diagnostic repertoire in dealing with patients who have suspected bile duct cancers. In addition, owing to the high accuracy of AI-assisted cholangioscopy, patients with highly suggestive lesions on cholangioscopy who are suitable for surgery may be able to proceed to early surgery before cancer progresses.

One of the major potential benefits of AI-assisted cholangioscopy is that a diagnosis may be made without further invasive testing such as biopsy and hence is likely to result in fewer procedure-associated adverse events.[2] Although the potential of AI-assisted cholangioscopy is promising, it is critical to delineate some challenges. CNN algorithms require large datasets for validation, which are not readily available. As with any computer vision machine learning modality, addressing "overfitting" and bias are also important.[3] It is key that we focus not only on algorithm performance but also on increasing the trustworthiness of the algorithms; and these AI-imaging applications should be able to help save diagnosis time.

We predict a trajectory of increased use and adoption of AI-assisted cholangioscopy. AI-assisted cholangioscopy is likely to meet the test of pervasiveness, improvement, and innovation. The adoption of AI-assisted cholangioscopy will likely follow Amara's law and the 5 stages of the hype cycle. We believe that we are still in the infant stages of this technology, and this phase may last 3 to 5 years before there is a peak of inflated expectation. The trough of disillusionment and slopes of enlightenment may only be observed in the next decades.

DISCLOSURE

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Response:

We are honored by the interest of Njei et al[1] in our proof-of-concept work.[2] We share their view of a potential role of artificial intelligence (AI) for significantly enhancing the diagnostic yield of digital cholangioscopy for malignant biliary strictures. In our view, the application of AI to cholangioscopy will, at this stage, work alongside current criterion standard techniques, as a complement rather than disrupting the current standard of care. Therefore, although we agree with Njei et al[1] that AI-assisted cholangioscopy should ultimately achieve diagnosis without more invasive techniques, we believe that in the near future AI will be applied to increase the yield of current techniques, particularly cholangioscopy-guided biopsies, which remain the current criterion standard. This could be potentially accomplished through accurate detection of morphologic features intricately associated with malignant strictures, as is the case with tumor vessels.[3,4]

The potential of convolutional neural networks for the analysis of endoscopic images is vast. Notwithstanding, we subscribe that these promising results should be analyzed with consideration of current methodologic limitations and knowledge gaps. We believe that the path toward clinically applicable AI-assisted cholangioscopy has only just begun. In fact, the readiness level of AI technologies for cholangioscopy remains at early stages (Fig. 1), because most studies assess their performance in controlled settings.[2,5]

Trusting the clinical output of an AI algorithm will require moving from opaque black-box AI models toward explainable AI algorithms, in which users (preferably both healthcare practitioners and patients) understand AI recommendations. Attempts to improve explainability, for example through the application of heat maps, are ongoing.[6,7] The development of this technology will require several years, probably decades, and we should not expect a linear path. A nadir after this initial zenith of enthusiasm is predictable, but we expect that work on this field will ultimately lead to a heightened plateau of productivity.

Environment	Goal	TRL	Description
Laboratory	Research	TRL 1	Verification of basic principles of the technology
		TRL 2	Formulation of the technology's concept and applications
		TRL 3	Measure of paramaters in laboratory – experimental proof-of-concept
		TRL 4	Technology validated in laboratory environment
		TRL 5	Technology validated in a relevant environment
Simulation		TRL 6	Prototype tested in a relevant environment
	Development	TRL 7	Protoype tested in the operation environment
		TRL 8	System complete and qualified. Results of the system in its final configuration
Operational	Implementation	TRL 9	System proven in operational environment. Reports in working condition or actual mission.

Figure 1. Description of technology readiness levels (TRLs). Adapted from Martínez-Plumed F, Gómez E, Hernández-Orallo J. Futures of artificial intelligence through technology readiness levels. Telemat Inform 2021;58:101525.

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Caution should be exercised in denying the protective effect of clip closure on post-EMR perforation of a proximal large nonpedunculated colorectal polyp

To the Editor:

We read with great interest the article by Forbes et al[1] entitled "Clip closure to prevent adverse events following endoscopic mucosal resection of proximal