ARTIFICIAL INTELLIGENCE - A THREAT OR OPPORTUNITY FOR PATHOLOGISTS

Madiha Anwar, Muhammad Asif, Muhammad Tahir Khadim

Armed Force Institute of Pathology, Rawalpindi Pakistan

Artificial intelligence (AI) is the counterfeit of human brilliance, comprehension and intellectual abilities, elicited by machines (computing systems) through acquisition of information, visual perception and self-correction. Based on all data which have been fed to the AI monsters, it can simulate most of the Human task intelligently like Human. In March 2016, there was a defining moment in the history of mankind when, 18-time champion of the complex game called Go, was defeated by Google's artificial intelligence (AI) computer program AlphaGo [1]. Though, these machines are created by humans, yet these are smarter, much smarter, than their creators in some areas.

Medical research, pathological diagnosis, and complex treatment planning has been predicted to get benefited from the algorithms used in AlphaGo [2], upon which the future of the Pathologist is also dependent. Will AlphaGo like programmes are going to replace the Pathologist in the future? Contrary to AlphaGo's triumph over human experts, computer vision algorithms fail to meet some basic human vision capabilities, like object dynamic prediction [3] thus failing to anticipate what will follow in actual photographic scenes [4].

Digital pathology has brought a revolution in the field of pathology and is becoming the state of art in life sciences. Whole slide imaging (WSI) is now being adopted in lieu of traditional light microscopes. Accessibility to digital slides aids remote primary diagnostic work, tele-consultation, clinical review, image analysis and scientific exploration. Establishing whole-slide image (WSI) database of millions of images was initially considered a difficult task, but few recent studies demonstrated an algorithm being successful in interpreting and classifying whole slide images into different categories after being divided into different patches [5]. Still, each algorithm proved to be 70 - 85% precise, lagging far behind the human pathologist's diagnostic capabilities [6].

Pathologists can recalibrate their diagnosis based on clinical and patient-specific information acquired from different sources such as physician's notes, clinical history, other relevant investigations, and multidisciplinary team meetings with clinical peers. Sometimes, pathologists use descriptive terminology for opinion, differential diagnosis and useful comments for difficult and rare cases. This complex nature of pathology diagnosis cannot be dealt by AI. Traditional microscopes are interestingly, speculated to continue to exist for another 144 years [7]. Digital pathology, whole-slide imaging, and AI should reasonably be considered as synergistic technologies rather than substitution to human cognition.

Key challenges in exploiting digital pathology include lack of labelled data, dimensionality obstacle and affordability of the cost incurred in computational requirements [8]. All programmes are contingent on using Graphical Processing Units (GPUs) and peculiar electronic circuits for swift processing of digital images and graphics, therefore making use of ordinary computers with Central Processing Units for this purpose, impractical [9].

On the other hand, AI software tools also provides the opportunity to reduce the workload of pathologists by aiding in dealing with arduous chore (e.g., counting mitoses, screening for easily discernible cancer types, sorting and prioritizing biopsies that need urgent attention and ordering appropriate stains when suggested). AI method can perform image retrieval for malignant regions in breast cancer with a sensitivity of 92% [10]. To seek consensus in the cases facing interobserver variability, assessing image data would be beneficial.

There is an upcoming trend witnessed in recent years, of advising molecular testing, sometimes in replacement of morphological

Correspondence: Dr Muhammad Asif, Department of Histopathology, Armed Forces Institute of Pathology, Rawalpindi, Pakistan

Email: asifwahab2012@gmail.com

Received: ***12 Apr 2019****; Accepted:* ***23 Jun 2019***

evaluation of the tissue. However, by utizing and pulverizing tissue for such scrutiny, there is a definite loss of valuable histopathological and morphological details (e.g., desmoplasia, which is host stromal response around tumor cells, immune response to tumor and transplant rejection features). Most AI approaches to mitosis counting, nuclear grading and estimating Gleason scores ply H&E stained images [11], favouring the concept of renaissance of hematoxylin and eosin images.

Image analysis algorithms are being used to interpret and quantify pathology images information. Open source image analysis programs have been introduced, which can be used alone or in combination in pathology for analyzing whole slide images (WSI). These software programs (e.g., ImageJ, QuPath, Cell Profiler, Ilastik, Orbit, Icy, etc) can be freely accessed, shared (in modified or unmodified form) by anyone using open source licenses. The upcoming technologies such as three-dimensional imaging are making deep analysis of the pathology images possible, rendering useful diagnostic and prognostic information [12].

In conclusion, AI instead of competing and substituting the pathologists, is rather succoring their unremarkable diagnostic capabilities and potentialities favouring a bright future of the world of diagnostics.

REFERENCES

1. Choe S. Google's computer program beats Lee Se-dol in Go tournament. New York Times. March 3, 2016. Available from: http://www.nytimes.com/2016/03/16/world/asia/korea-alphago-vs-lee-sedolgo.html.
2. Roeder O. Don't forget humans created the computer program that can beat humans at Go. Published March 16, 2016. Available from: http://fivethirtyeight.com/features/dontforget-humans-created-the-computer-program-that-can-beat-humans-at-go/.
3. Granter SR, Beck AH, Papke DJ., Jr AlphaGo, deep learning, and the future of the human microscopist. Arch Pathol Lab Med. 2017; 141: 619–21.
4. Fouhey DF, Zitnick CL. Predicting object dynamics in scenes. Poster presented at: IEEE Conference on Computer Vision and Pattern Recognition; June 24–27, 2014; Columbus, Ohio.
5. Hou L, Samaras D, Kurc TM, Gao Y, Saltz JH. Patch-based convolutional neural network for whole slide tissue image classification. Cornell University Library Web site. Published March 9, 2016. Available from: http://arXiv.org /abs/1504.07947v5.
6. Sharma G, Carter A. Artificial intelligence and the pathologist: Future frenemies? Arch Pathol Lab Med. 2017; 141: 622–3.
7. Granter SR. Reports of the death of the microscope have been greatly exaggerated. Arch Pathol Lab Med. 2016; 140(8): 744 - 5.
8. Tizhoosh HR, Pantanowitz L. Artificial intelligence and digital pathology: Challenges and opportunities. J Pathol Inform 2018; 9: 38.
9. Chen XW, Lin X. Big data deep learning: Challenges and perspectives. IEEE Access 2014; 2: 514-25.
10. Zheng Y, Jiang Z, Zhang H, Xie F, Ma Y, Shi H, *et al*. Histopathological whole slide image analysis using context‐based CBIR. IEEE Trans Med Imaging. 2018; 37: 1641-52.
11. Litjens G, Kooi T, Bejnordi BE, Setio AA, Ciompi F, Ghafoorian M, *et al*. A survey on deep learning in medical image analysis. Med Image Anal 2017; 42: 60‐88.
12. Van Laak J, Rajpoot N, Vossen D. The Promise of Computational pathology: Part 1. The pathologist. 2018a. Available from: https:// thepathologist.com.