

Teasing apart the roles that oncogenic miRNAs play in breast cancer

Oncogenic miRNA and breast cancer

Since the early 2000's, the field of RNA has been contributing to major discoveries in cancer research. MicroRNAs are small RNA molecules (miRNA), inhibit the messenger RNAs that produce our proteins. Normally, they keep a check on (or control) the expression of genes. However, in cancer, these tiny genetic molecules can have widespread and detrimental effects. Cancer causing miRNAs, also known as oncogenic miRNAs, play fundamental roles in the initiation, progression and spread of breast cancer.

Oncogenic miRNA roles

The field of breast cancer research has enjoyed many advances of the past decades, especially in the treatment of early stage breast cancer. However, advanced breast cancer continues to challenge researchers to find new ways to overcome early diagnosis issues, treatment resistance, and metastasis. In the last decade, oncogenic miRNAs have provided better understanding of how their dysregulation causes the onset, progress, survival and metastasis of breast cancer. Upregulation of oncogenic miRNA can cause the repression of critical tumor suppressing genes. The consequence of this is the release of downstream pathways that push the cell towards a cancer cell phenotype. For example, one of the more commonly known miRNA, miR-21, found to be overexpressed in breast cancer is deemed oncogenic due to its large amount of tumor promoting effects. The result of its overexpression in breast cancer results in reducing cell death, causes the cell to continue to grow and divide. It also aids in increasing the cell's ability to travel from its original location into the blood stream, and then to other organs in the body. Similar to miR-21, there are many oncogenic miRNA that shut down regulatory proteins, thus making the cell less accountable for its actions. When we look at the large picture, dysregulation of oncogenic miRNA can be found at every level of the cancer process. Several have been found to aid in the initiation of a normal cell to a cancer cell and then coax these cells to live in colonies, compromising the requirements of tissue structure. Others shift metabolism requirements allowing these cells to survive in an environment with lower oxygen, a hallmark of cancer. A large subset of oncogenic miRNAs observed in breast cancer have been shown to increase cellular growth and survival. Many others influence mobility of breast cancer cells and encourage invasion into distant organs. Additionally, many miRNAs are found to cause progression of breast cancer through its various stages as they influence multiple pathways simultaneously.

What does this mean for breast cancer treatment? The answer is not so simple. While identifying oncogenic miRNAs in breast cancer has opened many avenues for potential targeted treatments, some have also been shown to play roles in treatment resistance. Take miR-21 again; in breast cancer treatment, doxorubicin, a chemotherapeutic drug, can actually increase miR-21 levels within cells thus encouraging the cancer to grow and spread. A few others have also been shown to contribute to chemoresistance, resistance to the hormone therapy, tamoxifen, and even resistance

to radiation treatment. However, there is a hope. For example, miR-21 can be targeted to increase breast cancer sensitivity to treatment and this follows with others that also contribute to therapy resistance.

Oncogenic miRNAs highlight the need for more personalized treatment options in the clinic. We need to be able to identify oncogenic miRNAs that may contribute to a patient's cancer profile to better decide on treatment options that will benefit the patient and increase survival chances. Overall oncogenic miRNAs provide new targets that could increase the number of treatments available as well as creating a more personalized treatment approaches. These tiny RNA molecules have a huge impact on breast cancer and it is in our best interest to take advantage of the opportunities they present us with to push breast cancer treatment forwards.

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