Artificial Intelligence (AI) in Histopathology: An Emerging Technology in Diagnostic Fields

*Talukder SI

Microscopic examination of tissue sections on glass slides prepared from formalin fixed paraffin embedded tissue section stained with hematoxylin and eosin is histopathological diagnostic technique. It is an old but is the gold standard diagnostic technique till now. Newer techniques, such as immunohistochemistry is used for refining the histopathological diagnosis. Both techniques are time consuming and laborious job. Artificial intelligence (AI) is a branch of computer science that deals with building smart machine capable of performing tasks that typically require human intelligence.[1] AI technology of computer science and engineering has been incorporated in tissue level diagnosis.[2] This technology is applied on histological glass slides. Microscopic images of glass slides are digitized by computer. These images are presented as digital matrix and is called virtual slide. A virtual slide allows calculation and related presentation of image information that otherwise can only be seen by individual pathologist. The digital world permits attachments of several (if not all) fields of view and the contemporary visualization on a screen. The presentation of all microscopic magnifications is possible if the basic pixel resolution is less than 0.25 microns. To start digital histopathological diagnosis into the daily routine practice of a histopathologist requires a new setup of workflow arrangement and procedures. The quality of digitized images is sufficient for diagnostic purposes; however, the time needed for viewing virtual slides exceeds that of viewing original glass slides by far. It is due to a slower and more difficult sampling procedure, which is the selection of information containing fields of view. By application of artificial intelligence, Kayser et al, mentioned, histopathological diagnosis in routine work can be managed automatically in steps as follows: 1. The individual image quality has to be measured, and corrected, if necessary. 2. A diagnostic algorithm has to be applied. An algorithm has be developed, that includes both object based (object features, structures) and pixel based (texture) measures. 3. These measures serve for diagnosis classification and feedback to order additional information, for example in virtual immunohistochemical slides. 4. The measures can serve for automated image classification and detection of relevant image information by themselves without any labeling. 5. The pathologists' duty will not be released by such a system; to the contrary, it will manage and supervise the system, i.e., just working at a "higher level".[1] Virtual slides are already in use for teaching and continuous education in anatomy and pathology. Attempts to introduce them into routine histopathology laboratory work have been reported. Application of AI has been established by automated immunohistochemical measurement systems (EAMUS, www. diagnomX.eu). The performance of automated diagnosis has been reported for a broad variety of organs at sensitivity and specificity levels > 85%.

*Dr. Sadequel Islam Talukder, Associate Professor, Department of Pathology Mymensingh Medical College, Mymensingh. sadequel@yahoo.com

Histopathology has undergone major changes firstly with the introduction of Immunohistochemistry, and latterly with Genomic Medicine. Salto et al (2018) argued that a third revolution, Artificial Intelligence (AI) is coming on Digital Pathology (DP).[3] The introduction of AI has the potential to both challenge traditional practice and provide a totally new realm for diagnostic pathology.

Hereby, all pathologists should accept new revolutionary technique and be ready to innovate and actively engage in the creation, application and validation of technologies and oversee the safe introduction of AI into diagnostic histopathology practice.

References

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