Artificial Intelligence for diagnosis and image synthesis in breast cancer

Document status and date:
Published: 01/01/2024

DOI:
10.26481/dis.20241216ytz

Document Version:
Publisher's PDF, also known as Version of record

Impact

The research presented in this thesis delves into the application of artificial intelligence (AI) in breast cancer healthcare, offering insights and solutions to key challenges in the field. Through the exploration of feature extraction, prediction, and image synthesis, this work contributes novel methodologies aimed at improving patient outcomes and clinical decision-making. From predictive models for risk assessment to innovative approaches in image synthesis, each aspect of the research in this thesis expands our understanding of AI's potential in breast cancer care, offering potentially effective avenues for future progress in the field.

First, the thesis explores the current use of AI in breast imaging, demonstrating the potential of AI-based models in revolutionizing the detection, characterization, and diagnosis of breast lesions. Through comprehensive literature review and empirical analysis, it elucidates the advancements in AI-driven radiomics, showcasing its efficacy in risk prediction, lesion classification, and outcome prognosis. By leveraging AI algorithms, clinicians can make more informed decisions, leading to earlier detection and better management of breast cancer cases.

Second, the thesis explores the application of NLP techniques in breast-related research, particularly in extracting valuable insights from unstructured electronic health records (EHRs). By introducing the RadioLOGIC model, it presents a novel approach to extract radiological features from textual data, enabling the integration of clinical and imaging information for enhanced decision-making. This innovation streamlines the research process, facilitates knowledge discovery, and ultimately potentially improves patient care by leveraging untapped data sources.

Furthermore, the thesis addresses the challenge of molecular subtype prediction in breast cancer, a critical determinant of treatment selection and patient outcomes. The developed multi-modal deep learning-based model provides a robust framework for accurately predicting molecular subtypes using various imaging data. In this case mammography and ultrasound, but it could be extended to other imaging methods too. This approach not only improves the accuracy of subtype classification, but also can potentially guide treatment selection, thereby providing solutions for personalized treatment strategies for patients.

Finally, the thesis advances the field of image synthesis, offering a solution to the limitations of multi-parameter MRI acquisition. Through the development of AI models capable of synthesizing specific MRI sequences, it may enable clinicians to access comprehensive imaging information without the need for additional scans. This innovation promotes cost-effectiveness, may enhance workflow efficiency, and reduces patient burden, thereby improving overall healthcare delivery.

In essence, this thesis not only contributes to the scientific understanding of breast cancer but also promotes the translation of research findings into tangible clinical benefits such as more holistic characterisation of breast lesions, more complete inclusion of information from EHR and reduced demand on MRI scanners. By harnessing the power of AI, radiomics, NLP, and image synthesis, it empowers healthcare professionals with potential tools and methods to improve clinical decision-making, eventually hopefully benefiting the healthcare and quality of life of breast cancer patients.