EDITORIAL

Artificial Intelligence in Pathology

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INTRODUCTION

Laboratory medicine or the field of pathology are omnipresent from continuous advancement and hence their impact on patients' health care. Research in pathology plays a crucial role in the development of cutting-edge technologies for disease diagnosis and innovation in the field of laboratory medicine. Undeniably, these innovations were aimed at improvement in making accurate diagnosis which is the cornerstone in providing effective treatment.

Being an image-rich specialty, pathology is one of the medical specialties most impacted by the introduction of artificial intelligence (AI) (1). Most ordinary pathologists know very little about data mining and artificial intelligence (AI), and most are minimally exposed to the enormous potential of these formidable new tools for pathology in particular. Aside from the many terms used in pathology, machine learning and deep learning in AI are unaccustomed to the pathologists. In the context of pathology, these terms relate to the machine 'learning' and 'training' their applications to produce desired output from the actual datasets provided by their developers, or simply put, these devices are "trained" to carry out activities that need human intelligence (2).

Digital pathology is one field where deep learning and machine learning have shown some promise where it makes AI for image interpretation conceivable. A digitized set of microscopic pictures along with the corresponding diagnosis determined by human expert pathologists could be used for training or validation. The use of whole slide imaging (WSI) as a platform for integrating artificial intelligence (AI) and recent developments in computational algorithms are revolutionizing the diagnosis and prognostic fields of pattern recognition and image interpretation (2,3). With the use of this technology, pathologists can view and assess samples remotely, conduct teleconsultations to fill the gaps in pathology services in underserved areas, participate in external quality assurance programs, improve teamwork by efficiently balancing workloads, collaborate, review central clinical trials, analyse images, provide virtual education, conduct creative research, and potentially speed up diagnosis (4). Among the most notable applications of artificial intelligence (AI) in anatomic pathology (AP) are the automated evaluation of prognostic biomarkers Ki67 in breast cancer and prostate cancer tumor grading by WSI which were comparable to pathologist performance (5,6).

Recently in Lancet, the field of pathology was reported to produce the most number of articles out of all the 17 disciplines involved in medical AI research. This is according to a recent Delphi survey by Berbis and colleagues on prediction of the role of AI in pathology over the next ten years (2). Throughout the next decade, computational pathology (CPATH) specialisation is predicted to gain more popularity with AI tools helping pathologists generate diagnoses that are more precise, consistent, objective, quantitative, and comprehensive. It is anticipated that it will also have a positive effect on many aspects of the pathology workflow. Though, this study also highlighted that no consensus was reached regarding whether AI would lower the number of cases requiring pathologist's review or the cost per case.

Inevitably, the contentious subject of "will AI replace pathologists?" was raised. An AI algorithm that could aid in time-consuming or laborious tasks such as tumor grading, microorganism identification (i.e., acid-fast bacilli), cancer detection, and computerised counting of immunohistochemistry (IHC) biomarkers would assuredly be welcomed by any pathologist (5). AI through deep learning has also been used in studies related to quantitative analysis such as counting lymphocytes or mitotic figures, identifying lymph node metastases, perineural and lymphovascular invasions (2,3). Instead of replacing human resources, the goal of integrating such technology into the pathology service is to assist and enhance diagnostic and performance efficiency through improved resource allocation, higher service cost-effectiveness, and more consistent pathology reviews (4).

AI's use in pathology is not without its challenges. Concerns over these technologies' unintentional negative effects are emerging. Chances for incorrect use of AI that could jeopardize patient care and raise problem including systemic algorithmic bias, unintentional information disclosure, sufferings from faulty AI-generated outputs, and the complication of healthcare disparities must be addressed. Potential for misdiagnoses in AI-assisted diagnosis may occur for which the pathologist will still be legally liable. Therefore, before AI is successfully implemented, regulatory bodies made up of a teamwork of researchers in AI, pathologists, clinicians, institutional administration, and professional societies must develop guidelines for AI integration into pathology. These guidelines must include streamlined regulatory steps for AI tools and verification protocols (2).

Nonetheless, we leave you with this famous quote from Curtis Langlotz, a professor in radiology that pathologists may find insightful (7). "*AI won't replace radiologist, but radiologists who use AI will replace radiologists who don't*".

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