Precision medicine in surgical oncology: From diagnosis to treatment.

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Introduction

Surgical oncology plays a crucial role in the management of cancer, aiming to remove tumors and provide the best possible outcomes for patients. Over the years, advancements in precision medicine have revolutionized the field of surgical oncology, offering personalized approaches from diagnosis to treatment. Precision medicine utilizes genomic profiling, molecular diagnostics, and targeted therapies to tailor treatments based on an individual's unique genetic makeup and the characteristics of their tumor [1].

One of the key components of precision medicine in surgical oncology is genomic profiling. By analyzing the genetic alterations within a tumor, clinicians can identify specific mutations and aberrations that drive cancer growth. Through techniques such as next-generation sequencing, oncologists can obtain a comprehensive genomic profile of the tumor, enabling a deeper understanding of its biology. This information guides treatment decisions, as specific mutations may predict responsiveness to targeted therapies or identify patients at higher risk of recurrence [2].

Precision medicine allows for personalized treatment strategies based on the genomic profile of a tumor. Targeted therapies, such as tyrosine kinase inhibitors or immune checkpoint inhibitors, can be utilized to selectively target specific molecular alterations in cancer cells. By matching the genetic abnormalities identified through genomic profiling with the appropriate targeted therapy, surgeons can optimize treatment outcomes while minimizing unnecessary interventions. This approach has shown significant success in various cancer types, including lung, breast, and colorectal cancers [3].

Precision medicine extends beyond treatment selection and encompasses preoperative planning and intraoperative guidance. With the aid of advanced imaging techniques, such as positron emission tomography-computed tomography (PET-CT) and magnetic resonance imaging (MRI), surgeons can accurately visualize tumor location, size, and its relationship to surrounding structures. This information helps in planning the surgical approach, facilitating more precise and minimally invasive procedures. Additionally, intraoperative technologies like fluorescence-guided surgery and real-time imaging enable surgeons to identify and remove tumor tissues with greater precision, reducing the risk of incomplete resections.

The incorporation of precision medicine in surgical oncology has enhanced risk stratification and prognostication for patients. Genetic markers and molecular signatures can provide valuable insights into a patient's prognosis, allowing clinicians to identify high-risk individuals who may benefit from more aggressive treatment approaches. These biomarkers also aid in determining the likelihood of disease recurrence, enabling close surveillance and early intervention if necessary. By tailoring treatment plans based on individual risk profiles, precision medicine optimizes patient care and improves long-term outcomes [4].

Precision medicine contributes to minimizing treatment-related toxicities by avoiding unnecessary interventions and tailoring therapy to individual patients. Traditional treatment modalities like chemotherapy and radiation therapy often result in significant side effects that can impact patients' quality of life. Through precision medicine, surgeons can identify patients who are less likely to respond to certain treatments or may be more susceptible to adverse effects. This information allows for the selection of alternative therapies or the adjustment of treatment dosages, minimizing toxicity while maximizing efficacy.

Cancer cells can develop resistance to therapies over time, leading to disease progression or recurrence. Precision medicine provides valuable tools for monitoring treatment response and identifying emerging resistance mechanisms. Serial genomic profiling can track tumor evolution, detect acquired mutations, and guide the selection of subsequent therapies to overcome resistance. Additionally, liquid biopsies, which analyze circulating tumor DNA, offer a non-invasive means of monitoring treatment response and detecting minimal residual disease, facilitating early intervention [5].

Conclusion

Precision medicine has revolutionized the field of surgical oncology, offering personalized approaches to cancer diagnosis and treatment. Genomic profiling, molecular diagnostics, and targeted therapies have transformed how surgeons manage cancer patients, enabling tailored treatment strategies, minimizing toxicities, and improving long-term outcomes. As technology continues to advance, precision medicine will play an increasingly vital role in surgical oncology, leading to further advancements in personalized care, better patient outcomes, and ultimately, a significant impact on the fight against cancer.

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