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Radiomics Approach for Cutaneous Melanoma Treatment Response Assessment in The Era of Precision Medicine

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Abstract

Novel target therapies as immunotherapy are revolutionizing oncology since they have been able to improve progression free and overall survival in many tumors. Although the enormous advantages demonstrated by these therapies in cutaneous melanoma patients there are still open challanges about the assessment of response due to the different imaging patterns could occur. Radiomics is an emerging field of medical imaging including those methodologies that extract additional quantitative data to support clinical decision. Radiomics is nowday an open field of research and a new multidisciplinary approach should be always considered when monitoring novel target therapies.

Keywords: Radiomics; Immunotherapy; Texture analysis; Melanoma

Introduction

With the introduction of oncology target therapies, there is an urgent need to adopt a personalized approach in which a therapy is tailored for each patient, providing a customized healthcare [1]. In particular, novel immunotherapies have revolutionized how clinicians take care of patients with cutaneous melanoma improving progression free and overall survival [2]. Although immunotherapy is changing the landscape of oncology, some open issues merit consideration. In fact, nowadays treatment response is commonly evaluated according to RECIST 1.1. However, immunotherapy can generate atypical patterns of response due to what is terms pseudo progression, a condition that cannot be well evaluated with the above-mentioned criteria, not suitable [3].

Other criteria (i.e. irRC, irRECIST, iRecist) has been proposed, however no sufficient data for final validation for the latest iRecist has been collected and they are not adopted regularly in the clinical practice [4]. Lack of validated response criteria for immunotherapy could cause delay to identify non responders patients. In fact, early prediction of treatments response can exclude or stop the administration of drugs to non-responder patients that severely affects the economic burden in charge to the National Healthcare System, also limiting potential unwanted side-effects that could occur in this patient. In the last years research efforts are focused on biomarkers (i.e. serological, molecular) validations for evaluation of treatment response [5]. However, despite the use of biomarkers is widespread in oncology only a limited number of these guide clinical decisions.

In this contest, novel imaging biomarkers (IBs) could be used as clinical decision-making tools. The advantage of an imaging-based approach, respect to conventional approach (biopsy-derived biomarkers), is to provide multiple lesions analyses at multiple anatomy sites and at multiple time points by the use of non- invasive methods [6]. Radiomics [7-9] is the recent field of research that analyze various tumor phenotypes by using a mathematical model and that allows to extrapolate a large amount of robust quantitative imaging-based parameters (features). The extracted features could be used as IBs to be associated to genetics and clinical outcomes. Nowadays immunotherapy is a primary option for cutaneous metastatic melanoma. These patients underwent several CT and PET-CT imaging for staging and monitoring therapy and MRI examination specially to evaluate brain metastases. Only a limited part of the informations present in the acquired images (i.e. CT, MRI, PET) are taken into consideration. Radiomics allows to extrapolate an increasingly amount of quantitative data present in the images [10]. Texture analyses is an emerging area of "radiomics" that

extracts, analyzes, and interprets quantitative imaging features and it has already demonstrated it could be a useful tool in some malignant tumors, in particular when applied to CT imaging, however only few studies investigated it in melanoma patients [11-14].

A major limitation of radiomics could be represent by the reproducibility of the data since many variables are generated. To overcome this drawback, machine learning models need to be implemented and methodologies have to be validated on a large cohort of patients [15]. Obviously, this approach is time consuming and it need advanced technological equipments. Moreover, a multidisciplinary approach is mandatory since specific medical, physics and informatics competencies must converge. With recent technological developments in radiology a road map has been drawn, however radiomics approach will take time to be feasible in the routine clinical workflow. The role of the medical physics acquire more importance and the radiologists has to change their approach to interpret and analyze the images [16]. Interactions among physicians has to be increased and informatics can help to support data analysis/sharing and the entire clinical decision process.

Conclusion

Malignant tumors and in particular cutaneous melanoma are biologically complex. Novel target therapies have revolutionized the treatment options and patient management. In the era of modern precision medicine a multidisciplinary approach is mandatory to guide clinical decision and to choose best treatment options. Radiomics has the potential to provide useful information to provide robust data supporting clinical decision. Features extracted by radiomics analysis could be associated to the information obtained to the others "omics" sciences (i.e.genomics) in order to strengthen them [17]. On the other hand, a novel approach need to be integrated in the clinical workflow and new technology has to be always available to the health care professionals. Educational and training programs need to be constantly updated and they should be directed to acquire new competencies by sharing among professionals. Strategies directed to implement artificial intelligence, machine learning and data analyses must be planned to overcome the challenges that national healthcare systems has to face in the next years.

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