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Tumor Discovery

LETTER TO EDITOR

Dosiomics in lung cancer

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Dear Editor,

I am writing to express my opinion on dosiomics as a very current and developing topic in lung cancer treatment.

Dosiomics has emerged as a promising tool in oncology that uses advanced radiotherapy dose distribution features to predict clinical outcomes. In lung cancer, where individualized treatment strategies are critical, dosiomics offers a unique approach to integrating radiotherapy planning with predictive analysis. The focus of dosiomic research has been to predict toxicity such as radiation pneumonitis or fibrosis. However, recent studies have begun to explore its potential in predicting oncological outcomes such as tumor control and survival. Despite these developments, literature pertaining to this new topic remains quite limited.[1] This letter aims to highlight the dual applications of dosiomics in lung cancer, discuss current limitations, and suggest future directions for research.

Inspired by radiomics, dosiomics is being developed to parameterize the dose distribution of regions of interest using textural features and to allow the spatial description of the dose distribution. The first studies on the use of dosiomics in lung cancer were set to predict treatment-related toxicity.[2-7] Radiation-induced toxicity remains a major challenge in radiotherapy, especially in the treatment of lung cancer, where critical body structures such as the lung, heart, and esophagus are in close proximity to the tumor. Studies have shown that dosiomics can extract meaningful features from dose distribution maps, such as texture, shape, and density, which are associated with the likelihood of developing radiation pneumonitis or esophageal toxicity.[2,3] Dosiomic features can be extracted using a handcrafted method. Handcrafted features have been used to predict toxicity such as radiation esophagitis, pneumonia, and lymphopenia.[2-7] Handcrafted features contain 3D dose distribution information but do not fully reflect it. If well trained, the convolutional neural network method can reveal more detailed features hidden in the original data,[2] for example, upon testing radiomics, dosiomics, clinical features, and dose-volume histogram, both in isolation and combination, Zhang *et al.*[7] revealed that the hybrid model achieved high prediction accuracy rates. These findings highlight the potential of dosiomics to improve patient selection and treatment planning, thereby reducing the incidence of severe toxicity. Furthermore, integrating dosiomics with clinical and radiomics data increases the predictive power, allowing for a more comprehensive risk assessment.[7]

Tumor control probability and progression-free survival are critical measures for evaluating the efficacy of lung cancer treatments. Recent studies have shown that dosiomics can provide insights into these outcomes by analyzing the spatial and volumetric distribution of radiation dose within the tumor and surrounding tissues. For example, Bhandari *et al.*[8] conducted a study on lung cancer patients undergoing stereotactic body radiotherapy (SBRT) and effectively predicted treatment failure in the lung SBRT treatment with a dosiomic model that integrated the interaction between computed

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tomography and dose. Similarly, dosiomic-based models have been used to predict distant metastasis by analyzing the dose delivered to peritumoral regions.[1] These findings suggest that dosiomics may serve as a valuable tool for tailoring radiotherapy protocols to maximize therapeutic efficacy while minimizing unnecessary exposure to healthy tissues.

Despite these promising developments, there are still challenges in integrating dosiomics into routine clinical practice. First, the lack of standardization in feature extraction and analysis methods limits the reproducibility of findings across studies. Notwithstanding the existence of commercial software for extracting dosiomic features, much more informative feature extraction methods powered by artificial intelligence (AI) are also available. The creation of prediction models requires the usage of very different algorithms, with certain pilot studies diving into the incorporation of big data to enhance their predictability[1-8] There is no standardization in the studies yet, but these studies are very valuable and shed light on the studies that will be created with big data. Different algorithms and software platforms often produce inconsistent results, making it difficult to establish universal guidelines. Second, most dosiomic studies are retrospective, relying on a small number of pre-existing datasets with limited diversity. Prospective, multicenter, and international studies are needed to validate the clinical utility of dosiomics and ensure its generalizability across different patient populations and treatment settings, considering that demographic characteristics also affect prognosis. Future studies should take a holistic approach by integrating dosiomics with other forms of data, such as genomics and immunomics, to capture the complexity of treatment responses. To achieve personalized and successful treatments, decisions must be made based on more comprehensive data.

For clinically adopting dosiomics in the context of lung cancer, standardization with heterogeneous big data is necessary. First, efforts should be made to standardize methods for dosiomic feature extraction and identification of significant variables, which can be achieved through cross-study comparisons and meta-analyses. Second, AI techniques need to be integrated with dosiomics. AI-driven models can process high-dimensional dosiomic data to reveal complex patterns and relationships that may be overlooked by traditional statistical methods. In addition, incorporating AI into dosiomic workflows can also facilitate clinical decision-making by evaluating large amounts of data and providing real-time prediction. Third, collaborative efforts among researchers, clinicians, and industry stakeholders are essential to advance dosiomic research. Multicenter and international clinical studies should be designed to evaluate the predictive accuracy of dosiomics in both toxicity and oncologic outcomes. These studies should include diverse patient populations and treatment modalities to ensure that the findings are broadly applicable. Finally, expanding the scope of dosiomics beyond radiotherapy to include other treatment modalities such as concurrent chemotherapy, immunotherapy, and targeted therapies may provide a more comprehensive understanding of treatment responses. For example, analyzing the interaction between radiation dose distribution and immune activation may open new avenues to optimize combination therapies in lung cancer. In addition, consensus guidelines and guidelines for predictive models in dosiomics need to be established.

In conclusion, dosiomics is a powerful tool for achieving personalized treatments in lung cancer patients. Addressing standardization challenges will be crucial for integrating dosiomics into routine clinical practice. Dosiomics has the potential to improve both treatment efficacy and quality of life of patients undergoing lung cancer treatment by leveraging technologies. Further research with international collaboration is needed in this exciting area to realize its full potential.

Conflict of interest

The author declares that she has no conflict of interest and has no competing interests.

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