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ORIGINAL ARTICLE

A weakly supervised deep learning approach for guiding ovarian cancer treatment in prognosis: gigapixel histopathology analysis for personalized therapeutic response

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Abstract Patients battling with ovarian cancer (OC) often face a formidable prognosis, further complicated by the variability in their response to treatment. Established prognostic factors for OC encompass considerations such as homologous recombination deficiency status, age, pathological stage, and the extent of residual disease following the debulking surgery. Recent studies have illuminated the prognostic value present in histopathological specimens and computed tomography scans; these findings are suitable for investigation using machine learning and deep learning techniques. However, there is still a substantial lack of understanding concerning the unexplored possibilities of integrating data obtained from these diverse sources to improve the prognosis of therapeutic response in patients with OC. In this paper a pioneering methodology based on CLAM architecture for the analysis of gigapixel histopathological images in the context of OC therapeutic response prediction, while relying solely on slide-level labels without the need for detailed annotations. Several cutting-edge techniques have been harnessed in pursuit of this objective, including the utilization of convolutional neural network (CNN) models like Inception V3, a CNN-LSTM hybrid model, and the innovative Vision Transformer (ViT) model. Additionally, various preprocessing techniques have been judiciously employed to refine the process. Our CLAM-based model yeilds an accuracy of 73% on dataset with slide level labels and an AUC of 77%, while on the balanced dataset after data augmentation yeilds accuracy of 76% and AUC of 75%. This study represents a significant step forward in harnessing advanced image analysis and machine learning techniques to unlock critical insights into OC treatment response, ultimately contributing to the advancement of personalized medical care in this challenging domain.

Keywords Deep learning · Transformers · Therapeutic response · Ovarian cancer · Histopathology · Whole slide image (WSI)

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