be established to allow for the emergence of AI use in routine colonoscopy, supported by cost-effectiveness data. The convergence of major trends, such as increasingly resource constrained healthcare systems and a looming global warming crisis, mean the potential financial and environmental benefits of OD implementation need to be re-visited urgently. Thankfully, the emergence of AI has recaptured imaginations in the endoscopic community to make OD a reality.

Competing interests

O.F.Ahmad declares no conflict of interest

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