Quantitative imaging and artificial intelligence in oncology

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Abstract:

Quantitative Imaging and Artificial Intelligence Oncology

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Summary

Cancer is the second most fatal disease worldwide. Management of cancer is a complex process consisting of diagnosis and staging of the disease and planning and execution of treatment followed by post-treatment follow up. The conventional method of treatment often fails in many patients due to the variability of the disease process amongst a heterogeneous patient population. In the past few years, various biomarkers have been developed to identify the subtype of disease which leads to developing personalized treatment in oncology i.e., precision oncology. Medical imaging plays a key role in cancer management at various stages. Imaging modalities are used in diagnosis, staging, planning of treatment and follow up of disease. It is also used in the restaging of disease in case of progression or recurrence. The information stored in medical images is analysed by imaging experts either by qualitatively using visual interpretation or by semi-quantitative methods, which allows sub-optimal use of information stored in medical images. The huge amount of informative quantitative data stored in medical images remains unexplored. After intended use, these medical images are stored in the archival system (PACS) of the hospital. In the last decade, the medical images archived in hospital PACS have been identified for quantitative analysis and development of imaging biomarkers. The quantitative analysis of medical images (radiomics) has led to the data explosion which is the source of BIG data in oncology. Artificial intelligence (AI) algorithms like machine learning (ML) and deep learning (DL) have been applied to imaging Big data to develop decision support systems in precision oncology. Several imaging biomarkers (radiomic features) have been identified as digital phenotypes of the disease. Nevertheless, several radiomic features have shown potential to predict various endpoints in oncology, but the translation of these radiomics based prediction models as decision support systems (DSS) in the clinic will require addressing several key issues. The radiomic community needs to address the key issues related to the implementation of radiomics based DSS: (a) robustness of radiomic features, (b) development and implementation of AI infrastructure in hospitals, (c) multicentre and prospective radiomics studies, (d) creating awareness and faith among doctors and patients. Through this work, we have tried to address most of these issues to facilitate the implementation of radiomics based DSS in clinical practice.