Opinion Article

Precision Medicine and Cancer Risk Assessment: Their Impact on Molecular Mechanisms of Tumorigenesis

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DESCRIPTION

Cancer is a complex, multifactorial disease influenced by genetic and environmental factors. While external factors like lifestyle and environmental exposures contribute to cancer development, the role of genetic factors, specifically cancer-susceptibility genes, has accumulated significant observation. These genes play a key role in increasing an individual's susceptibility to certain types of cancer, providing acute insights into cancer etiology and prepare for the personalized risk assessment and preventive strategies. Cancer-susceptibility genes often referred to as oncogenes or tumor suppressor genes are inherent components of an individual's genetic character. These genes regulate cell growth, division, and repair processes, acting as a monitor for maintaining genomic stability. When cancer-susceptibility genes undergo mutations or alterations, they can damage these acute functions, increasing the risk of malignant cell transformation and cancer initiation. Understanding the genetic basis of cancer susceptibility is primary to resolving the complex molecular mechanisms underlying cancer development.

Two main categories of cancer-susceptibility genes, namely oncogenes and tumor suppressor genes, contribute significantly to cancer predisposition. Oncogenes are genes that promote cell proliferation when mutated or activated. Normally, these genes are involved in cell division regulation, tissue development, and growth. However, when mutations occur, oncogenes can become "stuck" in the "on" position, causing cells to divide uncontrollably, a distinctive feature of cancer. An example of an oncogene is the Epidermal Growth Factor Receptor (*EGFR*) gene, frequently involved in various cancers, including lung cancer. Conversely, tumor suppressor genes are responsible for restraining cell division and inhibiting the development of tumors. When these genes undergo mutations or inactivation, their tumor-suppressing abilities are compromised, leading to uncontrolled cell growth. The Tumor Protein p53 (*TP53*) gene is a well-known tumor suppressor gene, and mutations in this gene are linked to numerous cancer types. The identification of cancer-susceptibility genes has enabled the development of genetic testing and risk assessment strategies.

By analyzing an individual's genetic profile, it is possible to determine the presence of certain mutations or alterations in cancer-susceptibility genes, providing valuable information about their cancer risk. This genetic information allows healthcare providers to provide personalized counseling and screening recommendations. One of the most well-known examples of a cancer-susceptibility gene is *BRCA1* and *BRCA2*. Mutations in these genes significantly increase the risk of breast and ovarian cancer. Genetic testing for *BRCA* mutations has become an essential tool for assessing cancer risk and guiding clinical decisions regarding risk reduction measures, such as prophylactic surgery or enhanced surveillance. Precision medicine aims to modify medical treatment and preventive strategies to the specific genetic characteristics of an individual. By identifying mutations in cancer-susceptibility genes, healthcare providers can provide targeted therapies and personalized cancer risk management, thereby optimizing patient outcomes.

CONCLUSION

Cancer-susceptibility genes represent a acute component of cancer etiology, providing valuable insights into genetic predisposition to cancer. Understanding the complex interaction between oncogenes and tumor suppressor genes is essential for solving the molecular mechanisms behind cancer development. Moreover, the identification of cancer-susceptibility gene mutations through genetic testing has opened new approaches for personalized risk assessment and preventive strategies. As our knowledge of these genes deepens, the potential of precision medicine in the field of oncology continues to grow, ultimately benefiting individuals at risk of developing cancer.

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