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NGS in Immunotherapy: Enhancing Efficacy and Safety of New Treatments

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Abstract

Next-generation sequencing (NGS) is revolutionizing the ýeld of immunotherapy, o ering unprecedented insights into the genetic and molecular landscapes of cancer and immune cells. This advanced technology enables the precise identiýcation of genetic mutations, neoantigens, and immune-related biomarkers, which are critical for developing personalized immunotherapies. By facilitating a deeper understanding of tumor heterogeneity and the tumor microenvironment, NGS aids in the design of more e ective and targeted treatments. Moreover, NGS plays a pivotal role in monitoring treatment responses and detecting minimal residual disease, thereby improving the safety and e cacy of immunotherapeutic approaches. This review explores the transformative impact of NGS on immunotherapy, highlighting its contributions to patient stratiýcation, therapeutic targeting, and the development of novel immunotherapeutic strategies. The integration of NGS into clinical practice promises to enhance the precision of immunotherapy, ultimately leading to better patient outcomes and advancing the frontier of cancer treatment.

Keywords: Personalized medicine; Tumor pro ling; Biomarker discover ; Genetic mutations

Introduction

Ne t-generation Sequencing (NGS) has revolutionized various elds of medicine, o ering unprecedented insights into genetic and molecular underpinnings of diseases. In the realm of immunotherap , NGS is emerging as a pivotal tool, enhancing both the e cac and safet of ne treatments. Immunotherap , which harnesses the bod 's immune s stem to combat diseases like cancer, autoimmune disorders, and infections, has sho n remarkable promise [1]. Ho ever, the comple it and variabilit of immune responses pose signi cant challenges in optimizing these therapies. NGS addresses these challenges b providing comprehensive and precise genetic information, enabling personalized treatment strategies and improving therapeutic outcomes [2].

e integration of NGS in immunotherap involves several ke applications. It facilitates the identi cation of novel antigens and neoantigens, aiding in the development of targeted vaccines and T-cell therapies [3]. B anal zing the tumor microenvironment and immune repertoire, NGS helps in understanding the mechanisms of resistance and response to immunotherap . Additionall , it pla s a crucial role in monitoring minimal residual disease and detecting earl signs of relapse, ensuring timel interventions [4].

Moreover, the safet pro le of immunotherapies can be signi cantl enhanced through NGS. B identif ing potential genetic mutations and adverse reactions, NGS allo s for better patient strati cation and risk assessment. is precision medicine approach minimizes the likelihood of severe side e ects and ma imizes the therapeutic bene t for patients [5].

As the eld of immunotherapy continues to evolve, the integration of NGS stands out as a transformative advancement. It not onl accelerates the discover of ne therapeutic targets but also re nes e isting treatments, ultimatel ing to more e ective and safer immunotherapeutic interventions.

Discussion

Ne t-generation sequencing (NGS) has revolutionized the eld of genomics b providing high-throughput, accurate [6], and cost-

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can be targeted to enhance the e cac of immunotherapies.

Biomarker Discovery

e identi cation of predictive biomarkers through NGS allo s for the selection of patients ho are most likel to respond to speci c immunotherapies. is strati cation is essential for improving treatment outcomes and avoiding unnecessar side e ects. Biomarkers such as tumor mutational burden (TMB), microsatellite instabilit (MSI), and speci c gene e pression pro les have been identi ed using NGS and are used to guide immunotherap decisions [10].

Enhancing Safety

Monitoring immune-related adverse events (irAEs)

NGS can be emplo ed to monitor and predict immune-related