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ARTIFICIAL INTELLIGENCE IN BREAST DISEASE MANAGEMENT:NO INNOVATION WITHOUT EVALUATION.

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ABSTRACT

Artificial intelligence (AI) in medicine and healthcare has been a particularly hot topic in recent years,such a rapidly progressing, highly innovative subject including not only diagnostic modalities but also interventional as well as conventional treatment modalities mainly plastic surgery and transplants.

While there is a sense of great potential in the application of AI in medicine, there are also concerns around risks and quality assurance issues, the loss of the 'human touch' in such an essential and people-focused profession.

Artificial intelligence will be involved in complex interventions, the assessment of which is challenged by factors that depend on operator, team, and setting, such as learning curves, quality variations, and perception of equipoise.

KEYWORD

Artificial intelligence, Breast, Surgery.

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DISCUSSION:

In the field of computer science, artificial intelligence (AI), sometimes called machine intelligence, is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans and other animals. Computer science defines AI research as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals.[1]

Artificial Intelligence AI is able to use a large amount of data and makes sense of it, and make recommendations and predictions much clearer and accurate than humans,also AI detects potential problems sooner, gives better diagnoses according to the reported symptoms, it is very accurate at determining the right course of treatment, as well as at giving more precise predictions on how fast the treatment will work, it can also monitor the progress of the given treatment,which makes it a perfect tool in the field of plastic and reconstructive surgery.

In fact, AI is an umbrella term and basically contains 2 more components: "Machine Learning (ML)" and "brain-inspired deep learning convolutional neural networks (CNN)"

The history of AI starts in antic historical ages from Aristotle (BC 384-322) to Charles Babbage (1791–1871) to Alan Turing (1950's).[2]

AI algorithms, particularly deep learning, have already found a remarkable base on image recognizing tasks. AI methods excel at automatically recognizing complex patterns in imaging data and providing a quantitative assessment of imaging characteristics.[3]

Deep Learning / CNN networks work as if an intelligent human brain and a kind of mimic of human neural networks. Basically, there are input sections where the data entered, there are hidden layers of neural rows; at least one to several layers and each neuron-like unit has interactions with the nearby units.

Information processing language (IPL)was the first language developed for artificial intelligence in 1956. It includes features intended to support programs that could perform general problem solving, such as lists, associations, schemas (frames), dynamic memory allocation, data types, recursion, associative retrieval, functions as arguments, generators (streams), and cooperative multitasking.[4]

Python is now the most popular language widely used for artificial intelligence, with packages for a number of applications including General AI, Machine Learning, Natural Language Processing and Neural Networks.[5]

Examples of AI already being used in medicine include ; DXplainwhich comes up with a list of possible diagnoses ,when given a set of symptoms, Germwatcher which is a is Laboratory information systems designed to detect, track and investigate infections in hospitalised patients, The da Vinci robotic surgical system, with robotic arms, precise movement and magnetised vision, allows doctors to precision surgery that wouldn't be possible with an entirely manual approach, AI Therapy which is an online course for people struggling with social anxiety, Babylonis an online application where patients in the UK can book appointments and routine tests, plus consult with a doctor online, check for symptoms, get advice, monitor their health and order test kits to reduce human error.[6]

Since Breast cancer screening can lead to the detection of benign (noncancerous) findings, researchers at Massachusetts Institute of Technology's (MIT) Computer Science and Artificial Intelligence Laboratory (CSAIL), Massachusetts General Hospital and Harvard Medical School collaborated to develop a machine learning model to predict if a high-risk breast lesion identified on biopsy will be upgraded to cancer at surgery, or whether the lesion could be

safely surveilled. Tested on 335 high-risk lesions, the model correctly diagnosed 97% of the breast cancers as malignant and reduced benign lesion surgeries by more than 30% compared to current methods.[7]

Alejandro R etal concluded that a new algorithm provides digital breast tomosynthesis (DBT) volumes with better contrast and image quality, fewer artefacts, and improved visibility of calcifications for human observers, as well as improved detection performance with deep-learning algorithms.[8]

Ha R etal in their study which included 216 patients with available pre-treatment MRIs and immune-histo-chemical staining pathology data suggested that MRI analysis of breast cancers utilizing a novel CNN can predict the molecular subtype of breast cancers, yetlarger data sets will likely improve their model.[9]

AI can also assist in distinguishing types of cancer cells with nearly 100% accuracy, according to a recent study by researchers at Weill Cornell Medicine and New York-Presbyterian. The researchers developed a convolutional neural network (CNN), a computer program modelled on a human brain, to analyze pathology images and determine if they are malignant; if malignant, the program can also indicate what type of cancer is present. In addition to the CNN architecture, the program utilized Google's Inception with three training strategies and two state-of-the-art algorithms, Inception and ResNet.

To train the CNN, the researchers exposed the program to thousands of pathology images of known breast, lung and bladder cancers. Then, the researchers obtained more than 13,000 new pathology images of breast, lung and bladder cancer to test the algorithms. The network distinguished the type of cancer in the samples with 100% accuracy and could also determine lung cancer subtypes with 92% accuracy. Additionally, the program identified biomarkers for breast and bladder cancer with 91% and 99% accuracy, respectively.[10]

Every single innovation brings apprehensiveness as a human being almost always sceptical about new innovations since the ancient historical ages. Of course, introducing AI (meaning CNN, learning machines, and advanced robots) to day to day practice will definitely bring some handicaps. e.g., misdiagnosis, over diagnosis, low accuracy and low specificity issues.There is one example recently published an article about cardiovascular disease prediction in Journal of American Heart Association (JAHA); The Machine Learning Risk Calculator outperformed the ACC/AHA Risk Calculator by recommending less drug therapy, yet missing fewer cardiovascular disease events, findings demonstrate the potential of Machine Learning to improve cardiovascular risk prediction and assist medical decision-making .[11]

2017 has marked a step change for AI in health care. Demonstrable successes with deep learning in other industries have triggered remarkable clinical interest. AI requires a thorough and systematic evaluation prior to integration AI in routine clinical care but, like other disruptive technologies in the past, the potential benefit should not be underestimated.[12]

It is difficult to estimate where AI, in general, heading towards in the future, but recent survey amongst the AI experts done by Katja Grace, et al, mentioned in some complex tasks, AI outperforming human in may activities in the next decade such as translating languages (by 2024), driving a truck (by 2027), working as a surgeon (by 2053), etc. AI experts in this survey believe, there is a likelihood of a 50 % chance of AI will surpass human skills in 45 years.[13]

Yasaka K etal,summarised the limitations of AI highlighting that it is still a dilemma how AI works fully and the pathway of its outcomes; seems to remain for a while like "a black box". The optimal structuring and hyper-parameters of CNN's and the numbers ofcases needed to train models differ from one task to another would remain a challenge.

There would be associated with privacy concerns for whom have rare diseases, also the current CNN models are task – specific in specific narrow tasks and needs to be adjusted developed for more complex diagnostic studies.[14]

Another fear about AI would be human being would have been beaten one day by a CNN, like happened in a very complex game, more sophisticated game than that of Chess, called Go games (AlphaGo) beat world Go game master champion, Lee Sedol, 18 - time world champion and this was the milestone for AI .[15]

McCulloch P etal mentioned that Surgery and other invasive therapies are complex interventions, the assessment of which is challenged by factors that depend on operator, team, and setting, such as learning curves, quality variations, and perception of equipoise. So they encourage the widespread use of prospective databases and registries,also suggested that reports of new techniques should be registered as a professional duty, anonymously if necessary when outcomes are adverse.[16]

Hirst A etal presented The IDEAL Framework which includes 5 stages of evolution for new surgical therapeutic interventions-Idea, Development, Exploration, Assessment, and Long-term Study.[17]

Which might be helpful in evaluation of the use of Artificial intelligence based breast related diagnostic and treatment modalities.

CONCLUSION:

Whilst it's unlikely that machines will replace or eradicate the need for human doctors any time soon, those already in or considering a medical profession should be willing to adapt, learn and grow alongside technological advancements. Also evaluation should go hand in hand with training and innovation of the usage of artificial intelligence in the medical field in order to maximise the advantages and minimise the disadvantages.

REFERENCES:

1- Shane Legg, Marcus Hutter.A Collection of Definitions of Intelligence. Frontiers in Artificial Intelligence and Applications, 2007; 157:17-24.
2- McCorduck P.Machines Who Think (2nd ed.). Massachusetts: A.K.Peters, Ltd.;2004.ISBN 1-56881-205-1.
3- Ahmed Hosny, ChintanParmar, John Quackenbush, Lawrence H. Schwartz, Hugo J.W.L Aerts., 2018.Artificial intelligence in radiology.Nat.Rev.Cancer, Aug 2018;18(8), 500-510. Available from: doi: 10.1038/s41568-018-0016-5.
4- Daniel Crevier.AI: The Tumultuous Search for Artificial Intelligence. New York, NY: BasicBooks. 1993. ISBN 0-465-02997-3.
5- Mantra Malhotra.Reasons to Choose Python for AI Based Projects. Available from: https:// hackernoon. com/reasons-to-choose-python-for-ai-based-projects-7e3e6c8b954a. [Accessed 4th February 2018].
6- Mendeley .Artificial Intelligence in Medicine.Available from: https:// www. mendeley.com/ careers/ article/artificial- intelligence- in-medicine. [Accessed 4th February 2018].
7- Bahl M, Barzilay R, Yedidia AB, et al. High-Risk Breast Lesions: A machine learning model to predict pathologic upgrade and reduce unnecessary surgical excision. Radiology.Mar 2018; 286(3):810-818.

8- Rodriguez-Ruiz A, Teuwen J, Vreemann S, et al. New reconstruction algorithm for digital breast tomosynthesis: better image quality for humans and computers. ActaRadiol. 2017; 59(9):1051-1059. Available from: doi: 10.1177/0284185117748487.
9- Ha R, Mutasa S, Karcich J, Gupta N, Pascual Van Sant E, NemerJ,et al. Predicting Breast Cancer Molecular Subtype with MRI Dataset Utilizing Convolutional Neural Network Algorithm.J Digit Imaging. Jan 2019. Available from: doi: 10.1007/s10278-019-00179-2.
10- Khosravi P, Kazemi E, Imielinski M, Elemento O, Hajirasouliha I. Deep convolutional neural networks enable discrimination of heterogeneous digital pathology images. EBioMedicine.2018; 27:317–328.
11- Ioannis A. Kakadiaris,MichalisVrigkas,Albert A. Yen, Tatiana Kuznetsova, Matthew Budoff,MortezaNaghavi. J AM Heart Assoc. Nov 2018; 20; 7(22):e009476. Available from: Available from: doi: 10.1161/JAHA.118.009476.
12- The Lancet Editorial. Artificial intelligence in healthcare: within touching distance. The Lancet. December 2017. (390):2739.
13- Katja Grace, John Salvatier, Allan Dafoe, Baobao Zhang, Owain Evans. When will AI exceed human performance? Evidence from AI experts. Available from: https://arxiv.org/pdf/1705.08807.pdf. [Accessed 4th February 2018].
14- Yasaka K, Akai H, Kunimatsu A, Kiryu S, Abe O. Deep Learning with a convolutional neural network in radiology. Jpn J Radiol. Apr 2018; 36(4):257-272. Available from: doi: 10.1007/s11604-018-0726-3. Epub 2018 Mar 1.
15- Royal College of Radiologists (RCR) census report 2017. [Accessed 4th February 2018]. Available from: https://www.rcr.ac.uk/system/files/publication/field_publication_files/bfcr185_cr_census_2017.pdf.
16- McCulloch P, Altman DG, Campbell WB, Flum DR, Glasziou P, Marshall JC,et al. No surgical innovation without evaluation: the IDEAL recommendations. Lancet.Sep 2009; 26;374(9695):1105-12. Available from:doi: 10.1016/S0140-6736(09)61116-8.
17- Hirst A, PhilippouY, Blazeby J, Campbell B, Campbell M, Feinberg J, et al.No Surgical Innovation without Evaluation: Evolution and Further Development of the IDEAL Framework and Recommendations.Ann Surg. Feb 2019; 269(2):211-220. Available from: doi:10.1097/SLA.0000000000002794.