WHITEPAPER

Biocare Basics: Oncogenes

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An oncogene is a mutated gene that has the potential to cause cancer as a result of the mutation.[4,5] Oncogenes start as proto-oncogenes, a term for normal, unmutated genes that help regulate normal cell growth, division, proliferation, and programmed cell death.[3,4] Because cancer is a disease characterized by abnormal, unchecked cell growth, mutations in any of these regulating proto-oncogenes can cause these processes to spiral out of control, creating the potential for cancer.[3,4] The mutated copy of the proto-oncogene is then called an oncogene.[3,4]

The alterations that occur in oncogenes can be point mutations, gene amplifications, chromosomal translocations, or changes in gene expression.[4] Some oncogenes promote cancerous tumor growth by accelerating cell growth, pushing cells to multiply repeatedly in an uncontrolled manner.[4] Other oncogenes can cause a failure to brake, so to speak, by losing their tumor-suppressive function that was originally meant to slow and halt cellular growth to keep it under control.[4]

The MYC gene is a well-known proto-oncogene.[5] It encodes a transcription factor that regulates the expression of a wide range of genes involved in cell proliferation, differentiation, and apoptosis.[5] MYC amplification or overexpression is found in many types of cancer, including lymphoma, breast cancer, and lung cancer.[2,5]

Oftentimes, cancer forms as a result of multiple mutations leading to the development of multiple oncogenes, which deregulate cellular growth as well as disrupt tumor suppression.[3] For example, a mutation in the PI3K gene that influences cell growth and survival commonly accompanies a loss-of-function mutation in the PTEN tumor suppressor gene in cases of breast cancer.[3]

Mutations in the tumor suppressor genes BRCA1 and BRCA2 have been associated with a significantly elevated risk for breast and ovarian cancers, and BRCA1-driven breast cancers frequently also feature somatic mutations in tumor suppressors TP53 and PTEN.[3]

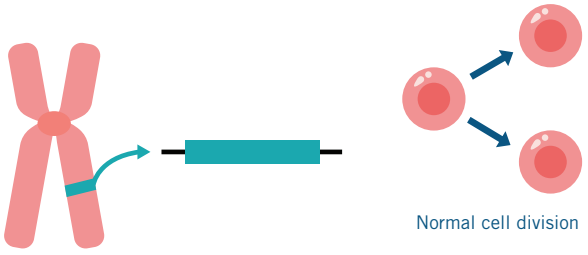
Amplification mutations of cell growth genes c-myc and HER-2/neu occur in a significant number of ovarian cancers, with HER-2/neu overexpression associated with poor survival.[1] Additionally, the gene p53 normally functions as a tumor-suppressor gene, but when mutated, it is associated with ovarian cancer.[1] This mutation has been found in approximately 50% of ovarian cancer cases.[1]

The BCR-ABL1 gene is an example of an oncogene formed by a chromosomal translocation.[5] It results from the fusion of the BCR gene on chromosome 22 with the ABL1 gene on chromosome 9.[5] This fusion gene can lead to uncontrolled cell growth and the development of chronic myeloid leukemia (CML).[5]

These examples highlight the diverse mechanisms through which oncogenes can contribute to the development of cancer. By understanding the function and alterations of oncogenes, researchers may gain insights into the underlying molecular mechanisms of cancer, which may help them administer better patient care. Researchers may also target oncogenes for future cancer therapies.[5]

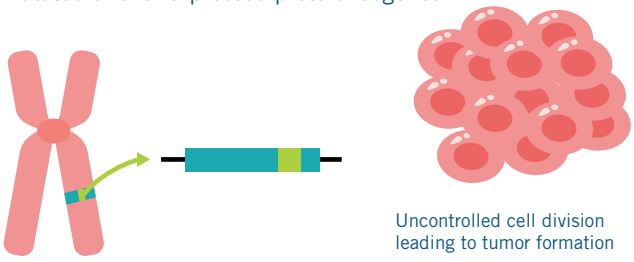
Oncogene Illustration

Proto-oncogene:
Genes that regulate cell divison



Normal cell division

Oncogene:
Mutated or over-expressed proto oncogenes



Uncontrolled cell division
leading to tumor formation

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